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## Frailty and its Correlates in Older Adults: A Challenging and Preventable Geriatric Syndrome

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### ABSTRACT

**Objective:** Frailty syndrome, defined as increased vulnerability to stressors, is an important cause of the negative health consequences of older adults. Defining related factors and struggling with these factors can be an important way for the prevention of frailty. This study aims to investigate the related factors of frailty using comprehensive geriatric assessment in community dwelled older adults attended the geriatric medicine outpatient clinic.

**Materials and Methods:** A total of 1001 patients aged 65 years and over were included in this study. Demographical characteristics, chronic illnesses, medications, were evaluated and recorded. Comprehensive geriatric assessment and anthropometric measurements were performed for each patient. The frailty status of patients was determined using the Edmonton frailty scale (EFS) and Fried's frailty index (FFI). The rate of frailty and associated factors were examined.

**Results:** Frailty rate was detected as 15.4% and 11.8% according to the FFI and EFS, respectively. Advanced age, educational status lower than university level, having dementia, depression, diabetes mellitus, coronary artery disease, higher malnutrition risk, lower activities of daily living scores, lower handgrip strength and absence of hyperlipidemia were the independently associated factors of frailty by FFI or EFS.

**Conclusion:** Frailty is a common geriatric syndrome that has interaction with other geriatric syndromes and cardiovascular diseases. Most of the related factors of frailty are reversible or preventable. A comprehensive assessment is essential for the prevention of frailty.

**Keywords:** Frailty, related factors, older adults, fried, Edmonton

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### INTRODUCTION

Older population is increasing worldwide. Frailty syndrome is a condition defined as increased vulnerability to stressors as a result of decreasing physiological reserve of the organs and systems. It has a common occurrence, particularly with increasing age and an independent predictor of dependency, morbidity, and mortality for older adults (1). It is also associated with the increased cost of health expenditures (2).

As the frailty syndrome constitute a significant cause of increased adverse outcomes and health expenditure in older adults, it is important to examine the frailty related factors to identify the modifiable conditions, and to reduce its worse clinical outcomes.

There is no international consensus on the standard definition or scale detecting the frailty (3). A large number of scales are used to discriminate this group of patients. Edmonton frailty scale (EFS), which is known as a valid and reliable tool for the assessment of frailty in the hospital setting and Fried frailty index (FFI) are some of the frequently used tools for determining frailty status in clinical research.

Frailty prevalence varies considerably among the diverse populations and group of patients (4, 5). Although there are some studies identifying the related factors of frailty in different groups of the older population (5–8), determining frailty prevalence and its correlates in community dwelled older adults attending to the outpatient clinic is of importance for raising the awareness and highlighting the importance of managing frailty in clinical practice. Moreover, further supporting comprehensive studies explaining the relationship between frailty and geriatric syndromes and other conditions are needed.

The present study aims to investigate the rate of frailty among community dwelled older adults attended to geriatric outpatient clinic, using EFS and FFI. Another aim was to examine the factors associated with frailty and the relationship between frailty and chronic comorbid conditions and geriatric syndromes.

### MATERIALS and METHODS

One thousand and one community dwelled patients, aged 65 years or older, admitted to our geriatric outpa-

tient clinic for any reason were consecutively included in this study during two years. The study protocol was approved by the ethics board of Hacettepe University Non-Interventional Clinical Research Ethics Committee (Approval date: 21.01.2015 Issue number: GO 15/36). Demographic characteristics, level of education, chronic co-morbid diseases, medications and the history of falls during the last one year were questioned for all patients and recorded. Comprehensive geriatric assessment and anthropometric measurements were performed, and frailty status was evaluated using FFI and EFS.

### Comprehensive Geriatric Assessment and Anthropometric Measurements

**Anthropometric Measurements:** Height (m), weight (kg), right and left calf circumferences were measured for each participant. Body mass index (BMI) was calculated by dividing weight (kg) by the square of the height (m<sup>2</sup>).

**Activities of Daily Living Assessment:** Katz Activity of Daily Living questionnaire (ADL) (9), Lawton-Brody Instrumental Activities of Daily Living (IADL) Scale (10) were used to determine the functionality of the patients. Any reduction in scores was thought of as an increase in the dependence on activities of daily living.

**Nutritional Risk Assessment:** Mini Nutritional Assessment short form (11) was used for malnutrition screening. The total score of  $\leq 11$  is defined as a high risk of malnutrition, and score  $\leq 7$  is as malnutrition.

**Depression Assessment:** Yesavage Geriatric Depression Scale short form (12) was performed to screen the presence of depressive mood. The cut-off point for a depression was defined as  $\geq 7$ . Furthermore, clinical and mood assessment were performed for depression diagnosis.

**Cognitive Assessment:** The standardized Mini-Mental State Examination (MMSE) (13) and the clock drawing test were also performed. The clock drawing test was evaluated from a total score of six (14). Having a score of less than four was defined as cognitive dysfunction.

**Urinary Continence:** The presence of any types of urinary incontinence was asked to the patient.

**Gait Speed and Handgrip Strength Assessment:** The walking time of six meter was measured using a chronometer for the patients who can walk. The walking time of 15 feet was calculated using the time of six meter-gait speed. Standardized isometric handgrip strength was determined using a hand-held dynamometer (Takei A5401). Three values were recorded for each hand. The maximum grip strength of each patient was used for the analyses.

### Frailty Assessment

The frailty status of the patients was determined using EFS and FFI.

#### Fried's Frailty Index

The presence of the following five criteria was evaluated for each participant: self-reported exhaustion, loss of weight, low physical activity, slow walking speed and low grip strength (15). Patients who met three or more of the criteria were classified as frail, who

met one or two of the criteria were defined as 'pre-frail', and patients who met none of them were defined as 'non-frail'.

#### Edmonton Scale of Frailty

Nine items that include cognition, general health status, self-reported health, functional independence, social support, polypharmacy, mood, continence, and functional performance were evaluated and scored for each patient (16). Total scores of the components were calculated and the frailty status of the patients was determined using the following cut-off scores: not frail (0–5); apparently vulnerable (6–7); mildly frail (8–9); moderately frail (10–11) and severely frail (12–17).

#### Statistical Analysis

SPSS (Statistical Package for Social Sciences) for Windows 15.0 was used for statistical analysis. Data were presented as mean and  $\pm$  standard deviation (SD) for normally distributed continuous variables and as median, (minimum-maximum) for non-normally distributed continuous variables. Categorical variables were presented as numbers and frequencies.

Normality assumption of continuous variables was tested using several criteria; (i) graphical validation (e.g., histogram graphs), (ii) skewness and kurtosis statistics and (iii) normality tests (e.g., Kolmogorov-Smirnov test).

The Chi-square or Fisher's exact tests where appropriate were used to compare the categorical variables between groups.

The Kruskal Wallis test was conducted to compare the non-normally distributed numerical parameters between three groups according to the frailty status of the patients. If statistically significant differences were found, the Jonckheere-Terpstra test was used to investigate whether or not there is a significant trend of the parameters between the groups.

To examine the associations between non-normally distributed and/or ordinal variables, the correlation coefficients and their significance were calculated using the Spearman test. A 5% type -1 error was used to infer statistical significance.

To determine the independently related factors of frailty, the possible factors identified with univariate analyses, factors having p score lower than 0.2 were further entered into the logistic regression analysis.

The concordance between the Edmonton frailty scale and FFI was examined using the Kappa test. P-value of less than 0.05 was considered to show statistically significant results.

## RESULTS

Median age of the patients was 73 years (min-max: 65–94) and 62.2% were female. Education levels of the participants were as follows: 23.1% were illiterate, 37.5% were primary school graduates, 12.1% high school graduates and 14.2% were university graduates. Most of them were living with their partners or families (the frequencies were 59.4% and 24.5%, respectively) and 15.2% of the participants were living alone. Three most common co-morbid conditions were hypertension, diabetes mellitus and urinary incontinence. Demographic results, the rate of the co-morbid diseases, and geriatric syndromes are shown in Table 1.

**Table 1.** The frequencies of co-morbid diseases and geriatric syndromes

Diseases and geriatric syndromes	Total sample (n=1001)
Age, years	73 (65–94)
Gender, Female	623 (62.2)
Hypertension	690 (69.3)
Urinary incontinence	362 (36.2)
Diabetes mellitus	358 (36.0)
Hyperlipidemia	303 (31.0)
Falls	279 (28.5)
Osteoporosis	240 (24.1)
Coronary artery disease	173 (17.4)
Fracture	111 (11.4)
Depression	111 (11.2)
Chronic obstructive pulmonary disease	66 (7.0)
Dementia	59 (6.0)
Congestive heart failure	46 (4.6)

Categorical variables are given as number, frequencies (%), age is given as median (min-max)

Frailty rates detected with the EFS and FFI were 11.8% and 15.4%, respectively. According to the EFS, the frailty status of the patients was found as follows in detail: not frail 76.4%, vulnerable 11.8%, mild frail 7.2%, moderate frail 3.8% and severely frail 0.8%. Rates of prefrail and robust patients evaluated by FFI were 49.2% and 35.5%, respectively.

Frail participants had more advanced age, higher female gender rate, lower educational level, lower BMI and calf circumference, more reduced muscle strength and lower gait speed, higher rates of dementia, depression, urinary incontinence, falls, hypertension, coronary artery disease, congestive heart failure, polypharmacy, dependence in ADL and/or IADL, malnutrition risk and lower rate of hyperlipidemia than non-frail participants according to FFI. Characteristics that were significantly differed by the frailty status according to FFI and EFS are presented in Table 2 and Table 3, respectively.

Parameters having a p-value lower than 0.2 in univariate analysis examining the association between the parameters and frailty status (FFI or EFS) were put into the equation in multivariate logistic regression analysis to investigate the independent associates of frailty. After this analysis, it was found that advanced age, educational status lower than university level, having coronary artery disease, depression, being at malnutrition risk, ab-

**Table 2.** Significantly related parameters with frailty groups determined by the Fried's Frailty Index

	Robust	Prefrail	Frail	p
Age, year, median (min-max.) <sup>1</sup>	71 (65–88)	73 (65–94)	78 (65–94)	<0.001
Female (%) <sup>2</sup>	32.9 <sup>a</sup>	49.8 <sup>a,b</sup>	17.3 <sup>b</sup>	0.027
Male (%) <sup>2</sup>	39.7 <sup>a</sup>	48.1 <sup>a,b</sup>	12.2 <sup>b</sup>	
Educational level, university graduate (%) <sup>2</sup>	53.0 <sup>a</sup>	44.8 <sup>b</sup>	2.2 <sup>c</sup>	<0.001
BMI, kg/m <sup>2</sup> , median (min-max.) <sup>1</sup>	28 (18.6–50.2)	27.7 (17–46)	26.6 (11.7–40)	0.002
Calf circumference, cm, median (min-max.) <sup>1</sup>	36.5 (17.8–54)	36 (23.5–54)	35 (19.5–47)	<0.001
Hypertension (%) <sup>2</sup>	31.9 <sup>a</sup>	50.9 <sup>b</sup>	17.2 <sup>b</sup>	0.001
Hyperlipidemia (%) <sup>2</sup>	40.9 <sup>a</sup>	47.2 <sup>a,b</sup>	11.9 <sup>b</sup>	0.020
Coronary artery disease (%) <sup>2</sup>	29.5 <sup>a</sup>	48.6 <sup>a,b</sup>	22.0 <sup>b</sup>	0.019
Congestive heart failure (%) <sup>2</sup>	15.2 <sup>a</sup>	37.0 <sup>a</sup>	77.8 <sup>b</sup>	<0.001
Dementia (%) <sup>2</sup>	11.9 <sup>a</sup>	52.5 <sup>b</sup>	35.6 <sup>c</sup>	<0.001
Depression (%) <sup>2</sup>	18.9 <sup>a</sup>	52.3 <sup>b</sup>	28.8 <sup>c</sup>	<0.001
History of falls (%) <sup>2</sup>	23.3 <sup>a</sup>	54.8 <sup>b</sup>	19.8 <sup>b</sup>	<0.001
Urinary incontinence (%) <sup>2</sup>	27.1 <sup>a</sup>	48.6 <sup>b</sup>	19.8 <sup>c</sup>	<0.001
The number of drugs, median (min-max.) <sup>1</sup>	3 (0–17)	4 (0–13)	5 (0–17)	<0.001
Katz activity of daily living score (ADL), median (min-max.)	6 (5–6)	6 (0–6)	5 (0–6)	<0.001
Lawton instrumental activities of daily living test score (IADL), median (min-max.) <sup>1</sup>	17 (5–17)	16 (0–17)	11 (0–17)	<0.001
Clock drawing test score, median (min-max.) <sup>1</sup>	6 (0–6)	5 (0–6)	3 (0–6)	<0.001
Mini-mental test score, median (min-max.) <sup>1</sup>	29 (2–30)	27 (0–30)	24 (5–30)	<0.001
Mini nutritional assessment test short form, score, median (min-max.) <sup>1</sup>	14 (0–14)	13 (2–14)	10 (0–14)	<0.001
Yesavage geriatric depression scale score, median (min-max.) <sup>1</sup>	0 (0–14)	2 (0–15)	7 (0–15)	<0.001
15 feet walking time, seconds, median (min-max.) <sup>1</sup>	4.05 (1.5–6.8)	5.1 (2.0–25.2)	9.01 (3.9–37.5)	<0.001
Handgrip, kg, median (min-max.) <sup>1</sup>	27 (14.4–53.2)	20 (5.7–48.6)	14 (0–33.8)	<0.001

1: Since the medians had trends between the three groups, we assessed these trends using Jonckheere-Terpstra test instead of Bonferroni adjusted Mann-Whitney U post hoc analyses. All had p-value lower than 0.05 in Jonckheere-Terpstra tests; 2: Post hoc analyses for the Chi-square test were carried out using the Bonferroni adjusted z test. Superscript letters indicate the differences between groups. If the parameters have different letters, it indicates statistically significant differences between groups

**Table 3.** Significantly related parameters with frailty groups determined by the Edmonton frailty scale

	Not frail	Vulnerable	Frail	p
Age, year, median (min–max.) <sup>1</sup>	72 (65–94)	77 (65–94)	78 (65–92)	<0.001
Female (%)	71.1 <sup>a</sup>	14.4 <sup>b</sup>	14.5 <sup>b</sup>	<0.001
Male (%)	85.1 <sup>a</sup>	7.4 <sup>b</sup>	7.4 <sup>b</sup>	<0.001
Educational level, university graduate (%)	95.8 <sup>a</sup>	2.1 <sup>b</sup>	2.1 <sup>b</sup>	<0.001
Calf circumference, cm, median (min–max.)	36 (17.9–52)	36 (22.5–47)	35 (23–47.5)	0.004
Chronic obstructive lung disease (%)	62.1 <sup>a</sup>	16.7 <sup>a,b</sup>	21.2 <sup>b</sup>	0.014
Coronary artery disease (%)	67.1 <sup>a</sup>	12.7 <sup>a,b</sup>	20.2 <sup>b</sup>	0.020
Congestive heart failure (%)	37.8 <sup>a</sup>	27.6 <sup>b</sup>	35.6 <sup>b</sup>	<0.001
Dementia (%)	28.8 <sup>a</sup>	27.1 <sup>b</sup>	44.1 <sup>b</sup>	<0.001
Depression (%)	56.4 <sup>a</sup>	16.4 <sup>b</sup>	27.3 <sup>b</sup>	<0.001
History of falls (%)	63.8 <sup>a</sup>	16.8 <sup>b</sup>	19.4 <sup>b</sup>	<0.001
Urinary incontinence (%)	53.8 <sup>a</sup>	18.1 <sup>b</sup>	23.6 <sup>c</sup>	<0.001
The number of drugs, median (min–max.)	5 (0–14)	5 (0–14)	6 (0–17)	<0.001
Katz activity of daily living score (ADL), median (min–max.)	6 (1–6)	5 (0–6)	5 (0–6)	<0.001
Lawton instrumental activities of daily living test score (IADL), median (min–max.) <sup>1</sup>	17 (0–17)	13(0–17)	9 (0–17)	<0.001
Clock drawing test score, median (min–max.) <sup>1</sup>	6 (0–6)	2 (0–6)	0 (0–6)	<0.001
Mini-mental test score, median (min–max.) <sup>1</sup>	28 (0–30)	25 (6–30)	22 (5–30)	<0.001
Mini nutritional assessment test short form, score, median (min–max.) <sup>1</sup>	14 (0–14)	12 (2–14)	10 (2–14)	<0.001
Yesavage geriatric depression scale score, median (min–max.) <sup>1</sup>	1 (0–15)	4 (4–14)	8 (0–15)	<0.001
15 feet walking time, seconds, median (min–max.) <sup>1</sup>	4.5 (1.5–14.2)	6.6 (2.9–28.5)	9.0 (3.0–37.5)	<0.001
Handgrip, kg, median (min–max.) <sup>1</sup>	22.8 (7–53.2)	16.7 (6–40.9)	15.4 (0–35.5)	<0.001

1: Since the medians had trends between three groups, we assessed these trends by Jonckheere-Terpstra test instead of Bonferroni adjusted Mann-Whitney U post hoc analyses. All had p-value lower than 0.05 in Jonckheere-Terpstra tests; 2: Post hoc analyses for the Chi-square test were done using the Bonferroni adjusted z test. Superscript letters indicate the differences between groups. If the parameters have different letters, it indicates statistically significant differences between groups

sence of hyperlipidemia and lower activities of daily living scores were the independently associated factors of frailty according to FFI. When the same analyses were conducted according to the frailty status of the patients by EFS, advanced age, educational status lower than university level, presence of diabetes mellitus, coronary artery disease, dementia, depression, falls, lower handgrip strength, being at malnutrition risk were identified as independently associated factors for frailty. Parameters that were detected independently associated with frailty according to FFI and EFS are shown in Table 4.

According to EFS, statistically significant ( $p < 0.001$ ) positive correlation was found between frailty and age, number of medications, Yesavage Geriatric Depression Scales scores and gait speed (correlation coefficients were 0.26; 0.37; 0.47; 0.54, respectively). Furthermore, statistically significant ( $p < 0.001$ ) negative correlations were found between frailty and weight, handgrip strength, ADL, IADL, MNA-SF test, MMSE, and clock drawing test scores (correlation coefficients were -0.12; -0.51; -0.53; -0.64; -0.45; -0.52; -0.63 respectively). The factors correlated with the frailty status according to the EFS and FFI are presented in Table 5.

Concerning assessing frailty, a statistically significant, moderate level of compliance was found in the evaluation of concordance between EFS and FFI ( $p < 0.001$ , kappa 0.47).

## DISCUSSION

In this study, frailty rate and related factors of community-dwelling older adults attended the geriatric medicine outpatient clinic were examined using two different frailty assessment tools in 1001 subjects. Rates of frailty were 15.4% and 11.8%, and pre-frailty rates were 49.2% and 11.8% according to the FFI and EFS, respectively. Regression analyses revealed that advanced age, education level lower than university graduate, having dementia, depression, diabetes mellitus, coronary artery disease, falls, higher malnutrition risk, lower activities of daily living scores, lower handgrip strength, and absence of hyperlipidemia were independently associated with frailty. Hyperlipidemia seems to have a protective effect on frailty. These results show that frailty is a compelling geriatric syndrome that should be evaluated and managed in outpatient clinics.

The frailty rate and related factors may vary among different races, populations and different patient groups. In Asia, Europe and North America, studies identified that frailty rate ranges from 4.9% to 27.3% (17–19). In another study, including community-dwelling elderly in 10 European countries, data showed that the frailty prevalence ranges from 5.8% to 15% (17).

In our study, the prevalence of frailty of older adults in the geriatric outpatient clinic was similar to the frailty rates in European countries, lower than the Physical Medicine and Rehabilitation outpa-

**Table 4.** Parameters independently associated with frailty according to Fried's frailty index and Edmonton frailty scale

	p	Exp (B)	95% CI
<b>Fried's Frailty Index<sup>1</sup></b>			
Age	0.035	1.04	1.003–1.087
Educational status, lower than university level	0.003	12.34	2.30–66.24
Coronary artery disease	0.033	1.97	1.06–3.67
Hyperlipidemia	0.002	0.36	0.19–0.68
Depression	0.017	2.23	1.15–4.30
ADL score	<0.001	0.48	0.36–0.66
IADL score	0.002	0.90	0.85–0.96
Mini-nutritional assessment score*	<0.001	0.763	0.70–0.84
<b>Edmonton Frailty Scale<sup>2</sup></b>			
Age	<0.001	1.07	1.03–1.10
Educational status, lower than university level	0.001	5.62	1.96–16.11
Diabetes mellitus	0.001	2.02	1.36–3.01
Dementia	<0.001	4.33	2.12–8.83
Depression	0.045	1.74	1.01–3.00
Coronary artery disease	0.007	1.94	1.20–3.14
Falls	0.028	1.57	1.05–2.35
Mini-nutritional assessment score*	<0.001	0.82	0.76–0.88
Handgrip strength	<0.001	0.89	0.87–0.93

\*: Mini nutritional assessment test short form; CI: Confidence interval; ADL: Activities of daily living; IADL: Instrumental activities of daily living; 1: Binary logistic regression analysis with backward stepwise elimination method was used for detecting independently associated factors for frailty according to Fried criteria. The variables were tested for multicollinearity using collinearity statistics (variance inflation factor) or correlation matrix. The statistically significant results for the last step (step 10) were shown in this table. Omnibus Test for the model had chi-square 251,531 and  $p < 0.001$ . Nagelkerke R square was 0.481. Hosmer and Lemeshow test for this model had  $p = 0.245$ ; 2: Binary logistic regression analysis with backward stepwise elimination method was used for detecting independently associated factors for frailty according to Edmonton Frailty Scale. The variables were tested for multicollinearity using collinearity statistics (variance inflation factor) or correlation matrix. The statistically significant results for the last step (step 7) were shown in this table. Omnibus Test for the model had chi-square 290,912 and  $p < 0.001$ . Nagelkerke R square was 0.426. Hosmer and Lemeshow test for this model had  $p = 0.366$

tient clinics patients and higher than older people living in the rural area in Turkey (5, 7).

Data regarding the frailty prevalence and its correlates in undeveloped or developing countries are limited. There is a need for every country's own data and studies about geriatric syndromes, especially frailty, because nutritional habits, genetic factors, socioeconomic status, education level, and cultural differences may affect the results.

In this study, we found that frailty rate was higher in female patients (17.3% for women and 12.2% for men), but it was not an

independently associated factor of frailty. Advanced age, lower education level (lower than university level), dementia, depression, poorer nutritional status, poorer activities of daily living, falls, lower handgrip strength were shown to be strongly and independently associated factors for frailty in our study. These results support the findings in the literature (6–8, 20–25).

In a study about prevalence and associated factors of frailty and of older adults aged 50 and over, from different developing countries, China had the lowest percentages of older adults with frailty (13.1%) while India had the highest rates (55.5%) (24). Similar to the findings of our study, frailty increased with age for all of these countries and was more frequent in women. Both income and education were detected as protective factors for frailty and disability in China, India and Russia, whereas only education in South Africa and only income was protective in Mexico (24). As in other developing countries, low educational level was found as an independently related factor for frailty in this study. Low educational level can be an indirect indicator of low socioeconomic status and quality of life for our population. That may be related with poor nutritional status and as a result with the status of frailty.

An interesting result of our study was showing increased frailty rate in the absence of hyperlipidemia. This can be interpreted as hyperlipidemia may have a protective role on frailty. This may be due to its link with malnutrition. Absence of hyperlipidemia can be an indirect indicator of malnutrition in geriatric patients. Malnutrition is known to be an important cause and predisposing factor for sarcopenia, disability and frailty. Two longitudinal studies have demonstrated that low cholesterol levels were associated with functional decline (26) and increased risk of mortality (27) in older patients. These results of the study may change hyperlipidemia management in frail older adults. Future longitudinal studies are needed to clearly demonstrate this relationship.

Diabetes mellitus and coronary artery disease were the co-morbidities independently associated with frailty in our study. Insulin resistance, chronic inflammation and mitochondrial dysfunction play role in the pathogenesis of diabetes mellitus and cardiovascular disease (28). These are also common pathological mechanisms for sarcopenia that is linked with physical frailty (28). Our study results support the relationship between diabetes mellitus and coronary artery disease with sarcopenia and frailty. This may be due to the common underlying mechanisms.

Most of the independently associated factors of frailty detected in our study are preventable or reversible. Prevention or control of the related co-morbid conditions and other factors can be an important way of struggling with the frailty syndrome.

One of the strengths of this study, besides the large study sample, is performing two different frailty scales for assessment. EFS is known to evaluate mainly the social and the cognitive aspects of frailty and FFI evaluate the physical frailty. Performing both of these frailty scales enabled the assessment of all aspects of frailty, namely physical frailty, cognitive frailty, and social frailty. Frailty rate detected with the EFS and FFI were similar (11.8% and 15.4%, respectively). However, there is a significant difference for prefrailty rate in the same patients (rates of prefrailty were 49.2% and 11.8% according to the FFI and EFS, respec-

**Table 5.** Correlation analysis results of the possible related factors both Edmonton Frailty Scale and Fried Frailty Index

	Age	Medications	ADL	IADL	CDT	MMSE	MNA-SF	Sleep duration	Yesavage depression scale	Handgrip strength	BMI	Walking time
EFS												
rho	0.264	0.374	-0.531	-0.637	-0.631	-0.518	-0.445	0.092	0.470	-0.511	0.059	0.543
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.005	<0.001	<0.001	0.066	<0.001
FFI												
rho	0.316	0.173	-0.370	-0.493	-0.350	-0.412	-0.459	0.057	0.329	-0.594	-0.095	0.628
p	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.083	<0.001	<0.001	0.003	<0.001

EFS: Edmonton Frailty Scale; FFI: Fried Frailty Index; ADL: Katz Activities of Daily Living; IADL: Instrumental Activities of Daily Living; CDT: Clock drawing test; MMSE: Mini-Mental State Examination; MNA-SF: Mini-Nutritional Assessment-Short Form; BMI: Body mass index

tively). Frailty is a complex geriatric syndrome that may contain multiple dimensions like physical, social, psychological and cognitive impairment (20). There are a large number of frailty scales and each scale can evaluate different dimensions of frailty. While some scales measure physical vulnerability better, other scales may focus on social, cognitive and psychological vulnerability. Therefore, the prevalence of frailty may vary among the same population depending on which scale was used (21, 22). On these terms, it can be difficult to compare the frailty prevalence of different populations or groups of patients evaluated by different frailty scales. In this study, statistically significant, moderate level of compliance was found between EFS and FFI. A new standardized frailty scale that evaluate all aspects of frailty and is sensitive for predicting mortality can be valuable for routine clinical assessment of older patients.

Some limitations of this study should be addressed. Because of the cross-sectional design, causality could not be determined. Further comprehensive, prospective, longitudinal studies are needed to identify the risk factors and protective factors.

In conclusion, frailty is an important and common cause of dependency, increased adverse outcomes and health spending in older patients. It is a compelling geriatric syndrome which has interaction with other geriatric syndromes chronic comorbid conditions, such as cardiovascular diseases. Malnutrition risk is an important related factor of frailty that related factor as an absence of hyperlipidemia in this study can support the need of nutritional assessment in older adults in clinical practice. Improving the quality of life by reducing frailty and dependency of older patients was one of the basic goals of geriatric and preventive medicine. Most of the related factors of frailty are reversible or preventable. Defining the related factors of frailty by a comprehensive assessment is important to notice and prevent from the reversible conditions to reduce the frailty in older adults admitted to outpatient clinics.

**Ethics Committee Approval:** The study protocol was approved by the ethics board of Hacettepe University Non-Interventional Clinical Research Ethics Committee (approval date: 21.01.2015 issue number: GO 15/36).

**Informed Consent:** Written informed consent was obtained from patients who participated in this study.

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## REFERENCES

- Kojima G, Iliffe S, Walters K. Frailty index as a predictor of mortality: a systematic review and meta-analysis. *Age Ageing* 2018; 47(2): 193–200. [CrossRef]
- Sirven N, Rapp T. The cost of frailty in France. *Eur J Health Econ* 2017; 18(2): 243–53. [CrossRef]
- Dent E, Kowal P, Hoogendijk EO. Frailty measurement in research and clinical practice: A review. *Eur J Intern Med* 2016; 31: 3–10. [CrossRef]
- Syddall H, Roberts HC, Evandrou M, Cooper C, Bergman H, Aihie Sayer A. Prevalence and correlates of frailty among community-dwelling older men and women: findings from the Hertfordshire Cohort Study. *Age Ageing* 2010; 39(2): 197–203. [CrossRef]
- Eyigor S, Kutsal YG, Duran E, Huner B, Paker N, Durmus B, et al; Turkish Society of Physical Medicine and Rehabilitation, Geriatric Rehabilitation Working Group. Frailty prevalence and related factors in the older adult-FrailTURK Project. *Age (Dordr)* 2015; 37(3): 9791.
- Buttery AK, Busch MA, Gaertner B, Scheidt-Nave C, Fuchs J. Prevalence and correlates of frailty among older adults: findings from the German health interview and examination survey. *BMC Geriatr* 2015; 15: 22. [CrossRef]
- Akın S, Mazıcioglu MM, Mucuk S, Gocer S, Deniz Şafak E, Arguvanlı S, et al. The prevalence of frailty and related factors in community-dwelling Turkish elderly according to modified Fried Frailty Index and FRAIL scales. *Aging Clin Exp Res* 2015; 27(5): 703–9. [CrossRef]
- Çakmur H. Frailty among elderly adults in a rural area of Turkey. *Med Sci Monit* 2015; 21: 1232–42. [CrossRef]
- 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(3): 344–50.
10. Graf C. The Lawton Instrumental Activities of Daily Living (IADL) Scale. *Medsurg Nurs* 2009; 18(5): 315–6.
  11. Sarıkaya D, Halil M, Kuyumcu ME, Kilic MK, Yesil Y, Kara O, et al. Mini nutritional assessment test long and short form are valid screening tools in Turkish older adults. *Arch Gerontol Geriatr* 2015; 61(1): 56–60. [\[CrossRef\]](#)
  12. Durmaz B, Soysal P, Ellidokuz H, Isik AT. Validity and reliability of geriatric depression scale-15 (short form) in Turkish older adults. *North Clin Istanbul* 2018; 5(3): 216–20. [\[CrossRef\]](#)
  13. Gungen C, Ertan T, Eker E, Yasar R, Engin F. Reliability and validity of the standardized Mini Mental State Examination in the diagnosis of mild dementia in Turkish population. [Article in Turkish]. *Turk Psikiyatri Derg* 2002; 13(4): 273–81.
  14. Stäahelin HB, Monsch AU, Spiegel R. Early diagnosis of dementia via a two-step screening and diagnostic procedure. *Int Psychogeriatr* 1997; 9 Suppl 1: 123–30. [\[CrossRef\]](#)
  15. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, et al; Cardiovascular Health Study Collaborative Research Group. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56(3): M146–56. [\[CrossRef\]](#)
  16. Aygör HE, Fadıloğlu Ç, Şahin S, Aykar FŞ, Akçiçek F. Validation of edmonton frail scale into elderly Turkish population. *Arch Gerontol Geriatr* 2018; 76: 133–7. [\[CrossRef\]](#)
  17. Santos-Eggimann B, Cuénoud P, Spagnoli J, Junod J. Prevalence of frailty in middle-aged and older community-dwelling Europeans living in 10 countries. *J Gerontol A Biol Sci Med Sci* 2009; 64(6): 675–81.
  18. Garcia-Garcia FJ, Gutierrez Avila G, Alfaro-Acha A, Amor Andres MS, De Los Angeles De La Torre Lanza M, Escribano Aparicio MV, et al; Toledo Study Group. The prevalence of frailty syndrome in an older population from Spain. The Toledo Study for Healthy Aging. *J Nutr Health Aging* 2011; 15(10): 852–6. [\[CrossRef\]](#)
  19. Rockwood K, Howlett SE, MacKnight C, Beattie BL, Bergman H, Hébert R, et al. Prevalence, attributes, and outcomes of fitness and frailty in community-dwelling older adults: report from the Canadian study of health and aging. *J Gerontol A Biol Sci Med Sci* 2004; 59(12): 1310–7. [\[CrossRef\]](#)
  20. Moreira VG, Lourenço RA. Prevalence and factors associated with frailty in an older population from the city of Rio de Janeiro, Brazil: the FIBRA-RJ Study. *Clinics (Sao Paulo)* 2013; 68(7): 979–85. [\[CrossRef\]](#)
  21. Hoogendijk EO, van Hout HP, Heymans MW, van der Horst HE, Frieters DH, et al. Explaining the association between educational level and frailty in older adults: results from a 13-year longitudinal study in the Netherlands. *Ann Epidemiol* 2014; 24(7): 538–44.e2. [\[CrossRef\]](#)
  22. Bollwein J, Volkert D, Diekmann R, Kaiser MJ, Uter W, Vidal K, et al. Nutritional status according to the mini nutritional assessment (MNA®) and frailty in community dwelling older persons: a close relationship. *J Nutr Health Aging* 2013; 17(4): 351–6. [\[CrossRef\]](#)
  23. Frisoli A Jr, Ingham SJ, Paes AT, Tinoco E, Greco A, Zanata N, et al. Frailty predictors and outcomes among older patients with cardiovascular disease: Data from Fragicor. *Arch Gerontol Geriatr* 2015; 61(1): 1–7. [\[CrossRef\]](#)
  24. Biritwum RB, Minicuci N, Yawson AE, Theou O, Mensah GP, Naidoo N, et al; WHO SAGE Collaboration. Prevalence of and factors associated with frailty and disability in older adults from China, Ghana, India, Mexico, Russia and South Africa. *Maturitas* 2016; 91: 8–18. [\[CrossRef\]](#)
  25. Park E, Yu M. Frailty and Its Related Factors in Vulnerable Elderly Population by Age Groups. [Article in Korean]. *J Korean Acad Nurs* 2016; 46(6): 848–57. [\[CrossRef\]](#)
  26. Schalk BW, Visser M, Deeg DJ, Bouter LM. Lower levels of serum albumin and total cholesterol and future decline in functional performance in older persons: the Longitudinal Aging Study Amsterdam. *Age Ageing* 2004; 33(3): 266–72. [\[CrossRef\]](#)
  27. Brescianini S, Maggi S, Farchi G, Mariotti S, Di Carlo A, Baldereschi M, et al; ILSA Group. Low total cholesterol and increased risk of dying: are low levels clinical warning signs in the elderly? Results from the Italian Longitudinal Study on Aging. *J Am Geriatr Soc* 2003; 51(7): 991–6. [\[CrossRef\]](#)
  28. Umegaki H. Sarcopenia and frailty in older patients with diabetes mellitus. *Geriatr Gerontol Int* 2016; 16(3): 293–9. [\[CrossRef\]](#)