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Authors: Sevgi Keskin, Yusuf Ali Altunci, Meltem Songür Kodik, Funda Karbek Akarca

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Comparison of falls and non-fall admissions to the emergency department in older adults and evaluation of the Barthel index and the Falls Efficacy Scale International scores

Sevgi Keskin, Yusuf Ali Altunci, Meltem Songür Kodik, Funda Karbek Akarca

Department of Emergency Medicine, Ege University Faculty of Medicine, Izmir, Türkiye

Corresponding author: Yusuf Ali Altunci, e-mail: yusuf.ali.altunci@ege.edu.tr

ORCID

SK: https://orcid.org/0000-0002-8291-3836

YAA: https://orcid.org/0000-0002-4803-5419

MS: https://orcid.org/0000-0003-4565-3374

FKA: https://orcid.org/0000-0003-2455-8044

ABSTRACT

Introduction and aim. The aim of this study was to describe the characteristics of patients aged 65 years and older who experienced falls and to examine the distribution of the Barthel index (BI) and Falls Efficacy Scale International (FES-I) scores.

Material and methods. Participants over 65 years of age who were admitted to the emergency department (ED) between 31.07.2019 and 31.01.2020 and who met the inclusion criteria were included in the study. Characteristics, BI, and FES-I scores of patients admitted to the emergency department for falls and nontraumatic reasons were compared.

Results. The study was carried out with 259 participants, 133 in the fall group and 126 in the control group. The mean age was 79±8.3 years in the fall group and 76.3±7.9 years in the control group (p=0.011). In the fall group, 61 (46.2%) were male and 71 (53.8%) were females. The most common trauma after a fall was soft tissue trauma. The FES-I and BI scores were found to be at higher risk in the fall group aged 75-84 years compared to the control group and there was a statistically significant difference between them (p=0.009; p=0.030, respectively).

Conclusion. FES-I and BI did not show significant differences between fall and control groups in all age groups. In the 75-84 age group, both scales showed higher values in the fall group. We believe these scales can be used as follow-up tools in screening and preventing fall risks, especially in this age group.

Keywords. Barthel Index, emergency department, fall, Falls Efficacy Scale International, older adult

Introduction

Trauma, which is a serious cause of morbidity and mortality in the elderly, is a health problem that should be prevented. Falls are the most common cause of trauma in the elderly and 1/3 of the population aged 75 years and older falls at least once a year. Worldwide, more than 50% of injury-related hospitalizations are seen in patients aged 65 years and older and 10–15% of all emergency department (ED) admissions are due to mild or severe injuries.[1]

The Barthel index (BI) is a scale based on measuring the individual's performance in activities of daily living and monitoring activities of daily living.[2] Its predictive value is in predicting the effects caused by neuromuscular and musculoskeletal diseases, the duration of hospitalization, and care needed. It is easy to use but limited in application due to unreliable results in patients with malignancy, dementia, and pelvic trauma.[3,4]

The Falls Efficacy Scale International (FES-I) was developed as a solution to the problems of the fear of falling, self-efficacy and balance confidence. FES-I is a test that shows almost perfect measurement characteristics in people with and without moderate cognitive impairment and has been validated for use in older adults.[5] The aim of both scores is to assess the patient's fall risk and implement early precautions. BI has mainly been used to monitor rehabilitation in cerebrovascular disease and predict mortality in various conditions.[6-11] Its role in fall prediction is less explored. Toots et al. identified high BI scores and environmental factors as fall risks, with greater morbidity observed in women with high BI values, especially those aged 70-90, where BI was a better predictor of falls in women than men.[12] In a study by Figueiredo et al., FES-I demonstrated high internal consistency when used with socially isolated older adults in the community.[13]

Aim

The aim of this study was to explore and compare the characteristics of patients over 65 years old who present to the ED with fall complaints versus those presenting with other complaints. Specifically, we sought to determine if there are significant differences between the fall group and a control group within the same age bracket. Our focus was on comparing the BI and the FES-I scores between these two groups. While the BI has been compared with various other scales in literature, the FES-I is less frequently utilized. We chose to use the FES-I to evaluate whether it provides a better prediction of fall risk compared to the BI. To avoid confusion, we focused on external risk factors, as both the Barthel Index and the Falls Efficacy Scale International are based on physical capacity and ability. Both scores aim to assess the patient’s fall risk and implement early precautions. By including patients presenting with other complaints as the control group, we were able to better evaluate the effectiveness of these indices in assessing external factors. Additionally, the study aimed to identify risk factors associated with falls, including patient-related factors such as visual and auditory impairments and frequent falls, as well as environmental factors like indoor

stairs and living alone. By investigating these factors, we aimed to understand their impact on fall risk. Furthermore, we documented the diagnoses of the patients included in the study to identify the most common conditions encountered. This study was conducted with these objectives in mind to better understand fall risk and inform preventive strategies.

Material and methods

Study design

The study was a descriptive cross-sectional study. Patients over the age of 65 who were admitted to Ege University Faculty of Medicine Hospital ED between July 31, 2019, and January 31, 2020, and met the study criteria were included. The Ethics committee approval for the study was obtained from Ege University Clinical Research Ethics Committee (Date: 31.07.2019, No: 19-7T/7). Informed consent was obtained from all patients via an informed consent form.

Study population

In the study, participants were divided into two groups: the fall group and the control group. The fall group consisted of patients aged 65 and older who presented to the ED with complaints of falling due to causes such as slipping, hitting an object or another person, or being pushed or shoved by a person. The height of the fall was not used as a criterion. However, falls due to non-mechanical causes (e.g., syncope, cerebrovascular events, etc.) were not included in the study. The control group consisted of patients aged 65 and older who were presented to the ED only for non-traumatic reasons. The inclusion criteria for the fall group were defined as being 65 years of age or older, presenting to the ED with a fall as described above, and agreeing to participate in the study. For the control group, the criteria were defined as being 65 years of age or older, presenting to the ED for non-traumatic reasons, and agreeing to participate in the study.

Exclusion criteria were defined as unconsciousness or not suitable for evaluation, sequelae of cerebrovascular events, trauma with mechanisms other than falls for the fall group, and ED visits due to falls within the last 1 year.

Sample size calculation

The minimum number of patients required to find a significant difference between BI and FES-I scores in trauma and non-trauma patient groups over 65 years of age was calculated as 210 in total, 105 patients in each group, using Gpower, with 95% power, type 1 error level 0.05, and a medium effect size of 0.5 under the independent sample t test.

Study procedure

Patients were evaluated by the primary responsible emergency physician. There was no intervention in the routine diagnosis, treatment and examination practices. A history was taken by the physician and then BI and FES-I scales were administered. These were recorded in the case report form.

Data and outcome measures

The date of admission, time of admission, age, gender, living arrangements, presence of stairs, visual and hearing problems, history of frequent falls, comorbidities, presenting complaints and diagnoses were taken into consideration. Information about the mechanism of trauma, physical examination findings, and hospital diagnosis were recorded. BI and FES-I scores of the patients were calculated and fall probability was determined.

BI and FES-I

BI is a 10-item scale. These are feeding, washing, self-care, dressing and undressing, bowel control, bladder control, toilet care, transfer from wheelchair to bed and vice versa, mobility (walking on a smooth surface, using a wheelchair), going up and down stairs. In the scale consisting of a total of 100 points, 0–20 is categorized as fully dependent, 21–61 as highly dependent, 62–90 as moderately dependent, 91–99 as mildly dependent and 100 as fully independent.

The FES-I consists of a total of 16 parameters and each parameter is scored from 1 to 4. I am not worried at all scored 1 point, a little worried is scored 2 points, quite worried is scored 3 points and very worried is scored 4 points. These are cleaning the house, getting dressed, cooking easy meals, bathing, shopping, sitting up and down in a chair, walking up and down stairs, walking around the house, facing an object above the head or on the floor, answering a landline phone before the caller gives up, walking on wet or icy slippery ground, visiting a friend or relative, walking in a crowded place, walking on uneven ground such as stony ground, walking up and down hills, going out of the house for community activities. The total score is scored from 16 to 64. A score of 16–19 is considered as low risk, 20–27 as medium risk and 28–64 as high risk.

Statistical analysis

Data analysis was performed using the Statistical Package for Social Sciences (SPSS, IBM, Armonk, NY, USA) Windows 22. The conformity of the data to normal distribution was evaluated by Kolmogorov-Smirnov test. Normally distributed numerical data were presented as mean±standard deviation and non-normally distributed numerical data were presented as median and interquartile range (IQR 25–75%). Categorical variables were presented as number (n) and frequency (%). Categorical variables were

compared by Chi-square or Fisher Exact test and continuous variables were compared by Student t test or Mann Whitney U test. Statistical significance level was accepted as $p<0.05$.

Results

A total of 259 participants were included in the study. We excluded 1 patient who was unconscious or not eligible for evaluation, 1 patient with sequelae of cerebrovascular events and 1 patient who presented to the ED due to a fall in the last 1 year. The study was conducted with 259 participants, 133 in the fall group and 126 in the control group. The total number of female participants was 131 (51%), while the total number of male participants was 126 (49%).

The mean age was 79±8.3 years in the fall group and 76.3±7.9 years in the control group (p=0.011). In the fall group, the number of male participants aged 65–74 years was 22 (48.9%), and the number of female participants was 23 (51.1%); the number of male participants aged 75-84 years was 25 (49%), and the number of female participants was 26 (51%); the number of male participants aged 85 and over was 14 (38.9%), and the number of female participants was 22 (61.1%) (Table 1).

The number of people living alone at home was 7 (5.3%) in the fall group and 13 (10.4%) in the control group. There was no significant difference between the groups in terms of living alone at home (p=0.127). The number of stairs in the house was 76 (57.6%) in the fall group and 61 (48.8%) in the control group (p=0.159) (Table 1).

Table 1. Comparison of demographic data, fall risk factors and comorbidities between groups

n (%)	**Fall group n=132**	**Control group n=125**	**p**
Male gender	61 (46.7)	65 (52)	0.354
Female gender	71 (53.7)	60 (48)	
Age group			
65–74	45 (34.1)	59 (47.2)	0.100
75–84	51 (38.6)	38 (30.4)	
≥85	36 (27.3)	28 (22.4)	
Risk factors			
Frequent history of falls	32 (24.2)	20 (16)	0.100
Use of hearing aid	7 (5.3)	8 (6.4)	0.708
Use of glasses	35 (26.5)	45 (36)	0.101
Living alone at home	7 (5.3)	13 (10.4)	0.127
Presence of stairs inside the home	76 (57.6)	61 (48.8)	0.159

Comorbidities			
Hypertension	77 (58.3)	69 (55.2)	0.612
Diabetes mellitus	36 (27.2)	39 (31.2)	0.489
Coronary artery disease	29 (21.9)	43 (34.4)	0.027
Congestive heart failure	15 (11.3)	27 (21.26)	0.027
Malignancy	9 (6.8)	25 (20)	0.002
Dementia	14 (10.6)	8 (6.4)	0.228
Chronic kidney disease	4 (3.03)	18 (14.4)	0.001
Chronic obstructive pulmonary disease	4 (3.03)	16 (12.8)	0.004
Asthma	7 (5.3)	2 (1.6)	0.073
Venous thromboembolism	6 (4.5)	3 (2.4)	0.502
Heart valve replacement	2 (1.5)	5 (4)	0.260
Hypothyroidism	2 (1.5)	0 (0)	0.359
Epilepsy	1 (0.75)	1 (0.8)	0.073

The most common comorbidities in the fall group were hypertension (HT) in 77 participants (58.3%), diabetes mellitus (DM) in 36 participants (27.2%) and coronary artery disease (CAD) in 29 participants (21.9%). CAD was statistically significantly more frequent in the control group (p=0.027). In the fall group, the number of participants with congestive heart failure (CHF) was 15 (11.4%), chronic renal failure was 4 (3%), chronic obstructive pulmonary disease (COPD) was 4 (3%) and malignancy was 9 (6.8%). In the control group, the number of participants with CHF was 27 (21.6%), with CKD was 18 (14.4%), with COPD was 16 (12.8%) and with malignancy was 25 (20%). The frequency of CHF, CKD, COPD and malignancy was significantly higher in the control group (p=0.027, p=0.001, p=0.004, p=0.002, respectively). The number of participants without comorbidities was 32 (24.2%) in the fall group and 18 (14.4%) in the control group (p=0.046) (Table 1).

When the most common outcome diagnoses of the participants with falls were classified, soft tissue trauma was seen in 62 (45.9%), lower extremity trauma in 41 (30.3%), and upper extremity trauma in 14 (10.3%) participants. This was followed by head trauma, vertebral trauma, thoracic trauma, maxillofacial trauma and cervical trauma. The most common association was the association of lower extremity trauma with head trauma, which was seen in 4 participants (3.1%) (Table 2, (Fig. 1).

Table 2. Distribution of injury regions after falls

	Fall group (n=132)	
	n	**%**
Soft tissue	62	45.9

Upper extremity	14	10.3
Lower extremity	41	30.3
Head	8	5.9
Cervical	3	2.2
Maxillofacial	5	3.7
Thoracic	7	5.18
Vertebral	8	5.9

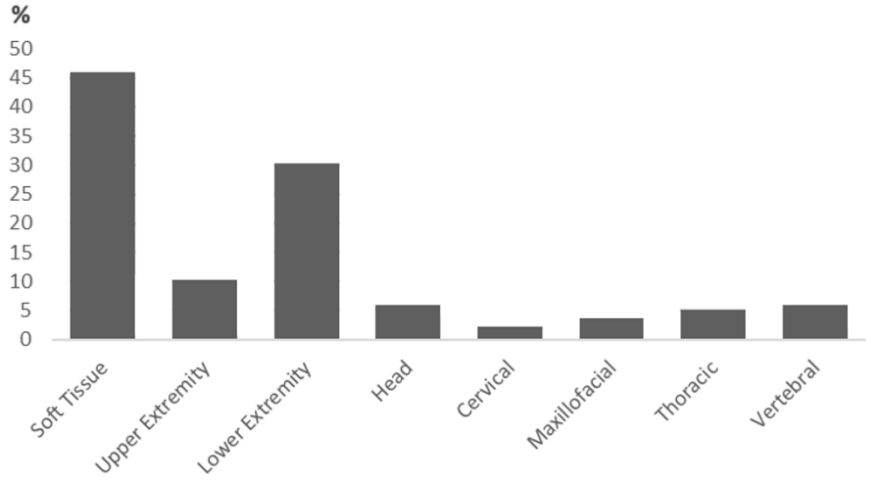

Fig. 1. Graphic of injury regions distribution

According to FES-I, there were 32 (24.2%) low-risk, 13 (9.8%) moderate-risk, 87 (66%) high-risk participants in the fall group and 20 (16%) low-risk, 18 (14.4%) moderate-risk, 87 (69.6%) high-risk participants in the control group (p=0.184). According to BI, there were 6 (4.5%) fully dependent, 37 (28%) severely dependent, 40 (30.3%) moderately dependent, 19 (14.4%) mildly dependent, 30 (22.7%) completely independent participants in the fall group; 15 (12%) fully dependent, 31 (24.8%) severely dependent, 37 (29.6%) moderately dependent, 17 (13.6%) mildly dependent, 25 (20%) completely independent participants in the control group (p=0.300) (Table 3). Participants aged 75–84 years who underwent FES-I and BI were found to have higher fall scores in the fall group compared to the control group and a statistically significant difference was found between them (p=0.009, p=0.03, respectively) (Table 3).

Table 3. Comparison of FES-I and BI between groups*

	Fall group n=132			Control group n=125			p
Age group	**65–74**	**75–84**	**>85**	**65–74**	**75–84**	**>85**	
FES-I							
Low risk	23 (71.9)	6 (18.8)	3 (8.4)	12 (60)	8 (40)	0 (0)	
Moderate risk	6 (46.2)	6 (46.2)	1 (7.7)	13	2 (11.1)	3 (16.7)	0.184[a]
High risk	16 (18.4)	39 (44.8	32	(72.2)	28	25	0.009[b]
			(36.8)	34	(32.2)	(28.7)	
				(39.1)			
BI							
Completely dependent	1 (16.7)	1 (16.7)	4 (67.7)	5 (33.3)	5 (33.3)	5 (33.3)	
Severely dependent	4 (10.8)	11	22	10	12	9 (29)	
Moderately dependent	12 (30)	(29.47)	(59.5)	(32.3)	(38.7)	9 (24.3)	0.300[a]
Mildly dependent	7 (36.8)	20 (50)	8 (20)	16	12	2 (11.8)	0.030[b]
Independent	21 (70)	11 (57.9)	1 (5.3)	(43.2)	(32.4)	3 (12)	
		8 (26.7)	1 (3.3)	8 (47.1)	7 (41.2)		
				20 (80)	2 (8)		

* FES-I – Falls Efficacy Scale International, BI – Barthel Index, p[a] – the p-value for the Pearson Chi-Square test between the fall and control groups, p[b]– The p-value for the Pearson Chi-Square test between the fall and control groups within the 75–84 age group

Discussion

In this study, aiming to define characteristics of older adult patients presenting with falls and compare BI and FES-I scale properties in this group with other admissions, FES-I and BI comparison showed no significant difference between fall and control groups across all age groups; however, in the 75-84 age group, both scales exhibited higher values in the fall group.

In the study conducted by Galet et al. the distribution of age groups among falls in older adults was found to be 24.93% between the ages of 65–74 years, 35.59% between the ages of 75–84 years, and 39.48% aged 85 years and older.[14] In our study, 45 (33.3%) aged 65–74 years, 51 (37.7%) aged 75–84 years and 36 (26.6%) aged 85 years and older were found. We are of the opinion that the relatively younger population in the country where we conducted the study is related to the lower number of admissions aged 85 years and older. Similar to our study, in the systematic review conducted by Hopewell et al., the mean age of the elderly who fell was 77.7±8.4 years.[15]

There are studies showing that the female gender is more risky for falls than the male gender.[16-18] In a study by Henfy et al. it was shown that 60.9% of patients aged 65 years and older who presented with falls were women.[19] In the study conducted by Gökçek et al. in our country, it was found that 60.8% of patients admitted to the ED with falls were women.[20] Studies in the literature showing that falls are more common in women have explained these results by the fact that women present to the hospital more frequently and that female patients are more prone to traumas related to age-related osteoporotic process.[19,20] However, some studies suggest no significant relationship between gender and fall admissions. It is theorized that this may be due to similar rates of activity restriction among both sexes with aging, leading to the disappearance of differences between them at older ages.[21]

In a study by Gökçek et al. 91.6% of older adults who presented with falls had any comorbidity and the most common comorbidity was found to be HT.[20] In the same study, it was shown that the risk of falls increased with increasing number of chronic diseases.[20] In the study by Mitchell et al. it was observed that individuals with falls had multiple chronic diseases.[22] In our study, comorbidities in the control group were: CAD, CHF, malignancy, CKD and COPD were more common in the control group without falls. We believe that the fact that the control group in our study consisted of patients admitted to the ED for reasons other than falls was effective on this result. The finding that certain comorbidities were higher in the control group who presented to the ED for other reasons is an expected result for our study. This result can be interpreted as no prominent comorbidity in the fall group among all ED admissions of older adults.

According to Berry et al. the most common injury sites in older adults in falls are the head and thorax with a total rate of 54.7%.[23] Choi et al. reported that lower extremity injuries (32.1%), upper extremity injuries (23.1%), shoulder, neck, back and/or hip injuries (23.9%) were the most common injuries after falls in older adults, followed by head injuries (15.3%).[24] In the study group in which data were collected in Choi et al. and Berry et al. study, the trauma group was handled more broadly and high-energy trauma was also included.[23,24] We believe that limiting the mechanism of trauma to fall and not including other mechanisms of trauma in our study explains these results.

BI has been primarily studied in monitoring rehabilitation response in cerebrovascular disease patients and predicting mortality across various conditions.[5,14-18] Few studies focus on fall prediction. Toots et al. found high BI scores and presence of ≥2 environmental factors to be fall risk factors.[12] They also noted greater morbidity in women with high BI values, particularly among those aged 70-90, where BI was a better fall predictor in women than men.

In Figueiredo et al.'s study, FES-I was given to socially isolated older adults living in the community, showing high internal consistency.[13] FES-I scores were notably higher in females, those with lower education levels, and individuals reporting fear of falling. In Sparrow et al.'s study on a demanding balance program for Parkinson's disease patients, those compelled to undergo the regimen experienced a decrease in fall rates, as evidenced by FES-I. The FES-I score significantly decreased following the exercise

program.[25] In our study, no significant difference was found between the fall and control groups in terms of BI scores. Our study sample consisted of patients with high comorbidity, multiple risk factors and high BI scores. We think that our sample selection was effective on our results. However, in our study, BI was significantly higher in the fall group aged 75–84 years. We believe that this result is due to the fact that patients aged 65–74 years are more independent and patients over 85 years are more dependent. Therefore, we believe BI may be more meaningful in predicting fall risk, especially in the 75–84 age group. Similar results were obtained with FES-I. Additionally, most patients over 85 years old in our study were not living alone. Despite being a descriptive study with certain limitations, we suggest that BI and FES-I scores can be useful in assessing fall risk in older adults, particularly in the 75–84 age group.

Study limitations

Our study is a single center study. Only ED admissions were evaluated, and non-fall ED admissions were included as a control group. The study was conducted during the winter period, and the seasonal effects on falls could not be evaluated. Differences in the distribution of demographic data between the study and control groups may have led to biased results.

Conclusion

FES-I and BI showed no significant difference between fall and control groups across all age groups. However, in the 75-84 age group, both scales exhibited higher values in the fall group. We believe decreased self-sufficiency and mobility among participants over 75 years of age may have contributed to this outcome. The limited group size, focus on falls, and relatively low rate of living alone in patients over 85 years old may have influenced the similar results between patients over 85 years old and those under 75 years old.

Declarations

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Author contributions

Conceptualization, Y.A.A. and S.K.; Methodology, Y.A.A. and M.S.; Software, S.K.; Validation, M.S., F.K.A. and S.K.; Formal Analysis, S.K.; Investigation, S.K.; Resources, S.K.; Data Curation, M.S.; Writing – Original Draft Preparation, Y.A.A.; Writing – Review & Editing, Y.A.A., F.K.A. and M.S.; Visualization, F.K.A.; Supervision, Y.A.A. and M.S.; Project Administration, Y.A.A.

Conflicts of interest

We have no conflicts of interest to disclose.

Data availability

All data supporting the findings of this study are included in this published article and its supplementary information files.

Ethics approval

The ethics committee approval for the study was obtained from Ege University Clinical Research Ethics Committee (Date: 31.07.2019, No: 19-7T/7).

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