

Comprehensive Analysis of Factors Affecting Falls in the Elderly in the Light of Biopsychosocial Approach: A Logistic Regression Model

Biyopsikososyal Yaklaşım Işığında Yaşlılarda Düşmeyi Etkileyen Faktörlerin Kapsamlı Analizi: Bir Lojistik Regresyon Modeli

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ABSTRACT

The aim of this study was to comprehensively analyze the factors influencing fall risk in older adults. A detailed assessment form was developed based on risk factors identified in previous literature and expert opinion. This form encompassed personal factors such as age and gender, environmental factors including icy surfaces and stair height, and psychological and functional variables such as education level, depression, difficulty with sitting and standing, and dressing. Among the 245 participants included in the study, 28.5% (n = 70) had a history of at least one fall. Using the data collected, the impact of these factors on fall risk was analyzed through logistic regression modeling. No statistically significant differences were found between individuals who had fallen and those who had not in terms of body mass index, gender, smoking status, or exercise habits ($p > 0.05$). The logistic regression model demonstrated strong predictive performance, with an overall accuracy of 88.2%, sensitivity of 77.1%, and specificity of 92.6%. Medication use was significantly associated with a reduced risk of falling ($p = 0.002$), while decreased muscle strength ($p = 0.024$) and difficulty in sitting or standing ($p = 0.019$) significantly increased the risk. Among environmental variables, the use of assistive devices—such as canes ($p = 0.002$) and glasses ($p < 0.001$)—and the presence of favorable environmental conditions for example, good ambient lighting ($p = 0.033$) were associated with a significantly lower risk of falling. In conclusion, our logistic regression model showed that a moderate to good discrimination between bio-psycho-social indicators and fall risk could be achieved. Functional mobility indicators such as difficulty in sitting up and down and decreased muscle strength were consistently associated with higher risk. However, findings related to medication use and assistive devices came to the forefront as factors reducing the risk of falls.

Keywords: Activities of daily living, Biopsychosocial model, Muscle strength, Risk factors.

ÖZ

Bu çalışmanın amacı, yaşlı bireylerde düşme riskini etkileyen faktörleri kapsamlı bir şekilde analiz etmektir. Literatürde daha önce tanımlanmış risk faktörleri ve uzman görüşleri doğrultusunda; yaş, cinsiyet gibi kişisel faktörler; buzlu zemin, merdiven yüksekliği gibi çevresel faktörler; eğitim düzeyi, depresyon düzeyi, oturma-kalkma ve kıyafet değiştirme zorluğu gibi psikolojik ve fonksiyonel değişkenleri içeren kapsamlı bir değerlendirme formu oluşturulmuştur. Çalışmaya dâhil edilen 245 katılımcının %28,5'inde (n=70) en az bir düşme öyküsü bulunduğu belirlenmiştir. Elde edilen veriler doğrultusunda, düşme riskine etki eden faktörler lojistik regresyon analizi ile incelenmiştir. Beden kitle indeksi, cinsiyet, sigara kullanımı ve egzersiz alışkanlıkları açısından düşenler ve düşmeyenler arasında anlamlı bir fark saptanmamıştır ($p > 0.05$). Lojistik regresyon modeli %88,2 doğruluk, %77,1 duyarlılık ve %92,6 özgüllük değerleri ile güçlü bir öngörü performansı göstermiştir. İlaç kullanımı düşme riskini anlamlı düzeyde azaltırken ($p = 0.002$), kas gücündeki azalma ($p = 0.024$) ve oturma/ayakta durma güclüğü ($p = 0.019$) düşme riskini anlamlı düzeyde artıran faktörler olarak belirlenmiştir. Yardımcı cihaz kullanımı (baston: $p = 0.002$, gözlük: $p < 0.001$) ve örneğin ortam aydınlatmasının iyi olması gibi olumlu çevresel koşulların varlığı ($p = 0.033$) ise düşme riskini anlamlı düzeyde azaltmıştır. Sonuç olarak oluşturduğumuz lojistik regresyon modeliyle, biyopsiko-sosyal göstergelerle düşme riskine ilişkin orta-iyi düzeyde ayırt edicilik sağlanabileceği gösterilmiştir. Oturup-kalkmada güçlük ve kas gücü azalması gibi fonksiyonel mobilite göstergeleri tutarlı biçimde daha yüksek risk ile ilişkiliydi. Ancak ilaç kullanımı ve yardımcı cihazlara ilişkin bulgular düşme riskini azaltıcı faktörler olarak ön plana çıkmıştır.

Anahtar Kelimeler: Biyopsikososyal model, Günlük yaşam aktiviteleri, Kas gücü, Risk faktörleri.

Highlights

Fall risk increases significantly with reduced muscle strength and mobility difficulties such as sitting and standing. Use of medications and simple assistive devices like canes and glasses significantly reduces fall risk in the elderly. Environmental factors, especially poor conditions, also play a crucial role in fall risk but can be mitigated with proper support.

The study was approved by the Ethics Committee of [Muş Alparslan University] ([Approval no: 193288]).

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INTRODUCTION

Falling is an important public health problem that is frequently encountered in elderly individuals and can lead to serious consequences. The World Health Organization defines a fall as "an event that results in a person unintentionally falling to the ground, floor or other lower level"(1). Falls, a concern for many older adults, are a leading cause of unintentional injuries and premature death worldwide (2). An estimated 684,000 fatal falls occur each year and this is the second leading cause of unintentional injury death after road traffic accidents.¹ The frequency of a fallen individual falling again is 60% (3). While 70% of falls in the elderly aged 65 and over result in injury, 90% of all fractures seen in this period are caused by falls (4). Falls in older adults can cause irreversible physical injuries and these injuries can even lead to disability or death (5).

The effects of falls on older adults are not limited to physical injuries. Fear of falling is a common psychological outcome among older adults who have experienced falls. It is reported by a significant proportion of older individuals and studies have shown that 74.1% of older women who have fallen experience this fear (6). Fear of falling can lead individuals to restrict their physical activity and social isolation (7). This further increases the risk of falls by causing loss of muscle strength and balance. In addition, mobility limitation and dependency following falls negatively affect the quality of life of elderly individuals. From an economic point of view, falls create a significant burden on the health system. In the United States, healthcare expenditure attributable to non-fatal falls among older adults is approximately \$80 billion in 2020 (8).

In this context, falls are common in elderly individuals and can lead to serious consequences. Considering the psychosocial and economic effects as well as physical injuries, prevention of falls and identification of risk factors are of great importance.

Factors Affecting Falls

Prevention of falls and identification of risk factors are of great importance in terms of improving the quality of life of elderly individuals and maintaining their independence. In order to develop measures to reduce the risk of falls, it is necessary to correctly classify and analyse the factors underlying this risk. It is difficult to attribute falls in older people to a single risk factor, because the causes of falls are multifactorial and interact with each other. In this direction, fall risk factors can generally be divided into two as intrinsic and extrinsic. Intrinsic factors are factors that depend on or arise from the elderly person himself/herself. Extrinsic factors are the factors created by the environmental conditions that do not depend on the elderly person (9).

To better understand the influence of intrinsic factors, older adults are known to be more vulnerable to falls due to age-related declines in physical and cognitive functioning. The presence of multiple comorbidities exacerbates this risk (10). At this point, the most important intrinsic factors that increase the risk of falls are physiological disorders. For example, muscle weakness and mobility disorders are important intrinsic factors that can cause falls. Muscle weakness, especially in the lower extremities, is an important intrinsic factor contributing to falls. Decreased muscle strength affects balance and gait, increasing the likelihood of falls (11). It should be especially noted that the presence of chronic diseases in elderly individuals is an important risk factor. Diseases such as arthritis and diabetes that negatively affect mobility cause falls (12). Studies show that being physically inactive is also an important risk factor for falls (13).

Another intrinsic factor that increases the risk of falls is cognitive impairment. Problems such as decreased judgment, slower reaction times, and attention or concentration disorders are associated with an increased risk of falls. These impairments may reduce an individual's ability to respond to

environmental hazards (14). In addition, fear of falling can lead to a low activity cycle, further weakening muscles and balance and thus increasing the risk of falling (15). Another important intrinsic factor is the use of medications such as benzodiazepines, sedative-hypnotics and other psychotropic drugs. The use of these drugs is a well-documented intrinsic factor that increases the risk of falls. This is because these drugs can cause dizziness, sedation and impaired coordination (10).

Although intrinsic factors are critical in understanding fall risks, it is important to consider the interaction with extrinsic factors such as environmental hazards. External factors outside the individual play a very important role in the occurrence of falls. Indeed, a significant proportion of falls occur indoors, particularly in areas such as bedrooms and bathrooms. Common hazards include poor lighting, slippery floors, loose carpets and lack of grab bars in critical areas such as bathrooms and stairs. In addition, inadequate space ergonomics and poor

construction also contribute to the risk of falls (15). On the other hand, outdoor falls are often caused by uneven surfaces, wet or slippery floors, and uneven steps or pavements. These hazards are common in community settings and can be exacerbated by poor lighting and inadequate maintenance of public spaces (16). Furthermore, in hospitals and care facilities, environmental factors such as improper use of bed rails and inadequate staffing levels can increase the risk of falls (10).

Therefore, the multidimensional nature of falls in elderly individuals is clearly seen. Evaluation of personal environmental, psychological and functional factors together requires accurate analysis of the risk and development of effective intervention strategies. In this study, it is aimed to contribute to the development of preventive health services and to improve the quality of life of elderly individuals by systematically addressing the factors that increase the risk of falls. The aim of this study was investigated factors affecting fall in elderly.

MATERIAL AND METHOD

Research Group and Sample

This study was conducted May 2025 among elderly individuals aged 60 years and over living in Muş province in the eastern region of Turkey. The study has a cross-sectional design and was conducted with descriptive and analytical methods. Sample selection was carried out by convenience (case-dependent) sampling method.

Inclusion Criteria;

- To be enrolled in Mus Alparslan University Refresher University,
- 60 years of age or older,
- To have the cognitive competence to read and understand the questionnaire form,
- To sign the informed consent form by agreeing to participate voluntarily,
- Physical mobility on their own or with support.

Exclusion Criteria;

- To be under 60 years of age,

- Not being able to complete the questionnaire due to severe cognitive impairment (e.g. diagnosed dementia),
- Individuals with acute illness or health conditions requiring hospitalisation,
- Individuals who completed the questionnaire incompletely or did not want their data to be used,
- Individuals who did not give informed consent.

Data Collection Tool

The data were collected through a structured questionnaire developed to determine the factors that may cause the risk of falls in elderly individuals. The questionnaire was prepared by a team of researchers specialised in geriatrics on the basis of existing scientific studies in the literature. Also, Depression levels were assessed using the Beck Depression Inventory (BDI).

The questionnaire covers three main areas that may affect falls:

- Individual factors: age, gender, body mass index (BMI), medication use, fear of falling and decreased muscle strength (17-19).
- Environmental factors: use of assistive devices, environmental conditions, floor slope, rocky surface, ambient lighting, wet/icy floor and step height (18).
- Psychological and functional factors: educational status, economic status, falls during housecleaning, daily mobility level, difficulty using stairs, difficulty getting up and down, dressing function, and difficulty bathing/washing (18,20).

Each item in the questionnaire was answered on a Likert-type scale ranging from 1 to 4. Within the scope of this scale, a score of 1 indicates the lowest level of difficulty or anxiety in the relevant field, and a score of 4 indicates the highest level of difficulty or anxiety. The questionnaire form was administered to the participants once by face-to-face interview. The assessments were performed by a physiotherapist with 12 years of experience in geriatric rehabilitation.

Beck Depression Inventory (BDI) was used to assess depression level of participants. BDI was developed by Beck et al. (21). The inventory consists of 21 items designed to assess depressive symptoms experienced by individuals in the last two weeks and each item is scored between 0 and 3. These items include cognitive, emotional, somatic and behavioural components of depression such as sadness, pessimism, guilt, loss of energy and insomnia. The total score obtained is used to determine the severity of depression of the individual; 0-13 indicates minimal depression, 14-19 indicates mild depression, 20-28 indicates moderate depression and 29-63 indicates severe depression (Beck et al., 1996). The BDI-II is a reliable self-report tool with high internal consistency coefficient (Cronbach's alpha > 0.85) and validity levels (22). A validity and reliability study had been conducted in Turkish (23).

Ethics approval and consent to participate was approved by the Ethics Committee of [Muş Alparslan University] ([Approval no:193288]). All participants were informed about the purpose of the study and provided written informed consent prior to participation, in accordance with the Declaration of Helsinki.

Sample size

It was calculated using G*Power 3.1 programme. The calculation was based on a drop rate of 30% ($\Pr(Y=1|X=1) = 0.30$), odds ratio corresponding to a medium effect size ($OR = 1.5$), significance level ($\alpha = 0.05$) and 80% power ($1-\beta = 0.80$). As a result of the analysis performed with these parameters, it was determined that at least 196 participants were required to ensure the statistical power of the model (24).

Statistical analysis

Quantitative variables were summarized using mean and standard deviation. The normality of data distribution was assessed with the Shapiro–Wilk test. As the data did not conform to a normal distribution, group comparisons were conducted using the Mann–Whitney U test. Categorical variables were described by frequency and percentage (n, %), and comparisons between groups were performed using either the chi-square test (χ^2) or Fisher's exact test, depending on the expected cell counts. No correction was applied for multiple comparisons. Additionally, logistic regression analysis was carried out to explore factors associated with the likelihood of falling. To assess potential multicollinearity among independent variables, Variance Inflation Factor (VIF) values were examined, all of which were found to be within acceptable limits (VIF range: 1.136–1.197).

Adequacy of the logistic regression model was assessed with following tests: 1) The Omnibus Test was used to determine the overall significance of the model. 2) The Hosmer–Lemeshow goodness-of-fit test evaluated how well the model's predicted values aligned with the observed outcomes. 3)

The -2 Log Likelihood value and Nagelkerke R^2 were examined to assess the model's explanatory power.

A classification table was generated to evaluate the model's predictive accuracy.

Additionally, odds ratios (Exp(B)) was reported to interpret the influence of each independent variable on the likelihood of falling. All analyses were conducted using IBM SPSS Statistics version 26, and statistical significance was set at $p < .05$.

RESULTS

We found that 70 (%28.5) of the elderly people who participated in our study had a history of falls before. The mean age of the fall group was 73.11 ± 9.60 years and the mean age of the non-fall group ($n:175$, 71.5%) was 67.87 ± 5.32 years. The mean age of the fall group was significantly higher ($p: <.001$). There was no significant difference between the groups in terms of BMI, gender, smoking and exercise habits ($p>.05$). In terms of medication use, presence of chronic disease and fear of falling, the group experiencing falls was significantly more affected ($p: <.001$) (Table 1).

When the chronic disease status of the participants was analysed, it was seen that the most common diseases were hypertension

(18.0%), diabetes (18.4%) and heart diseases (9.8%). Lung disease was detected in 5.3% of the participants, Parkinson's disease in 0.4% and Alzheimer's disease in 0.4%. 47.8% of the participants did not have any chronic disease. The most common diseases in the group of individuals who experienced falls were diabetes (27.1%), hypertension (24.3%) and heart disease (15.7%), while these rates were 14.9%, 15.4% and 7.4%, respectively, in individuals who did not experience falls. Lung disease was also observed more frequently in the group who experienced a fall (11.4%). In addition, the presence of chronic diseases was 58.9% in the group who experienced a fall, while this rate was 20% in the group who did not experience a fall (Table 1).

Table 1. Comparison of Sociodemographic and Clinical Characteristics According to Fall History

Characteristics	Total (n = 245)	Fall group (n = 70)	Non-fall group (n = 175)	Z/ χ^2	P
Age (years) M $\pm$ SD	-	73.11 $\pm$ 9.60	67.87 $\pm$ 5.32	4.31	0.001
BMI (kg/m²) M $\pm$ SD	-	27.88 $\pm$ 3.25	27.28 $\pm$ 3.23	1.31	0.19
Sex (n, %)				0.499	0.480
Male	131 (53.5%)	40 (57.1%)	91 (52.0%)		
Female	114 (46.5%)	30 (42.9%)	84 (48.0%)		
Medication Use (n, %)				23.331	0.001
Yes	133 (54.3%)	59 (84.3%)	74 (42.3%)		
No	112 (45.7%)	11 (15.7%)	101 (57.7%)		
Smoking (n, %)				0.916	0.338
Yes	63 (25.7%)	15 (21.4%)	48 (27.4%)		
No	182 (74.3%)	55 (78.6%)	127 (72.6%)		
Regular Exercise (n, %)				2.711	0.100
Yes	59 (24.1%)	12 (17.1%)	47 (26.9%)		
No	186 (75.9%)	58 (82.9%)	128 (73.1%)		
Fear of Falling (n, %)				30.442	0.001
Yes	132 (53.9%)	58 (82.9%)	74 (42.3%)		
No	113 (46.1%)	12 (17.1%)	101 (57.7%)		
Chronic Disease (n, %)				21.831	0.001
Yes	127 (51.8%)	56 (80.0%)	71 (40.6%)		
No	118 (48.2%)	14 (20.0%)	103 (58.9%)		
Type of Chronic Disease (n, %)				31.975	0.001
Hypertension	44 (18.0%)	17 (24.3%)	27 (15.4%)		
Diabetes	45 (18.4%)	19 (27.1%)	26 (14.9%)		
Heart Disease	24 (9.8%)	11 (15.7%)	13 (7.4%)		
Lung Disease	13 (5.3%)	8 (11.4%)	5 (2.9%)		
Parkinson	1 (0.4%)	0	1 (0.6%)		
Alzheimer Disease	1 (0.4%)	1 (1.4%)	0		
None	117 (47.8%)	14 (20.0%)	103 (58.9%)		

Categorical data are presented as number with percentage (n, %) and compared by chi-square test. Continuous data are presented as mean $\pm$ SD, Mann-Whitney U test. Abbreviations: BMI: body mass index, M $\pm$ SD: mean $\pm$ standard deviation. %: percentage, n: number of sample, χ^2 : chi-square test statics, Z: Mann-Whitney U test statics, $p < 0.05$.

The logistic regression model was found to be statistically significant ($\chi^2(54) = 171.260, p < .001$). This shows that the model predicts falls significantly. The explanatory level of the model was high and Nagelkerke $R^2 = .721$, which indicates that the model explained 72.1% of the variance in the fall phenomenon. The Hosmer-Lemeshow test result ($\chi^2(8) = 2.504, p = .962$) revealed that the model provided a good fit to the observed data. The overall accuracy of the model is 88.2%.

When the classification performance was evaluated, the sensitivity and specificity of

the model were found to be 77.1% and 92.6%, respectively. This shows that the model is quite successful in correctly predicting individuals who fall.

When the individual factors were analysed, medication use ($B = 2.901, p = .002, \text{Exp}(B) = .074$) significantly decreased the risk of falls, while decreased muscle strength ($B = 3.157, p = .024, \text{Exp}(B) = 23.505$) significantly increased the risk of falls. Other individual variables were not statistically significant ($p > .05$) (Table 2).

Table 2. Individual Factors and Their Association with Fall Risk

Variable	B (SE)	p	Exp(B)	95% CI [Lower– Upper]
Age	-0.027 ± 0.051	0.594	0.973	0.88 – 1.07
Medication Use	2.901 ± 0.947	0.002	0.074	0.09 – 0.35
Chronic Disease	1.155 ± 0.713	0.105	3.173	0.78 – 12.82
Fear of Falling	1.184 ± 0.817	0.147	3.266	0.65 – 16.18
Muscle Strength Decline (Disagree)	1.688 ± 2.685	0.530	5.409	1.51 – 6.46
Muscle Strength Decline (Agree)	2.839 ± 1.729	0.101	17.090	15.77 – 19.25
Muscle Strength Decline (Strongly agree)	3.157 ± 1.399	0.024	23.505	22.8 – 28.52

B = Beta Coefficient, Exp(B): Odds Ratio, SE: Standart Error, CI: Confidence Interval, $p < 0.05$.

In terms of environmental factors, the use of assistive devices (Levels 3 and 4) and environmental conditions (Levels 1-3)

significantly reduced the risk of falls ($p < .05$). Other environmental variables were not significant (Table 3).

Table 3. Environmental Factors and Their Association with Fall Risk

Variable	B (SE)	p	Exp(B)	95% CI [Lower - Upper]
Assistive Device Use (wheelchair)	24.304 ± 1016	0.998	0.00	0.000 – 0.068
Assistive Device Use (tripod)	20.495 ± 1796	0.999	0.00	0.000 – 0.279
Assistive Device Use (cane)	-4.936 ± 1.083	0.002	0.01	0.001 – 0.060
Assistive Device Use (glasses)	-4.956 ± 1.147	0.000	0.013	0.001 – 0.067
Environmental Conditions (Disagree)	-5.933 ± 2.376	0.038	0.014	0.000 – 0.279
Environmental Conditions (Agree)	-8.117 ± 3.429	0.033	0.002	0.000 – 0.247
Environmental Conditions (Strongly agree)	-7.005 ± 3.178	0.065	0.002	0.000 – 0.460
Ground Slope	1.719 ± 1.324	0.192	5.582	0.434 – 7.81
Rocky Surface	5.779 ± 2.970	0.052	32.43	29.58 – 38.91
Ambient Lighting	1.374 ± 0.834	0.104	3.950	0.77 – 20.12
Wet/Icy Surface	0.965 ± 1.240	0.435	2.625	0.233 – 2.95
Step Height	0.884 ± 0.924	0.339	2.421	0.399 – 4.691

B = Beta Coefficient, Exp(B): Odds Ratio, SE: Standart Error, CI: Confidence Interval, $p < 0.05$.

In terms of psychosocial and functional factors, difficulty in sitting/standing ($B = 3.545, p = .019, \text{Exp}(B) = 34.647$) significantly increased the risk of falls. Other

variables (education level, depression level, falling during cleaning, difficulty in dressing, washing, etc.) were not found to be statistically significant (Table 4).

Table 4. Psychosocial and Functional Factors and Their Association with Fall Risk

Variable	B (SE)	p	Exp(B)	95% CI [lower- Upper]
Education Level	-20.391 (2.54)	0.999	0.0	0.414-0.709
Depression level	0.194 (0.192)	0.312	1.214	0.834 -1.769
Falling During House Cleaning	-0.704 (0.725)	0.333	0.495	0.120 – 2.036
Daily Movement Activity	-0.463 (0.544)	0.395	0.629	0.216 – 1.834
Difficulty Using Stairs	0.402 (0.773)	0.602	1.495	0.334 – 6.690
Difficulty Sitting and Standing	3.545 (1.508)	0.019	34.647	32.14-.37.14
Dressing Function	-0.515 (1.066)	0.626	0.597	0.073 – 4.872
Difficulty with Bathing/Showering	-1.094 (0.872)	0.21	0.335	0.061 – 1.851

B = Beta Coefficient, Exp(B): Odds Ratio, SE: Standart Error, CI: Confidence Interval, $p < 0.05$.

DISCUSSION

In this study, logistic regression was employed to evaluate the extent to which individual, environmental, psychosocial, and functional factors predict fall risk among older adults. Functional disabilities such as decreased muscle strength and difficulty in sitting/standing stand out as important factors that increase the risk of falls. On the other hand, the use of basic assistive devices (cane, glasses), favorable environmental conditions and using medications decrease the risk of falls. The statistical significance, high explanatory power and classification success of the model support the reliability of the results. Conversely, Education Level, Falling During House Cleaning, Daily, Movement Activity, Difficulty Using Stairs, Dressing Function, Difficulty with Bathing/Showering, Ground Slope, Rocky Surface, Ambient Lighting, Wet/Icy Surface, Step Height, Age, Medication Use, Chronic Disease, Fear of Falling did not have a significant effect on the model.

Falls among older adults pose significant health, economic, and social challenges (25). They are the leading cause of injury in this population, (26) and a serious fall may result in loss of independence and diminished quality of life. Hip fractures, in particular, are among the most severe and life-altering outcomes of falls in the elderly (27).

We found that 70 of the elderly people who participated in our study, approximately 28.5% of all participants, had a history of falls before. In the prevalence study, which was conducted with data obtained from one hundred and four studies and studies

involving 36,740,590 participants and calculated the percentage of falls in the elderly, it was found that the rate of falls in the elderly was 26.5% (95% CI 23.4-29.8%), The highest rate of prevalence of falls in the older people was related to Oceania with 34.4% (95% CI 29.2-40%) and America with 27.9% (95% CI 22.4-34.2%) (27). The results of our study were in parallel with this important study. These results showed that the participants included in the study had similar fall rates to the elderly in the world.

In our study, the effects of personal factors such as age, gender, education, smoking, medication use, chronic disease, fear of falling and muscle strength decline on falls were analysed. In particular, muscle strength decline significantly increased the risk of falls, while medication use decreased the risk of falls. In a meta-analysis study, history of falls was associated with gait problems (OR = 2.1; 2.2), use of walking aids (OR = 2.2; 3.1), vertigo (OR = 1.8; 2.3), Parkinson's disease (OR = 2.7; 2.8) and use of antiepileptic drugs (OR = 1.9; 2.7). However, a fall risk was not calculated for important factors such as balance and muscle weakness due to the methodological diversity of the studies (28). In another meta-analysis of 22 studies, Older age, lower education level, polypharmacy, malnutrition, living alone, living in an urban area, smoking, and alcohol consumption increased the risk of falls in the aging population. Additionally, comorbidities such as cardiac disease, hypertension, diabetes, stroke, frailty, previous history of falls, depression, Parkinson's disease, and pain increased the

risk of falls and concluded that demographic characteristics, comorbidities, and lifestyle factors may increase the risk of falls (20). A meta-analysis found that four key risk factors—balance and mobility (RR: 1.33, 95% CI: 1.11–1.60), medication use (RR: 1.51, 95% CI: 1.07–2.11), psychological status (RR: 1.39, 95% CI: 1.08–1.79), and sensory-neuromuscular disorders (RR: 1.51, 95% CI: 1.29–1.78)—are indicators of frailty in older adults. Impairments in these areas are associated with a 33% to 51% increased risk of recurrent falls. Therefore, early identification and management of frailty markers should be a central strategy in fall prevention efforts (29). Although the studies in the literature have revealed different results about the personal factors affecting falls, loss of muscle strength stands out as a common risk factor in parallel with the results in our study. Contrary to the literature, we found that the use of medication decreased the risk of falls. We think that this may be due to the positive results of medication use on functional parameters and the fact that the majority of patients use medications such as hypertension and painkillers that may have minimal effect on falls. Furthermore, descriptive statistics such as age and gender did not show a significant difference between faller and non faller, therefore, these variables were not considered to have a meaningful effect on the risk of falling in this study. In conclusion, exercise approaches to minimise the decrease

function, and difficulty with bathing or showering were examined. Among these, difficulty sitting and standing emerged as a significant risk factor for falls. The literature also supports a range of fall-related risk factors, including depression, (33) fear of falling (34), limitations in activities of daily living, gait and balance impairments (35), vision and hearing problems, a history of previous falls (which increases the risk nearly threefold) (36), dizziness (37) and proprioceptive loss (38). Our findings highlight that difficulty in transitioning between sitting and standing—a task central to balance, mobility, and daily functioning—significantly elevates fall risk. This may be

in muscle strength and conscious use of medication before and during old age are important for the prevention of falls and fall-related comorbidities.

In our study, the effects of environmental factors such as assistive device use, environmental conditions, ground slope, rocky surface, ambient lighting, wet/icy surface, step height, which are likely to affect falls, on the risk of falls were examined and it was observed that regular environmental conditions and the use of simple assistive devices significantly reduce the risk of falls. When the literature is examined, uneven and slippery floors, loose carpets, thresholds, (17,19) wet floors such as toilets and bathrooms (30), insufficient and excessively bright lighting, stairs and inadequate support systems in bathroom toilets increase the risk of falls (17,19), and similar conditions in the outdoor environment have been shown to significantly increase the risk of falls (31,32, 17). As a result, it should be taken into consideration that various environmental factors, both inside and outside the home, may increase the risk of falls in the elderly and appropriate indoor and outdoor modifications should be developed.

In this study, psychological and functional factors such as education level, depression, falling during house cleaning, daily movement activity, difficulty using stairs, difficulty sitting and standing, dressing

attributed to the fact that the sit-to-stand movement relies on multiple integrated components, including postural control, musculoskeletal strength, sensorimotor coordination, and cognitive functioning. We believe that fall prevention strategies should include exercises that target functional tasks such as sitting and standing, as these could play a critical role in reducing fall risk. Future studies should investigate the effects of exercise programs incorporating sit-to-stand training on fall incidence and related outcomes to further clarify this relationship.

This is a rare study that analyses the risk of falls in the elderly so comprehensively, and we believe that it will make important

contributions to the literature in this respect. In preventing the risk of falls in the elderly, it is important to develop appropriate strategies by making multidimensional evaluations under the leadership of the biopsychosocial model.

Of course, although this study was meticulously planned and conducted, it brings some limitations as in every research. Consideration of these limitations will contribute to a more accurate and careful interpretation of the results obtained. In our

study, especially the effects of environmental and functional conditions on falls were interviewed with the elderly and their opinions about these situations were tried to be measured with the help of a questionnaire. In addition, this study was conducted only at Muş Alparslan University 60+ Refreshment University; this may affect the generalisability of the results. Moreover, This study was based on a cross-sectional methodology and self-report of the participants. We think that these conditions may negatively affect the results.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, our logistic regression model showed that a moderate to good discrimination between bio-psycho-social indicators and fall risk could be achieved. Decreased muscle strength, poor environmental conditions, difficulty in sitting and standing up significantly increase the risk of falls, while the use of medication and the simple assistive devices reduce the risk of falls.

There is a need for biopsychosocial studies that comprehensively examine the factors affecting the risk of falls in the elderly in a society that changes and transforms with technological gains.

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Author contributions

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