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RESEARCH ARTICLE

Prevalence and Determinants of Falls in Community-dwelling Older Adults in Türkiye: A Population-based Cross-sectional Study Conducted between 2014-2015

Nezahat Muge Catikkas[1,*], Tugba Obekli Erdogan[1], Jean Yves Reginster[2], Meryem Merve Oren[1], Caglar Ozer Aydin[1], Duygu Erbas Sacar[1], Serdar Ozkok[1], Cihan Kilic[1], Mehmet Akif Karan[1] and Gulistan Bahat[1]

[1]*Division of Geriatrics, Department of Internal Medicine, Istanbul Medical School, Istanbul University, Capa, 34093, Istanbul, Turkiye;* [2]*Department of Public Health, Epidemiology and Health Economics, Liège Medical School, University of Liège, Liège, Belgium*

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Abstract: ***Purpose*:** Falls are a common public health problem in older adults regarding increased morbidity, mortality, and healthcare costs. Determining the factors associated with falls is of utmost importance for detecting at risk people. We present here a field study conducted to examine the prevalence of falls and the associated factors among community-dwelling older adults.

***Methods*:** In this population-based cross-sectional study, we included adults aged > 60 years living in the Fatih District of the Istanbul Province between November 2014-May 2015, through a simple random sampling method. We noted age, sex, falls, fear of falling, number of diseases and medications, the presence of diabetes, hypertension, dyslipidemia, urinary and fecal incontinence, and chronic pain. Frailty was assessed with the FRAIL questionnaire. Functional capacity was evaluated by Katz's 6-item ADL and Lawton Brody's 8-item IADL scales. The European quality-5 dimension (EQ-5D) questionnaire was used for the quality of life assessment. The cognitive status screening was conducted with a Mini-cog test. Depressive mood was evaluated with the Geriatric Depression scale short form (GDS-SF). Malnutrition screening was conducted by the mini-nutritional assessment short form. Handgrip strength (HGS) was measured with a hand dynamometer. Body composition was assessed through a bioimpedance analysis. The 4-meter usual gait speed was recorded. The European Working Group on Sarcopenia in Older People2 (EWSGOP2) criteria was used for the sarcopenia definition. The Romberg and the postural instability tests were evaluated for balance and gait. Continuous variables were expressed as mean ± standard deviation or median and interquartile range for descriptive statistics, while categorical variables were expressed as the number and percentages. The differences between groups were determined through an independent sample t-test or Mann-Whitney U test when required, and Chi-square and Fisher's exact tests were applied for categorical variables. A multivariate logistic regression analysis was used to determine the independent factors associated with falls among the factors identified as significant in univariate analyses.

***Results*:** The prevalence of falls was 28.5% [mean age: 75.4 ± 7.3 (range: 61-101 years), 53.6% female], and a significant association was identified between falls and the number of diseases and medications, diabetes, chronic pain, frailty, ADL, IADL, and EQ-5D scores, dementia, GDS-SF score and level of ambulation in univariate analyses (p = 0.001, 0.030, 0.030, 0.010, 0.004, 0.040, 0.007, 0.003, 0.030 and 0.007, respectively). In the multivariate analysis, positive dementia (OR = 3.66, 95% CI = 1.40-9.53; p = 0.010) and frailty screenings (OR =1.47, 95% CI = 1.05-2.06; p = 0.020) were identified as associates of falls.

***Conclusion*:** Falls were independently associated with positive dementia and frailty screening. These results will help develop specific and tailored precautions for at-risk groups to prevent the negative outcomes of falls.

Keywords: Community, dementia, falls, frailty, older adults, population-based, prevalence.

*Address correspondence to this author at the Division of Geriatrics, Department of Internal Medicine, Istanbul Medical School, Istanbul University, Capa, 34093, Istanbul, Turkiye; Tel: +905367111248; E-mail: nz444mg@hotmail.com

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1. INTRODUCTION

Falls are defined as an accidental event that occurs involving a descent to the ground or other lower-level surface when balance and center of gravity are lost [1]. They are one of the most important geriatric syndromes, seen in 28%-35% of community-dwelling older adults. The prevalence rises to 50% in those aged > 85 and 60% for nursing home residents. In half of these cases, falls are recurring [2-4]. Falls are a common public health problem in older adults regarding increased morbidity, mortality, and healthcare costs [4]. Older people are prone to injury due to the presence of multiple comorbidities, aging-related physiological changes, and prolonged recovery periods, leading to greater functional decline. 5-10% of falls result in major injuries such as fractures or head trauma. Hip fractures in particular are a significant consequence of falls in older adults. Although the hip fracture rate associated with falls is only around 1%, almost 90% of hip fractures are caused by falls [5, 6]. Osteoporotic fragility fractures principally occur after a fall from standing height. In 2000, an estimated 8.9 million new osteoporotic fractures were sustained worldwide, including 1.6 million hip fractures, 1.7 million forearm fractures, and 1.4 million vertebral fractures. After the age of 60, the risk of such fractures rises to 90% [7]. In this context, the prevention of falls plays an important role in the prevention of osteoporotic fractures. In 20-40% of older adults who experience a fall, fear of falling (FOF) develops, in which debility, dependency, social isolation, depression, and the need for institutional care can occur [6]. Falls, as such, are a considerable problem with potentially devastating outcomes, decreased quality of life, and high care burden [8].

Around 21% of falls can be prevented through individual and environmental arrangements [9]. Therefore, determining the factors associated with falls is of utmost importance and can aid clinicians and caregivers in identifying older adults at high risk of falls so that specific and tailored precautions can be undertaken.

Female gender, advanced age (> 80 years old), medications, dementia, comorbidities, malnutrition, urinary incontinence, balance and gait disorders, fall-related self-efficacy, poor quality of life and reduced mobility are among the factors that have been shown to be associated with falls in literature [6, 10]. Studies differ significantly in terms of the types of risk factors assessed, the populations studied, and the outcomes defined. In a systematic review of 18 longitudinal cohort studies, age was reported to be an independent risk factor in only four of 11 studies considering age in a multivariate analysis [11]. The prevalence of falls varies depending on the living setting, between community-dwelling older adults, those under long-term care, and nursing home residents, and between older adults that apply or do not apply to healthcare centers. Studies reporting the prevalence and factors associated with falls have mostly focused on older adults who have presented to an outpatient clinic or hospital [4, 12], while the identification of falls in the community is commonly overlooked, as not all older adults seek care from geriatricians following falls due to the common misapprehension that falls are natural consequence of aging and are thus inevitable, or they do not have the opportunity to apply for healthcare visits. We present here a field study conducted to examine the prevalence of falls and the associated factors among community-dwelling older adults.

2. METHODS

The prevalence of falls in community-dwelling older adults has been reported in literature in the range of 28-35% [2-4], based on which a sample size of 194 was calculated for this population-based cross-sectional study, with a 10% precision, 80% power and 95% confidence level. Considering the potential for missing cases, the sample size was expanded by 5%, and it was thus aimed to reach 203 cases. The study was carried out in compliance with the principles of the Helsinki Declaration, approval for the study was obtained from the Istanbul University Faculty of Medicine Clinical Research Ethics Committee (Number: 1213 and file number: 2014/1199) and all participants gave their signed consent for inclusion in the study before the interviews. The study was also conducted in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [13].

2.1. Study Design and Population

Older adults aged 61-101 living in the community in the Fatih district of Istanbul province between November 2014 and May 2015 were included in the study. Information on the residents of the Fatih neighborhood who were aged 60 and over was obtained from the Turkish Statistical Institute (TSI). Older adults were enumerated based on the information received from TSI, and they were determined by simple random sampling method according to the number of samples. Considering reasons such as not being found or refusing to participate in the study, a substitute was determined for each participant. After older adults in the specified neighborhood were selected using a simple random sampling approach, they were visited in their homes consecutively and invited to participate in the study. The interviewers for the study were selected from among medical faculty students who had been educated by health professionals qualified in such assessments at the outset of the study. The enumerators were educated before the study and the standards for the study were explained. Thus, it was aimed to provide standardization. However, no statistical analysis was made for inter-rater reliability of enumerators. The sample numbers were shared among the interviewers, and if the randomized individuals could not be found or declined to participate in the study, they were replaced in the designated sample by others to preserve the sample size. Included in the study were adults aged 60 and over who gave their consent for participation in the study, while those who had implants or edema/major fluid-electrolyte disorders, those who were illiterate or had cognitive impairment, and those without anyone to accompany them were excluded.

2.2. Comprehensive Geriatric Assessment

Age, sex, falls, fear of falling, number of diseases and medications, the presence of diabetes, hypertension, dyslipidemia, urinary and fecal incontinence, and chronic pain were evaluated.

We asked the participants and/or their relatives whether they had fallen and/or had a fear of falling (FOF) within the last year with the basic question: "Have you experienced any falls and/or fear of falling in the past year?" The presence of such conditions as diabetes, hypertension, dyslipidemia, and urinary and fecal incontinence was inquired through multiple-choice questions, and the number of medications used regularly and the number of diseases were recorded. For the assessment of chronic pain, we asked the respondents whether they had experienced pain for more than six months and, in the presence of pain, we asked them to score their pain level on a scale of 0-10 using the Visual Analog Scale (VAS) (0: least severe pain, 10: most severe pain in their life) [14] which has been validated for use in Türkiye as well [15].

Frailty was assessed with the FRAIL questionnaire, which evaluates five components of frailty: *i.e.,* fatigue, resistance, ambulation, illnesses, and weight loss. The questionnaire scores frailty in the range of zero (best health status) to five (worst health status), with patients scoring 3-5 being classified as frail, 1-2 as prefrail, and zero as robust [16]. It has been validated for use in Türkiye [17].

Functional capacity was assessed using Katz's 6-item ADL scale and Lawton Brody's 8-item IADL scale, which have been also validated for use in Türkiye with a modified scoring approach that provided greater detail [18-22]. The participant scored 1 point for all activities specified in the questionnaire that they were unable to do, 2 points for those they could do with help, and 3 points for those that they could do without help. For the present study, a score of 6 points on the ADL scale indicated dependent, 7-12 points semi-dependent, and 13-18 points independent, while 8 points on the IADL scale indicated dependent, 9-16 points semi-dependent, and 17-24 points independent [22].

We used the first part of the European quality-5 dimension (EQ-5D) questionnaire for the descriptive assessment of quality of life (QoL), in which a 3-point Likert scale is applied to five items: mobility, self-care, usual activities, pain, and anxiety/depression [23]. It has been also validated for use in Türkiye [24].

The cognitive status screening was conducted with a Mini-cog test [25], which has been validated for use in Türkiye [26]. It involved a memory task in which the respondent is asked to recall three words, and a clock-drawing test. The participant was considered to have no cognitive impairment if they remembered all three words and scored 4/5 points in the clock-drawing test [27], which has been validated for use in Türkiye [28]. If the participant remembered 1-2 words and drew the clock incorrectly, or could not remember any words, we considered it a positive dementia screening test.

Depressive mood was evaluated based on the results of the application of the Geriatric Depression scale short form (GDS-SF), which consisted of 15 questions [29] and has been validated for use in Türkiye [30]. According to the GDS-SF, 0-4 points was considered normal, 5-8 points as mild depression, 9-11 points as moderate depression, and 12-15 points as severe depression.

Malnutrition screening was conducted using the mini-nutritional assessment short form (MNA-SF) test [31], validated for use in Türkiye [32], and in which scores of 0-7 points indicated malnutrition, 8-11 points malnutrition risk, and >11 points normal nutritional status.

2.3. Measurements

The height of the respondents was measured using a regular standard stadiometer, and body mass index (BMI) was calculated as weight (kg) divided by height^2 (m^2).

Handgrip strength (HGS) was measured with a Jamar hydraulic hand dynamometer, while for the measurement of muscle strength, the participant was asked to squeeze the hand dynamometer as hard as possible for 2-3 seconds while sitting in a standard chair with a back, with the arm adjacent to the body and elbow in 90° flexion, and with the forearm and wrist in the neutral position. We took three measurements from both hands and recorded the highest measurement value [33]. We used the cut-off values previously reported in the EWSGOP2 for HGS, being 27 kg and 16 kg for males and females, respectively [34].

Body composition was assessed through a bioimpedance analysis (BIA) (Tanita BC532). Tanita BC-532 BIA was a device operating from leg to leg, with a single frequency of 50 hertz and a current of 200 microamps. The device measures the amount of fat and water in the body as a percentage, muscle and bone in kg, and the basal metabolic rate in kilocalories. BIA has been reported to be a reliable technique for the assessment of body composition (*i.e.*, fat-free mass and fat) [35]. We adopted the EWGSOP2 criteria for the definition of sarcopenia. According to EWSGOP2, sarcopenia can be divided into three categories of probable sarcopenia (low muscle strength), confirmed sarcopenia (low muscle strength and low muscle quantity or quality) and severe sarcopenia (low muscle strength and low muscle quantity or quality, and low physical performance) [34]. We used the documented low muscle mass thresholds defined as the total skeletal muscle mass lower than two standard deviations of young Turkish reference groups (9.2 kg/m^2 and 7.4 kg/m^2 in males and females, respectively) in line with the recommendation of the EWGSOP2 authors [36, 37].

For the 4-meter usual gait speed (UGS) test, we asked the respondent to walk at his/her natural walking speed along the 4-meter marked track and recorded the walking time, and used a cut-off of >0.8 m/s [32]. For participants who could walk only with assistance or who could not walk at all, ambulation classifications were made as 1) unable to walk, 2) able to walk with assistance, 3) able to walk without assistance [38].

We evaluated balance and gait using the Romberg test and the Postural Instability test. For the Romberg test, we asked the participants to stand for 10 seconds with their eyes closed, legs together, and arms next to the body, adjacent to the trunk. Romberg was counted as (+) in the event of an oscillation or balance disorder in the body [38]. For the Postural Instability test, we told the participant that we would stand behind him/her and pull back on his/her shoulders and asked them to maintain their balance. The participants whose

balance was upset were classified as being positive for Postural Instability [39].

2.4. Statistical Analysis

We applied a Kolmogorov Smirnov analysis to determine the compatibility of continuous data with a normal distribution. Continuous variables were expressed as mean ± standard deviation or median and interquartile range for descriptive statistics, while categorical variables were expressed as the number of subjects and percentages. The differences between groups were determined through an independent sample t-test or Mann-Whitney U test when required, and Chi-square and Fisher's exact tests were applied for 2 X 2 contingency tables appropriate for categorical variables. A multivariate logistic regression analysis incorporating the Enter method was used to determine the independent factors associated with falls among the factors identified as significant in univariate analyses. Before making a regression analysis, multicollinearity was checked among the parameters selected for the model, with associations expressed as odds ratio (OR) and at a 95% confidence interval (CI). The fitness of the model was evaluated using a Hosmer-Lemeshow goodness-fit test. *P*-values were based on two-sided tests and were considered statistically significant at $p < 0.05$. IBM SPSS Statistics (Version 20.0. Armonk, NY: IBM Corp.) was used for the analysis of the data.

3. RESULTS

The study population was 203 cases with a mean age of 75.4 ± 7.3 (range: 61-101 years), of which 109 (53.6%) were female. The prevalence of falls was 28.5% in all cases (male: 41.4%, female: 58.6%, $p = 0.370$), while the prevalence of FOF was 32.5%.

The univariate analyses revealed a significant association between falls and the number of diseases, the number of medications, the FRAIL score, ADL score, IADL score, EQ-5D score, and GDS-SF score ($p = 0.001$, 0.030, 0.001, 0.040, 0.007, 0.003 and 0.030, respectively). Significant differences were found for the presence of diabetes mellitus (41.4% *vs.* 26.2%), chronic pain (59.6% *vs.* 41%), frailty (39.7% *vs.* 22.1%), positive dementia screening (29.3% *vs.* 10.3%) and level of ambulation (32.8% *vs.* 14.5%) ($p = 0.030$, 0.010, 0.004, 0.001 and 0.007, respectively) among the fallers and non-fallers (Table **1**).

Table 1. Demographic and clinical characteristics of older adults with and without falls (n = 203).

-	Older Adults with Falls [n: 58]	Older Adults without Falls [n: 145]	*p*
Age (years)	75.4±7.3	75±7.0	0.980
Sex (female/male)	34 (58.6%) / 24 (41.4%)	75 (51.7%) / 70 (48.3%)	0.370
Fear of falling	24 (41.4%)	42 (29%)	0.080
Number of diseases†	**4 (2-5)**	**3 (2-4)**	**0.001***
Diabetes mellitus	**24 (41.4%)**	**38 (26.2%)**	**0.030***
Hypertension	44 (75.9%)	100 (69%)	0.320
Dyslipidemia	8 (13.8%)	14 (9.7%)	0.390
Urinary incontinence	23 (40.4%)	49 (33.8%)	0.380
Fecal incontinence	2 (3.5%)	4 (2.8%)	0.670
Number of medications†	**4 (2-7)**	**3 (2-5)**	**0.030***
Chronic pain	**34 (59.6%)**	**59 (41%)**	**0.010***
VAS score†	6 (4-8)	5 (5-8)	0.910
Pre-frailty or frailty	**23 (39.7%)**	**32 (22.1%)**	**0.004***
FRAIL score†	**2 (1-3)**	**1 (0-2)**	**0.001***
ADL† score	**18 (16-18)**	**18 (18-18)**	**0.040***
IADL† score	**23 (16-24)**	**24 (22-24)**	**0.007***
EQ-5D score	**8 (6.5-9.5)**	**6 (5-9)**	**0.003***
Dementia	**17 (29.3%)**	**15 (10.3%)**	**0.001***
Depression	11 (19.3%)	17 (12%)	0.170
GDS-SF score	**4 (1-7)**	**2 (1-5)**	**0.030***

(Table 1) Contd...

Malnutrition or malnutrition risk	11 (10-13)	12 (11-14)	0.053
BMI (kg/m^2)[‡]	29.7±5.8	29.2±6.3	0.600
Handgrip strength (kg)[†]	22 (19-30)	24 (20-34)	0.090
Prevalence of probable sarcopenia (n=199)	17 (29.3%)	31 (22.0%)	0.272
SMMI (SMM/height^2)[‡]	10.2±1.3	10.2±1.7	0.920
Low SMMI (SMM/height^2) (n=183)	3 (5.7%)	15 (11.5%)	0.226
Prevalence of confirmed sarcopenia (n=183)	1 (1.9%)	4 (3.1%)	1.000
UGS (m/s)[‡]	1±0.3	1±0.3	0.890
Low UGS (m/s) (n=163)	10 (24.4%)	31 (25.4%)	0.896
Prevalence of severe sarcopenia (n=160)	0	2 (1.7%)	1.000
Ambulation			
Immobile	**0**	**3 (2.1%)**	**0.007***
Walk with help	**19 (32.8%)**	**21 (14.5%)**	
Walk without help	**39 (67.2%)**	**121 (83.4%)**	
Romberg test	11 (19.6%)	19 (13.8%)	0.300
Postural instability	14 (25%)	24 (17.3%)	0.210

Note: ADL: Activities of daily living, BMI: Body mass index, EQ-5D: European quality-5 dimension, GDS-SF: Geriatric depression scale-short form, IADL: Instrumental activities of daily living, MNA-SF: Mini nutritional assessment-short form, SMM: Skeletal muscle mass, SMMI: Skeletal muscle mass index, UGS: Usual gait speed, VAS: Visual analog scale ‡: Mean ± standard deviation. †: Median (interquartile range). *$p < 0.05$. Frailty was evaluated using the FRAIL scale [16]. Functional capacity was assessed using Katz's ADL and Lawton Brody's IADL scales [18-22]. EQ-5D was used for the quality of life measurement [23]. Dementia was screened using the Mini-cog test [25]. GDS-SF was used for depression screening [29]. Malnutrition was screened using the MNA-SF [31]. Sarcopenia was defined according to EWSGOP2, which defines sarcopenia in three categories: probable sarcopenia (low muscle strength), confirmed sarcopenia (low muscle strength and low muscle quantity or quality), and severe sarcopenia (low muscle strength and low muscle quantity or quality and low physical performance) [34].

In the multivariate logistic regression analysis, the dependent variable was the presence of falls; the independent variables were the number of diseases and medications, the presence of diabetes mellitus, chronic pain, frailty and positive dementia screening, and the IADL, EQ-5D and GDS-SF scores. In this analysis, the presence of positive dementia screening (OR = 3.66, 95% CI = 1.40-9.53; $p = 0.010$) and frailty screening (OR = 1.47, 95% CI = 1.05-2.06; $p = 0.020$) were independently associated with falls within the last year (Table **2**).

4. DISCUSSION

The present study investigates the prevalence of falls and their associated factors with a field study of community-dwelling older adults in Türkiye. The prevalence of falls was 28.5% and there was a significant association between falls and the number of diseases and medications, FRAIL score, ADL score, IADL score, EQ-5D score, GDS-SF score, diabetes mellitus, chronic pain, frailty, positive dementia screening and ambulation. In a multivariate logistic regression analysis, positive dementia and frailty screening were identified as independent factors associated with falls.

There have been few population-based studies to date reporting the prevalence of falls in literature. In a population-based, cross-sectional study conducted in Çanakkale, Türkiye, involving 1,001 older adults, the prevalence of falls over the preceding six months was reported to be 32.1% [40]. This study, however, was conducted in a province (Çanakkale) in which the Mediterranean diet is prevalent and included different environmental factors, whereas our study was carried out in a metropolitan city (Istanbul). On the other hand, while the study mostly evaluated such parameters as the social networks of the older population and their quality of life, the present study investigated the relationship between falls and other geriatric syndromes, such as sarcopenia, malnutrition, frailty and cognitive impairment. Furthermore, the present study population was approximately 15 million people, while the Mediterranean study had a population of approximately 143,000. Lastly, in the present study we visited the homes of potential participants consecutively and invited older adults to participate in the study, while in the Mediterranean study, older adults from different neighborhoods and those attending social venues that are popular among older adults were included. In a field study involving 599 people aged 50 and over in Ethiopia, the prevalence of falls was reported to be 28.4% [41]. Bekibele and Gureje reported that 23% of community-dwelling older adults aged 65 years and older, with a mean age of 75.2 years, had suffered a fall within the previous 12 months [42]. In a cross-sectional, population-based study conducted in a municipality in the extreme south of Brazil, a prevalence of falls of 28.9% was recorded [43]. The prevalence of falls in the present study was similar to these studies in literature. In a cross-sectional study in the province of Sinop, which has the highest older population in Türkiye, Telatar reported a fall prevalence of 36.4% [44]. In another cross-sectional study involving patients admitted to outpatient clinics in our country, the prevalence of falls within the preceding year was

Table 2. Results of multivariate logistic regression analysis of fall-related factors.

Odds Ratio	95% Confidence Interval		*p*
Number of diseases	1.05	0.80-1.39	0.710
Diabetes mellitus	1.61	0.72-3.62	0.250
Number of medications	1.01	0.88-1.16	0.860
Chronic pain	1.46	0.64-3.33	0.360
Frailty	1.47	1.05-2.06	0.020*
IADL	1.03	0.92-1.16	0.590
EQ-5D	0.93	0.70-1.23	0.610
Dementia	3.66	1.40-9.53	0.010*
GDS-SF	1.01	0.88-1.16	0.850

Note: EQ-5D: European quality-5 dimension, GDS-SF: Geriatric depression scale- short form, IADL: Instrumental activities of daily living. Hosmer & Lemeshow Model $\chi 2$ (8)=5.97; $p = 0.651$. (dependent variable: falls; independent variables: number of diseases, number of medications, diabetes mellitus, chronic pain, frailty, IADL, dementia, EQ-5D, and GDS-SF). *: significant predictors of falls Frailty was evaluated using the FRAIL scale [16]. Functional capacity was assessed using Katz's ADL and Lawton Brody's IADL scales [18-22]. EQ-5D was used for the quality of life measurement [23]. Dementia was screened using the Mini-cog test [25]. GDS-SF was used for depression screening [29].

28.5% [45]. Our study is the first field study to evaluate the prevalence of falls and associated factors in community-dwelling older adults in Türkiye, and can be considered necessary, as older adults often consider falls to be a normal result of aging and are unaware of risk factors, and do not apply to physicians after suffering a fall. Such a field study allows the screening and identification of older adults in this group and can contribute to the prevention of future falls and the associated negative consequences.

The present study revealed positive dementia screening to be independently associated with falls, concurring with the findings of previous studies. In a study by Allan *et al.*, the study participants with dementia experienced approximately eight times more falls than those without [46]. Furthermore, recent evidence suggests that cognitive impairment and falls are related; and that gait disturbances and falls are more common among those with dementia [47]. Accordingly, both pharmacological and non-pharmacological cognitive interventions should be applied to reduce falls in older adults with cognitive impairment.

Another significant finding of the present study is that falls are independently associated with frailty screening. Although using different frailty indicators to predict fall incidence has been shown to yield insignificantly different results, the findings of a meta-analysis by Cheng *et al.* revealed that frail older adults are at the highest risk of falls [48]. In a cross-sectional, population-based study from Kayseri, Türkiye, the prevalence of frailty based on the FRAIL scale was found to be independently associated with falls [49]. On the other hand, in a study by Brutto *et al.* it was observed that frailty, when assessed based on the Edmonton Frailty Scale (EFS) and Downton Fall Risk Index (DFRI), was not independently associated with falls in older adults living in rural environments [50]. In the literature, however, frailty has been shown to be significantly related to such adverse outcomes as low physical performance and impaired ADL scores, and so has been accepted as a predisability syndrome associated with a higher risk of hospitalization or disability [51]. Frailty should thus be considered as an integral part of fall risk assessments aimed at identifying those at risk of falls.

In the present study, a statistically significant relationship was noted between falls and the number of diseases. A previous study reported a link between previous diseases and the occurrence of falls [52]. In a 2021 meta-analysis, a significant relationship was found between the presence of chronic diseases and falls [53], and so our finding is in accordance with literature.

The relationship between falls and diabetes identified in the present study is consistent with literature. In a study by Vinik *et al.*, older adults with type 2 diabetes mellitus were at higher risk of falls than healthy people of a similar age, related to the loss of strength secondary to diabetes, sensory perception, and loss of balance, secondary to peripheral neuropathy and decreased cognitive function [54].

The number of medications was significantly associated with falls in the present study, and previous studies of older adults have reported similar results. In a systematic review by Fried *et al.*, an association between polypharmacy and falls among community-dwelling older adults was reported [55]. The Longitudinal Aging Study Amsterdam reported the use of ≥ 4 medications to be associated with an increased risk of falls and recurrent falls [56], leading us to suggest that the appropriateness of prescriptions should be constantly reassessed, for which STOPPFall (Screening Tool of Older Persons Prescriptions in older adults with high fall risk) - a deprescribing tool providing a complete and uniform list of drugs to avoid in older adults who are at risk of falls - may be used [57].

In the present study, while there was a statistically significant negative correlation between ADL and IADL scores and falls, there was a positive correlation between EQ-5D and GDS-SF scores and falls. In a study by Britton *et al.*, IADL limitations and depressive symptoms were associated with an increased likelihood of recurrent falls [58]. In a pre- and post-intervention study by Blain *et al.*, a multifactorial

fall prevention program was said to help maintain mobility and improve functional status [59]. While data on the impact of falls on EQ-5D-rated quality of life has to date been insufficient, the study conducted by Pérez-Ros *et al.* reveals the number of previous falls to have a negative effect on EQ-5D scores [60]. A bidirectional relationship exists between falls and depression, dependency, and decreased quality of life, as while falls can increase depression, dependence and lead to a decrease in quality of life through social isolation; depressive mood, dependency and poor quality of life can also cause falls. As such, the development and implementation of intervention strategies focused on fall prevention may reduce falls and increase social participation.

In a longitudinal population-based study of the factors increasing the risk of falls in community-dwelling people (MOBILIZE study), chronic musculoskeletal pain was reported to be associated with falls [61]. In the present study, a significant relationship was noted between chronic pain and falls, and so effective treatment options for both the peripheral and central components of chronic pain and comorbid conditions can play an important role in the prevention and relief of chronic pain and falls.

A significant relationship between ambulation status and falls was identified in the present study. In a study by Pirrie *et al.*, older adults with mobility problems were significantly more likely to suffer falls [62]. Furthermore, in the WHO global report on the prevention of falls in those of older age, it was reported that the rehabilitation of mobility problems in older adults living in the community contributed to a reduction in falls [63].

Although the components of the recent sarcopenia criteria stated in EWSGOP2 (low handgrip strength, low muscle mass, and low usual gait speed) are major determinants of falls in older adults [64], in our study, no association was identified between falls and sarcopenia. This may be attributed to the different criteria and assessment tools applied for sarcopenia and sex-related differences.

In the present study, no relationship was identified between MNA-SF score and falls, which is incompatible with the literature. In previous studies, the number of falls increased significantly in malnourished patients [65, 66]. This may be because we used only the MNA-SF method to evaluate malnutrition and/or malnutrition risk. Moreover, patients with cognitive impairment and no accompanying people were excluded from our study, but this group was at a particularly high risk of falls or malnutrition. Therefore, our results may have been affected and may cause underestimation. Nevertheless, assessments of malnutrition should be included in any fall risk assessment to highlight patients who are at higher risk.

The prevention of fractures has become an international public health priority with the global increase in the ageing population. Fracture liaison services (FLSs) have been established to address the secondary fracture prevention treatment gap after a fragility fracture [67], although the impact of fall prevention interventions on reducing fractures is as yet unclear due to the lack of randomized control trials. That said, a multifactorial fall risk assessment and interdisciplinary approach determined based on a personalized evaluation of functional, medical, and social problems is considered the most beneficial and cost-effective strategy for the prevention of falls in at-risk older adults [68, 69]. In this regard, we believe our study can not only contribute to the development of fracture prevention strategies, but also guide clinicians in enhancing the management of osteoporosis.

There are several limitations to our study. The sample size was not as large as other population-based studies [40, 41]. Regarding the study's cross-sectional nature, we were unable to establish causality by design, but only describe relationships. Furthermore, we used retrospective records of falls, which are not considered the best sources of data for the assessment of falls. Our results may also have the potential to be biased since some data were based on personal statements. Besides, recall bias could affect reporting as the fall rate was much higher in the participants with dementia, and the types and stages of dementia, depression, and frailty were not investigated. Another limitation is the inability of the results to be generalized to all older adults in the country, given the differences between regions and urban/rural characteristics. On the other hand, the comprehensive geriatric assessment performed in the present study is worthy of note. It was the first field study in the country evaluating the prevalence of falls and their associated factors in community-dwelling older adults. The study was performed in a large district of the largest metropolis in the country, and so we believe our study contributes to the elucidation of the risk factors of falls in older adults in the country, as an example of a developing country in Eastern Europe.

In conclusion, the prevalence of falls in the study of 28.5% was similar to that reported in the literature in community-dwelling older adults. Our study found falls to be independently associated with positive dementia and frailty screenings among community-dwelling older adults, and patients with multiple medication use and chronic diseases, diabetes mellitus, chronic pain, frailty, functional dependence, low quality of life, dementia and depression were found to be at greater risk of falls. As the detection of falls or the risk of falling is of utmost importance, these results may help in the provision of specific and tailored precautions in this high-risk group aimed at the prevention of negative fall-related outcomes.

5. PRACTICAL AND THEORETICAL IMPLICATIONS OF THE STUDY

Falls in advanced age is still a major challenge worldwide. Although there are studies on the older population, there is still a gap in the literature regarding falls and related factors in population-based studies in developing countries. In this context, we believe that our study will contribute to the enrichment of the literature.

CONCLUSION

Falls have the potential to cause many harmful consequences, including death. In addition, falls are associated with a sense of fear that can hinder functional independence and quality of life. Positive dementia and frailty screenings were among the factors associated with falls in our study. Identifying these risk factors could be a promising first step in

developing preventive strategies targeting older adults' falls. Thus, these preventive strategies can help avoid serious injuries, prolonged hospital stays, and increased costs due to falls. Our results can help to understand fall-related risk factors and implement fall prevention strategies in a daily routine. As a result, screening for dementia and frailty should be a part of comprehensive fall risk assessment in all older adults.

LIST OF ABBREVIATIONS

ADL	=	Activities of Daily Living
BIA	=	Bioimpedance Analysis
CI	=	Confidence Interval
EQ-5D	=	European quality-5 dimension
EWGSOP	=	European Working Group on Sarcopenia in Older People
FFM	=	Fat-free Mass
FLSs	=	Fracture Liaison Services
GDS-SF	=	Geriatric Depression Scale Short Form
HGS	=	Handgrip Strength
IADL	=	Instrumental Activities of Daily Living
MNA-SF	=	Mini Nutritional Assessment Short-Form
OR	=	Odds Ratio
SPSS	=	Statistical Package for Social Sciences
UGS	=	Usual Gait Speed
VAS	=	Visual Analog Scale

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The approval for the study was obtained from the Istanbul University Faculty of Medicine Clinical Research Ethics Committee (Number: 1213 and file number: 2014/1199).

HUMAN AND ANIMAL RIGHTS

No animals were used for studies that are the basis of this research. All the humans were used in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2013 (http://ethics.iit.edu/ecodes/node/3931).

CONSENT FOR PUBLICATION

The informed consent of all participants was obtained.

STANDARDS OF REPORTING

STROBE guidelines were followed.

AVAILABILITY OF DATA AND MATERIAL

The data of current study are available from author, [NMC], on a reasonable request.

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CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

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