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ORIGINAL RESEARCH

Prevalence, Complications, and Risk Factors of Falls and Fear of Falling Among Older Adults; Based on Ardakan Cohort Study on Aging (ACSA)

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Abstract: **Introduction:** The objective of this study was to assess the prevalence of falls, fear of falling (FOF), complications arising from falls, and identify possible sociodemographic and health-related factors associated with these outcomes among older adults. **Methods:** This cross-sectional study was based on the first wave of the Ardakan Cohort Study on Aging (ACSA), which includes participants over 50 years of age residing in Ardakan, Iran. Fall history, number of fall events, FOF, hospitalizations, and fractures in the past 12 months were assessed through a face-to-face interview. Health-related factors were recorded on a self-expressed basis. Associations were assessed using multiple logistic regression. **Results:** Among the 4,990 participants, fall history in the past 12 months was prevalent in 19.9%, with 10.1% reporting more than two fall events. Women ($p < 0.001$) and older participants ($p< 0.001$) had a higher prevalence. In females, 28.8% reported moderate to severe FOF, while 21% experienced disruptions in their daily activities as a result of this fear. The prevalence of fractures following falls was 5.1% in males and 8.6% in females. After adjusting for confounding factors, FOF (OR: 1.59, 95% CI: 1.33-1.91, p<0.001), imbalance (OR: 2.45, 95% CI: 1.68-3.58, p<0.001), urinary incontinence (OR: 1.44, 95% CI: 1.04-1.9, p=0.025), cognitive impairment (OR: 1.21, 95% CI: 1.01-1.46, p=0.049), vertigo or dizziness (OR: 1.39, 95% CI: 1.15-1.68, p<0.001), osteoporosis (OR: 1.24, 95% CI: 1.03-1.50, p=0.023), osteoarthritis (OR: 1.33, 95% CI: 1.13-1.56, p=0.001), depression (OR: 1.30, 95% CI: 1.06-1.60, p=0.010), and Central Nervous System (CNS)-affecting diseases (OR: 1.99, 95% CI: 1.33-2.97, p=0.001) were found to have positive associations with falls. **Conclusion:** This study showed that about one-fifth of those over 50 in Iran have experienced at least one fall within a year. Self-expressed imbalance, FOF, and urinary incontinence were the most prominent risk factors. Due to resulting in hospitalization and fractures, falls also lead to fear of falling and the associated limitation of activities.

Keywords: Accidental falls; Geriatrics; Aged; Osteoporotic fractures

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1. Introduction

The phenomenon of aging is becoming increasingly prevalent worldwide due to advancements in technology, healthcare, and the science of preventive diseases (1). This demographic change can result in falls having a more remarkable share of the burden of morbidity and mortality in every country (2). Falls are considered one of the leading causes of accidental deaths and nonfatal accidental injuries in individuals over 65 years old (3). According to a meta-analysis study, the average prevalence of falls among the elderly worldwide has been estimated to be 26.5% in 2020 (4).

In 2005, 1.8 million people aged 65 and over were treated in emergency departments for non-fatal fall injuries; of whom, 433,000 were hospitalized (5). According to Centers for Disease Control and Prevention (CDC), in 2020, emergency departments documented three million visits related to falls among older adults. Furthermore, falls resulted in more than 36,000 deaths, establishing it as the primary cause of injury-

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related deaths within this age group (3). Pelvic and thigh fractures are some examples of the complications resulting from falls and most injuries are seen in limbs, the torso, and the head. The majority of these injuries include fractures, dislocations, and more superficial traumas like laceration, and ecchymosis (6, 7).

Even when falls do not result in physical damage, they may still cause psychological discomfort for individuals. A fear of falling (FOF) is described as a sense of anxiety regarding a falling incident, with a reported prevalence rate varying from 21% to 85% (8). It hinders individuals from performing their activities of daily living (ADL), resulting in a disrupted life. This feeling was primarily described as an outcome of falls and marked as the central element of the post-fall syndrome. However, individuals with no previous falling episodes can also experience this sensation (9, 10).

Despite the extensive research conducted on the matters of falling and its complications, there needs to be ongoing research due to aging populations. The prevalence of falls and their consequent events varies among countries and communities. Also, it is difficult to universalize such issues across various populations due to differences in methodology and sampling techniques. This cross-sectional study aimed to address the ambiguities regarding the prevalence of falls, FOF, and complications resulting from these in a specific portion of Iran at the present time, in order to aid professionals in reducing and preventing them.

2. Methods

2.1. Study design and setting

This population-based cross-sectional study was based on the first wave of the Ardakan cohort study on aging (ACSA). Fall history, number of fall events, FOF, hospitalizations, and fractures in the past 12 months were assessed through a face-to-face interview.

Health-related factors, were recorded on a self-expressed basis. Associations were assessed using multiple logistic regression.

The research investigation adhered to the strengthening the reporting of observational studies in epidemiology (STROBE) guidelines.

Corresponding to the Declaration of Helsinki guidelines, this study was conducted and approved by the Research Ethics Committee of the University of Social Welfare and Rehabilitation Sciences (code: IR.USWR.REC.1394.490). Informed consent was obtained from all subjects involved.

2.2. Participants

The participants in the ACSA comprised men and women over 50 years of age who were residents of Ardakan city for more than 12 months. Participants were required to take part in interviews where they were asked about their health and wellness situation.

Therefore, they needed to be able to cooperate with the questioners and be capable of adequately answering the questions. Hence, our exclusion criteria were: a drastic physical impairment inhibiting the person from moving independently, severe cognitive impairment or dementia, any untreated mental illnesses hindering the patient from collaborating with others, and extreme visual disability. Several health centers were censused to determine the sample population; based on the age spectrum of each center, with a random cluster method, people over 50 years were selected to form the final sample.

Afterward, all of ASCA's participants were included in the current study without any additional exclusion criteria due to the population-based objectives of the study.

2.3. Data collection and measurements

During the participants' visits to the ACSA center, baseline characteristics of participants, including age, sex, body mass index (BMI), balance, vertigo, and any underlying diseases, in addition to primary outcomes, were obtained via a face-to-face interview.

The primary outcome of this study was the history of falls and related complications. According to the world health organization, fall was defined as an incident causing an individual to rest on the floor unwittingly or at a lower level (11). Participants were asked whether they had an incident of fall during the past 12 months. Moreover, cases with a fall history were asked about their episodes and related complications. Secondary outcomes included the number of incidents, whether or not they had led to fractures, if they had received any medical care and or were hospitalized (hospitalization was defined as being admitted for any amount of time due to their falling episode), and if their FOF had caused any disturbance in their daily activities.

Questions about the individual's balance were designed to be answered in three areas: walking, standing up, and in a standing position, with three possible answers: totally balanced, semi-balanced, and imbalanced. We considered the worst-case scenario as their final answer, meaning if they reported an imbalance even in only one of the three positions mentioned above, we placed them in the "imbalanced" category.

Obesity was assessed based on each individual's BMI, calculated by a trained questioner, and categorized into Obese (BMI over 30) and Non-Obese (BMI under 30).

Urinary incontinence was rated based on the Revised Urinary Incontinence Scale (RUIS), with scores of equal to or less than three, four to eight, nine to 12, and 13 and higher, meaning no incontinency, mild incontinency, moderate incontinency, and severe incontinency, respectively.

Minimal Cognitive Impairment was evaluated based on two questionnaires: Abbreviated Mental Test Score (AMTS) for the illiterates and Mini-mental state examination (MMSE) for the literates; we then combined their answers and categorized them into two main groups, those who had an impairment and those who did not.

Regarding MMSE, higher scores indicate better cognitive function. Three levels of cognition status were described in our study; normal (25 to 30), mild cognitive impairment (20 to 24), and moderate cognitive impairment (10 to 19) (12). As for AMTS scoring, just as established about MMSE, a lower score is indicative of a more severe cognitive impairment, and in this study, we classified individuals into two categories; severe to moderate impairment (0-6), and normal function (≥7).

Regarding orthostatic hypotension, we measured every participant's systolic and diastolic blood pressure while they were sitting and afterward while they were standing up; A drop of 20 millimetres of mercury (mm Hg) in the systolic blood pressure or a drop of 10 mm Hg in the diastolic blood pressure within 2 to 5 minutes of standing was indicative of orthostatic hypotension. To assess health status, participants were asked to self-report hypertension, type II diabetes mellitus, osteoporosis, osteoarthritis, depression, anxiety, epilepsy, Parkinson's disease, multiple sclerosis, and stroke history.

2.4. Statistical analysis

Data analysis comprised descriptive statistics and tests of the associations between study variables. The frequency with percentage for categorical variables, and mean ± standard deviation (SD) for continuous variables are displayed. In order to compare the groups, we used Chi-square and independent t-tests for categorical and continuous variables, respectively. Finally, univariate and multivariate logistic regression models were used to identify fall-related factors. All variables in the univariate models were entered into the eventual models; afterward, utilizing a backward stepwise method, only statistically significant variables ($p<0.05$) were preserved in the final multivariate model. To examine the factors associated with the risk of fracture and hospitalization, two final models were applied to all participants with falls during the last 12 months. The statistical significance level of 0.05 was set for all analyses. STATA Version 15 (Stata- Corp. 2017. Stata Statistical Software) was used to perform complete data analyses.

3. Results

3.1. Baseline characteristics

The final analysis included a total of 4,990 adults aged over 50, with a mean age of 60.98±7.07 years. Of these participants, 47.6% were female. The baseline characteristics of studied patients are shown in table 1.

Among participants under 65 years old, 18.5% (597 individuals; 95% confidence interval (CI): 17.9 - 19.2) reported at least one episode of falling and were classified as fallers.

Among those aged 65 and above, 22.4% (397 individuals; 95% CI: 21.5 - 23.4) reported experiencing at least one episode of falling and were also categorized as fallers.

Among individuals under 65, fallers tend to have higher rates of obesity, moderate to severe FOF, balance issues, urinary incontinence, cognitive impairment, vertigo, and underlying diseases compared to non-fallers. Orthostatic hypotension prevalence was not significantly different between these groups.

In participants over 65, the fallers were reported to be less obese but had higher rates of FOF, balance issues, urinary incontinence, cognitive impairment, vertigo, and orthostatic hypotension. Underlying diseases such as hypertension, type 2 diabetes, and others also had a higher rate in this group.

3.2. Prevalence and complications of falling

Table 2 displays the prevalence of the initial incident (falling) and its secondary outcomes (subsequent complications), as well as the rate of FOF among all participants. It is demonstrated that among all participants with at least one episode of falling, as the individuals got older, their risk of falling increased ($p = 0.004$); all other variables except fractures and hospitalization followed the same pattern.

Among multiple-time fallers, this pattern was only detected in the female participants. Among fallers, moderate to severe FOF, at least one falling episode, activity disturbance due to their FOF, and consequent fractures had higher rates among the female participants in this study.

3.3. Associated factors of falling

After adjusting for confounders, moderate to severe FOF ($p < 0.001$), semi-balance or imbalance ($p < 0.001$), mild and moderate urinary incontinence ($p < 0.001$), cognitive impairment ($p = 0.049$), vertigo or dizziness ($p < 0.001$), osteoporosis ($p = 0.023$), osteoarthritis ($p = 0.001$), depression ($p = 0.01$), and neurological issues such as Parkinson, multiple sclerosis (MS), or cardiovascular accidents (CVA) ($p = 0.001$), had positive associations with falls. Orthostatic hypotension did not have any significant association with falling ($p = 0.344$). The results of univariate and multivariate regression models of factors associated with one-time fall are shown in table 3.

3.4. Associated factors of multiple falling episodes

The logistic regression of factors associated with the odds of multiple falls is presented in Table 4. Our adjusted analy-

ses demonstrate that moderate to severe FOF, self-expressed balance issues, any degree of urinary incontinence, cognitive impairment, vertigo or dizziness, osteoarthritis, depression, epilepsy, and neurological conditions such as Parkinson's disease were significantly associated with multiple falls with the most prominent odds ratio belonging to imbalance (4.03, 95% CI: 2.67-6.08).

3.5. Associated factors of fracture after falling

The univariate and adjusted multivariate analyses of factors associated with the odds of fracture in participants with at least one episode of fall are presented in Table 5. The only variable that showed a statistically significant relationship with the risk of fracture in our final results was moderate to severe FOF (p= 0.006).

3.6. Associated factors of hospitalization after falling

The logistic regression of factors associated with the odds of hospitalization among all fallers is given in Table 6. As shown, moderate to severe FOF ($p < 0.001$), and a history of epilepsy ($p = 0.014$) were associated with higher risks of hospitalization. However, a BMI over 30 was associated with lower risk of hospitalization ($p = 0.029$).

4. Discussion

The present study investigated the prevalence of falls, FOF, and subsequent complications. Among the participants, 18.56% of those below 65 years old and 22.46% of those above 65 reported at least one fall, while 9.4% of those below 65 years old and 11.8% of those above 65 experienced more than two fall events. One-fifth of the total population reported FOF, and 14.3% reported fall-related activity disorders. Among the fallers, 15.1% sought medical care following the fall event, 7% experienced one bone fracture, and 3.4% required hospitalization.

The results of this study indicate that 18.65% of those younger than 65 years and 22.64% of those older than 65 years had fallen in the past year. This pattern of higher fall rates with increasing age is also found in previous literature. The study by Jafarian Amiri et al. showed a 2.5-fold higher risk of falls in persons over 75 years of age (13). Other cross-sectional studies have also shown a significant association between fall risk and age over 60 years (14, 15). A systematic review demonstrated that patients aged 60-65 years and older were at high risk for falls. However, individuals aged 80 years and older had the highest risk of falls (16). Furthermore, Deandrea et al. reported a consistent increase in fall risk with age and an odds ratio of 1.12 for a 5-year increase in age in their systematic review and meta-analysis (17).

The findings of this study showed 2.45 times higher odds of participants with self-expressed imbalance. A meta-analysis by Muir et al. on twenty-three studies suggests that balance issues are significantly associated with higher fall risk. The summary values in their review revealed that imbalance was associated with an almost two folds higher chance of falling (18).

Urinary incontinence is a substantial fall predictor. Patients having an urgent need to void cannot entirely focus on their posture, gait, and environmental hazards (19, 20). Our results showed that experiencing mild and moderate urinary incontinence can increase the risk of falls by 42 and 44 percent, respectively. Another study on the Iranian population reported a statistically significant association between urinary incontinence and fall risk, demonstrating that 56.3% of people with and 43.7% of people without incontinence experienced falling (21).

Studies have revealed that orthostatic hypotension increases with age progression. It is often linked to falls in the elderly and can cause considerable morbidity and mortality (22). Earlier studies have shown an association between orthostatic hypotension and falling episodes (23), but our findings suggest otherwise. After adjusting the findings for other variables, no significant association was found between orthostatic hypotension and falling.

Our study showed a positive association between intrinsic factors such as vertigo or dizziness, osteoporosis, osteoarthritis, depression, and minimal cognitive impairment (MCI), with falling. All of these factors increased the odds of falling by a percentage between 25 and 40. Previous studies have shown that individuals with a history of chronic diseases, such as vertigo, dizziness, and musculoskeletal diseases, were 4.5 times more likely to experience falling (3, 11, 13). Pahlevanian et al. have conducted a systematic review and concluded that there is a significant association between depression, dementia, and the risk of falling in Iranian population (24).

A previous history of falls is a significant risk factor for future falls (25). A study by Na'emani et al. examined the number of falls among 112 fallers, stating that 20, 7, 4, 2, and 1 percent of them experienced two to six episodes of falling, respectively, with multiple-time fallers making up 34 percent of their sample population (21). Due to the cross-sectional nature of current study, the assessment of the relationship between previous falls and recurrent falls was not possible. However, this association can be investigated in future waves of the ACSA through longitudinal studies.

According to our results, 15.9% of women and 8.7% of men over 65 years and 12.2% of women and 8% of men in the total population had at least two fall events within a year. However, after adjusting for other variables the association of female sex and recurrent fall was not statistically significant. Prior studies suggest that the female sex is a substantial

risk factor for recurrent falls. In 2018, Dai et al. conducted a study on 10,009 participants aged 40 years and older in Singapore, which found an odds ratio of 2.27 for the association between female sex and risk for recurrent falls (26). The disparity in findings between the aforementioned study and the current study may be attributed to differences in variable adjustments. It should be noted that the previous study did not account for certain variables such as CNS-affecting diseases, imbalance, and urinary incontinence, which were included in the present study.

According to our findings, having epilepsy can increase the chances of multiple-time falling by 2.15 times. The higher fall risk could be linked to anti-epileptic drugs (AED). Maximos et al. conducted a systematic review with the results showing that AED usage had an odds ratio ranging between 2.5 to 7.1 in association with the risk of falling (27). Additionally, epileptic events can directly contribute to an increased likelihood of falls (28).

Another finding of our study is that the risk of multiple falls is significantly associated with imbalance, resulting in an adjusted odds ratio of 4.03. The presence of imbalance, a common age-related condition, significantly contributes to an increased risk of falls among older adults, making it an important factor to consider in fall prevention strategies (3, 11). Furthermore, it can be observed that falling can result in a decrease in physical and motor activity, making individuals more vulnerable to a heightened risk of recurrent falls, particularly when they experience imbalance (29).

Our results show that 28.8% of females and 10.9% of males reported moderate to severe FOF. Also, the multivariate analysis in multiple faller participants yielded an odds ratio of 1.70 in patients with FOF. FOF has been shown to increase the risk of falls in the elderly. It is intertwined with fall risk; one leads to the other (30). The results of our adjusted logistic regression findings imply that FOF was associated with falls with an odds ratio of 1.59. One alternative interpretation of these findings is that a previous fall may elevate the risk of developing FOF by 60%. A study on 2212 patients examined this duality; the results showed that among those who had not fallen at baseline, the group with an FOF was 2.22 times more likely to fall, and those who had fallen were 1.75 times more likely to develop an FOF (31).

Previous falls or concern about falling may lead to decreased physical activity, lower muscle strength, general immobility, and disturbed function (32). Our findings revealed that the overall prevalence of activity disturbance in females (21%) is three times that of males (7.2%). Similarly, a study on 4031 community-dwelling older adults reported an activity avoidance rate of 46.1% and 25.8% among females and males, respectively (33).

According to previous studies, hospitalization imposes a heavy burden on fallers. It is estimated that two-thirds of fall-related costs are due to subsequent medical care (34, 35). Therefore, identification of the major risk factors leading to hospitalization is very important at many levels. Our results showed increasing hospitalization rates with age progression in the females, with the age group 85 and above having the highest prevalence rate.

Our findings suggest that epilepsy and moderate-to-severe FOF are major risk factors for patient admission and hospitalization, with a 5.40- and 3.89-fold higher risk, respectively. We believe that this high odds ratio results from physicians being more likely to admit individuals with a positive history of epilepsy so that they can be confident that the fall was not the consequence of a recent seizure.

We can also say that people with FOF may insist on being hospitalized after a fall because of their past trauma and difficulties.

However, to our knowledge, no other studies have examined these relations in Iran.

The only variable having a significant association with fracture risk was moderate to severe FOF, with 55 percent higher odds after multivariate adjustment. This positive association can also be observed in the study by Soleimani et al. (36), which suggests that FOF leads to an increased frequency of falling episodes, resulting in a higher likelihood of injuries and fractures. Additionally, it can be argued that the severity of a fall, and the subsequent fear and anxiety it generates, are directly proportional to the level of harm and damage caused.

4.1. Strengths and limitations

The large sample size and the stratification of the data by age and sex are some of the strengths of the current study. To the best of our knowledge, no other studies on aging with such a significant number of participants have been conducted in our region. This study also faces some limitations. We would like to note that some of the exclusion criteria of the ACSA, such as severe visual or cognitive impairment, are themselves risk factors for falls; therefore, generalizing our finding to the population should be done with caution. In our study, falls and related complications during the past year were recorded via the self-report method, which may raise potential recall bias. In addition, due to the cross-sectional nature of this study, causal relationships could not be established. We recommend conducting prospective longitudinal studies, such as the next wave of the ACSA, to further investigate these associations.

5. Conclusion

This study showed that about one-fifth of individuals over 50 years of age in Iran have experienced at least one episode of falling in one year. Although fall-related risk factors vary

among different populations, we suggest that imbalance, fear of falling, and urinary incontinence are prominent factors. However, our results showed no significant relationship between orthostatic hypotension and the odds of falling. Our results suggested that FOF and a history of epilepsy appear to be two major risk factors for hospitalization. Consideration of these factors could be influential in fall prevention.

6. Declarations

6.1. Acknowledgments

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6.2. Disclosure statement

The authors declare no conflict of interest.

6.3. Funding and supports

This study is part of and funded by the Ardakan Cohort Study on Aging (ACSA) fund.

6.4. Authors' contribution

All authors made a significant contribution to the work reported, whether in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

6.5. Data availability statement

The datasets used and analyzed in this study are available from the corresponding author upon reasonable request.

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This study is part of and funded by the Ardakan Cohort Study on Aging (ACSA) fund.

6.7. Using artificial intelligence chatbots

None.

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Table 1: Baseline characteristics of fallers and non-fallers

Variables	Under 65 years-old		p	65 years-old and above		p
	Non-faller (n = 2619)	Fallers (n = 597)		Non-faller (n = 1370)	Fallers (n = 397)	
Obesity						
Obese (BMI ≥ 30)	1010 (38.6)	281 (53)	< 0.001	771 (56.3)	199 (50.1)	<0.001
Not obese (BMI < 30)	1609 (61.4)	316 (47)		599 (43.7)	198 (49.9)	
Balance						
Balanced	2355 (89.9)	426 (71.5)	< 0.001	1009 (73.6)	201 (50.6)	<0.001
Semi-balanced	248 (9.5)	154 (25.8)		300 (21.9)	143 (36)	
Imbalanced	16 (0.6)	16 (2.7)		61 (4.4)	53 (13.4)	
Urinary incontinency						
No	2146 (83.8)	398 (68.1)	< 0.001	1014 (75.3)	250 (63.9)	<0.001
Mild	328 (12.7)	139 (23.8)		256 (19)	96 (24.6)	
Moderate	76 (3)	40 (6.9)		59 (4.4)	35 (9)	
Severe	12 (0.5)	7 (1.2)		18 (1.3)	10 (2.6)	
Minimal cognitive impairment						
Yes	243 (9.4)	91 (15.4)	< 0.001	320 (23.5)	132 (33.5)	<0.001
No	2352 (90.6)	501 (84.6)		1041 (76.5)	262 (66.5)	
Sign & symptoms						
Vertigo	319 (12.4)	146 (25)	< 0.001	224 (16.6)	100 (25.5)	<0.001
Orthostatic hypotension	537 (20.5)	124 (20.8)	0.984	252 (18.4)	86 (21.7)	0.140
Underlying diseases						
Hypertension	1076 (41.8)	290 (49.2)	0.001	812 (60.1)	276 (70)	<0.001
Diabetes (type II)	693 (27.1)	190 (32.5)	0.008	505 (37.7)	193 (49.2)	<0.001
Osteoporosis	364 (13.9)	146 (24.5)	< 0.001	241 (17.6)	116 (29.2)	<0.001
Osteoarthritis	609 (23.8)	221 (38.1)	< 0.001	397 (29.4)	154 (39.4)	<0.001
Depression	309 (12.1)	110 (18.8)	< 0.001	139 (10.4)	73 (18.6)	<0.001
Anxiety	338 (15.2)	115 (19.7)	0.008	136 (10.2)	51 (13)	0.116
Epilepsy	26 (1)	14 (2.4)	0.006	14 (1)	5 (1.3)	0.613
Parkinson / MS/ CVA	40 (1.5)	25 (4.27)	< 0.001	35 (2.6)	23 (5.9)	<0.001

Data are presented as frequency (%). BMI: body mass index; MS: multiple sclerosis; CVA: cerebral vascular accident.

Table 2: Prevalence of fall and its complications in the studied participants

Outcome	Age groups					P-value
	Overall (N: 4983)	age < 65 (N: 3417)	65 ≤ age <75(N: 1254)	75 ≤ age < 85 (N: 289)	85 ≤ age (N: 23)	
Fall ≥ 1 times						
Female	604 (23.3)	412 (21.8)	156 (26.53)	32 (30.5)	4 (57.1)	0.004
Male	390 (16.3)	230 (15.0)	110 (16.5)	46 (25.0)	4 (25.0)	0.005
Fall ≥ 2 times						
Female	316 (12.2)	205 (10.8)	85 (14.5)	24 (22.9)	2 (28.6)	< 0.001
Male	192 (8.0)	117 (7.7)	53 (8.0)	21 (11.4)	1 (6.2)	0.361
Fear of falling #						
Female	747 (28.8)	438 (23.2)	252 (42.9)	33 (50.5)	4 (57.1)	< 0.001
Male	260 (10.9)	128 (8.4)	83 (12.5)	44 (23.9)	5 (31.3)	< 0.001
Activity disturbance						
Female	543 (21.0)	286 (15.1)	204 (34.7)	49 (46.7)	4 (57.1)	< 0.001
Male	173 (7.2)	77 (5.0)	57 (8.6)	35 (19.0)	4 (25.0)	< 0.001
Medical care ##						
Female	94 (15.6)	63 (15.3)	23 (14.7)	7 (21.9)	1 (25.0)	0.719
Male	57 (14.6)	30 (13.0)	18 (16.4)	9 (19.6)	0 (0)	0.510
Fracture ##						
Female	52 (8.6)	35 (8.5)	10 (6.4)	5 (15.6)	2 (50.0)	0.009
Male	20 (5.1)	11 (4.8)	7 (6.4)	2 (4.3)	0 (0)	0.879
Hospitalization ##						
Female	21 (3.5)	13 (3.2)	4 (2.6)	3 (9.4)	1 (25.0)	0.025
Male	13 (3.3)	8 (3.5)	4 (3.6)	1 (2.2)	0 (0)	0.945

Data are reported as number (percentage). Percentages are calculated based on the number of patients in each age group and sex.
#Moderate to severe fear of falling; ##among fallers.

Table 3: Associated factors of falling based on univariate and multivariate analyses (n = 4785)

Covariates (Reference level)	Univariate (α<0.2)			Multivariate (α<0.05)		
	OR	P	95% CI	OR	P	95% CI
Age (under 65)						
65 ≤ <75	1.16	0.064	0.99 to 1.36	-		
75 ≤ <85	1.59	0.001	1.21 to 2.10			
85 ≤	2.30	0.058	0.97 to 5.46			
Sex (female)				-		
male	0.64	< 0.001	0.55 to 0.73			
BMI (kg/m2)				-		
≥30	1.37	< 0.001	1.19 to 1.58	-		
Fear of falling (low)						
Moderate to severe	2.68	< 0.001	2.30 to 3.13	1.59	< 0.001	1.33 to 1.91
Balance (completely balanced)						
Semi-balanced	2.90	< 0.001	2.46 to 3.42	1.87	< 0.001	1.55 to 2.26
Imbalanced	4.80	< 0.001	3.43 to 6.72	2.45	< 0.001	1.68 to 3.58
Urinary incontinency (no)						
Mild	1.96	< 0.001	1.64 to 2.33	1.42	< 0.001	1.18 to 1.71
Moderate	2.70	< 0.001	2.01 to 3.63	1.44	0.025	1.04 to 1.9
Severe	2.76	< 0.001	1.51 to 5.04	1.06	0.853	0.55 to 2.04
MCI (no)						
Yes	1.76	< 0.001	1.48 to 2.09	1.21	0.049	1.00 to 1.46
Orthostatic hypotension (no)				-		
Yes	1.08	0.344	0.91 to 1.28			
Vertigo or dizziness (no)						
Yes	2.09	< 0.001	1.76 to 2.48	1.39	< 0.001	1.15 to 1.68
Hypertension (no)				-		
Yes	1.46	< 0.001	1.27 to 1.68			
Diabetes (no)				-		
Yes	1.44	< 0.001	1.25 to 1.67			
Osteoporosis (no)						
Yes	2.00	< 0.001	1.69 to 2.36	1.24	0.023	1.03 to 1.50
Osteoarthritis (no)						
Yes	1.81	< 0.001	1.56 to 2.10	1.33	0.001	1.13 to 1.56
Depression (no)						
Yes	1.77	< 0.001	1.46 to 2.13	1.30	0.010	1.06 to 1.60
Anxiety disorders (no)				-		
Yes	1.31	0.005	1.08 to 1.59			
Epilepsy (no)				-		
Yes	1.92	0.020	1.11 to 3.34			
Parkinson / MS/ CVA (no)						
Yes	2.65	< 0.001	1.83 to 3.83	1.99	0.001	1.33 to 2.97

OR: odds ratio; 95% CI: 95% confidence interval; BMI: body mass index; MCI: minimal cognitive impairment; MS: multiple sclerosis; CVA: cerebrovascular accidents.

Table 4: Associated factors of multiple falls based on univariate and multivariate analyses (n = 4785)

Covariates (Reference level)	Univariate (α<0.2)			Multivariate (α<0.05)		
	OR	P	95% CI	OR	P	95% CI
Age (under 65)						
65 ≤ <75	1.18	0.108	0.96 to 1.46	-		
75 ≤ <85	1.77	0.001	1.26 to 2.48			
85 ≤	1.44	0.556	0.42 to 4.87			
Sex (female)				-		
male	0.62	< 0.001	0.51 to 0.75			
BMI (kg/m2)				-		
≥30	1.68	< 0.001	1.40 to 2.02	-		
Fear of falling (low)						
Moderate to severe	3.41	< 0.001	2.81 to 4.13	1.70	< 0.001	1.35 to 2.15
Balance (completely balanced)						
Semi-balanced	3.89	< 0.001	3.17 to 4.78	2.30	< 0.001	1.81 to 2.91
Imbalanced	8.96	< 0.001	6.28 to 12.79	4.03	< 0.001	2.67 to 6.08
Urinary incontinency (no)						
Mild	2.41	< 0.001	1.94 to 3.00	1.63	< 0.001	1.29 to 2.07
Moderate	3.31	< 0.001	2.34 to 4.69	1.60	0.016	1.09 to 2.935
Severe	6.10	< 0.001	3.29 to 11.28	2.14	0.029	1.08 to 4.23
MCI (no)						
Yes	2.27	< 0.001	1.84 to 2.81	1.37	0.008	1.08 to 1.74
Orthostatic hypotension (no)				-		
Yes	1.04	0.714	0.83 to 1.30			
Vertigo or dizziness (no)						
Yes	2.44	< 0.001	1.98 to 3.01	1.37	0.0091	1.08 to 1.74
Hypertension (no)				-		
Yes	1.65	< 0.001	1.37 to 1.99			
Diabetes (no)				-		
Yes	1.64	< 0.001	1.35 to 1.98			
Osteoporosis (no)						
Yes	2.09	< 0.001	1.70 to 2.58			
Osteoarthritis (no)						
Yes	1.86	< 0.001	1.53 to 2.25	1.26	0.027	1.02 to 1.56
Depression (no)						
Yes	1.92	< 0.001	1.52 to 2.43	1.35	0.020	1.064 to 1.75
Anxiety disorders (no)				-		
Yes	1.38	0.009	1.08 to 1.76			
Epilepsy (no)				-		
Yes	3.07	< 0.001	1.69 to 5.55	2.15	0.022	1.11 to 4.15
Parkinson / MS/ CVA (no)						
Yes	3.54	< 0.001	2.36 to 5.32	2.18	0.001	1.38 to 3.43

OR: odds ratio; 95% CI: 95% confidence interval; BMI: body mass index; MCI: minimal cognitive impairment; MS: multiple sclerosis; CVA: cerebrovascular accidents.

Table 5: Associated factors of fracture after fall based on univariate and multivariate analyses (n = 958)

Covariates (Reference level)	Univariate (α<0.2)			Multivariate (α<0.05)		
	OR	P	95% CI	OR	P	95% CI
Age (under 65)						
65 ≤ <75	1.02	0.910	0.71 to 1.44	-		
75 ≤ <85	1.06	0.825	0.60 to 1.88			
85 ≤	1.27	0.767	0.25 to 6.39			
Sex (female)				-		
male	0.69	0.030	0.50 to 0.96			
BMI (kg/m2)				-		
≥30	1.01	0.905	0.75 to 1.38	-		
Fear of falling (low)						
Moderate to severe	1.53	0.007	1.12 to 2.10	1.55	0.006	1.13 to 2.13
Osteoporosis (no)						
Yes	1.06	0.700	0.75 to 1.50	-		
Osteoarthritis (no)				-		
Yes	1.12	0.456	0.82 to 1.54			
Epilepsy (no)				-		
Yes	0.70	0.583	0.20 to 2.44			
Parkinson / MS/ CVA (no)						
Yes	1.13	0.722	0.56 to 2.26	-		

OR: odds ratio; 95% CI: 95% confidence interval; BMI: body mass index; MCI: minimal cognitive impairment;
MS: multiple sclerosis; CVA: cerebrovascular accidents.

Table 6: Associated factors of hospitaliazation after fall based on univariate and multivariate analyses (n = 958)

Covariates (Reference level)	Univariate (α<0.2)			Multivariate (α<0.05)		
	OR	P	95% CI	OR	P	95% CI
Age (under 65)						
65 ≤ <75	0.91	0.837	0.40 to 2.09	-		
75 ≤ <85	1.59	0.402	0.53 to 4.78			
85 ≤	4.22	0.187	0.49 to 8.8			
Sex (female)				-		
male	0.95	0.030903	0.47 to 1.93			
BMI (kg/m2)				-		
≥30	0.50	0.065	0.24 to 1.04	0.43	0.029	0.20 to 0.91
Fear of falling (low)						
Moderate to severe	3.15	0.001	1.56 to 6.38	3.89	< 0.001	1.86 to 8.14
Osteoporosis (no)				-		
Yes	1.35	0.421	0.64 to 2.81			
Osteoarthritis (no)				-		
Yes	0.75	0.446	0.36 to 1.56			
Epilepsy (no)				-		
Yes	5.80	0.007	1.60 to 20.97	5.40	0.014	1.41 to 20.6
Parkinson / MS/ CVA (no)				-		
Yes	0.59	0.615	0.07 to 4.45			

OR: odds ratio; 95% CI: 95% confidence interval; BMI: body mass index; MCI: minimal cognitive impairment;
MS: multiple sclerosis; CVA: cerebrovascular accidents.