Ulutas Med J 2020;6(3):162-168
DOI: 10.5455/umj.20200610062305

ORIGINAL ARTICLE OPEN ACCESS

Female Gender and Polypharmacy Results in An Increased Risk of High-Energy Trauma Associated With Falls in Elderly People

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Introduction: Falls represent a major clinical problem in the elderly population. Accordingly, prevention of falls is clinically important in this vulnerable population. The aim of the present study was to evaluate the clinical characteristics associated with falls and to define a patient subgroup that is at increased risk.

Materials and Methods: Consecutive patients aged ≥65 years, who presented with falls at Emergency Department of American Hospital, Istanbul, Turkey, from 01/02/2014 to 01/02/2015, were included in this cross-sectional study.

Results: A total of 166 (17%) patients met the study inclusion criteria, comprising 110 (57.2%) females and 56 (33.7%) males. The mean age was 86.2±7.6 (66-105) years. The incidence of high-energy trauma was significantly higher in individuals aged ≥80 years (t=6.71; p=0.0054). Female gender was associated with an increased risk of high-energy trauma (x^2=9.51; p=0.003). The frequency of angiotensin-converting enzyme inhibitors and polypharmacy was significantly higher in high energy trauma group (p<0.001).

Conclusion: Women aged ≥80 years are at an increased risk of falls. Moreover, polypharmacy is associated with falls that lead to high-energy trauma. Healthcare providers should pay particular attention to this patient group to prevent high-energy falls that may lead to temporary or permanent injuries.

Keywords: Elderly, women, falls, injury, trauma

Introduction

The life expectancy of the world's population has markedly increased over recent decades. Therefore, the proportion of elderly people in populations has increased. In 2000, there were 605 million people aged ≥60 years worldwide; however, this number is estimated to reach 2 billion in 2050 (1). In accordance with the World Health Organization definition of "elderly," which includes individuals with a chronological age of ≥60 years, the majority of developed countries and geriatric sciences have adopted the threshold of 60 years of age (2). Among many other age-related diseases, falls represent a major clinical problem in this population of individuals, with millions of older adults suffering falls every year.

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Received: Jul 13, 2020 **Accepted**: Aug 19, 2020
Published: Sep 19, 2020

The incidence of falls among elderly population living in the community is approximately 30-40%; however, this number may reach up to 60% for those living in nursing homes, i.e., almost twice the incidence of falls among the elderly living in the community (3, 4). Falls may lead to temporary and permanent deficits requiring frequent hospitalizations, thereby increasing the burden on healthcare systems. Fractures, such as hip fractures, are the most common and most expensive non-fatal injuries associated with falls. Moreover, fractures account for 61% of all non-fatal costs, despite comprising only a third of non-fatal injuries (5). In addition to temporary injuries, falls may cause permanent disability and even death. The injuries to internal organs are responsible for almost 28% of fall deaths and account for 29% of costs (6). Accordingly, the prevention of falls in clinically important is this high-risk group of individuals.

Risk factors should be identified and eliminated to prevent falls. Certain factors, such as gait disorders, depression, female gender, arthritis, the use of assistive devices and a history of stroke, incontinence, orthostatic hypotension, visual disorders, muscle weakness, as well as the use of medications for concurrent diseases, in addition to polypharmacy (i.e., the concurrent use of ≥4 drugs) have been shown to predispose elderly individuals to falls (7-9). Pharmacological agents that may increase the risk of falls include neuroleptics, benzo diazepines, tricyclic antidepressants, serotonin uptake inhibitors, antiepileptics, Class 1A anti-arrythmics, diuretics and digoxin (10, 11).

The present study aims to evaluate the clinical characteristics associated with falls and to define a patient subgroup that is at increased risk.

Materials and Methods

Consecutive patients aged≥65 years, who presented with falls at Emergency Department of American Hospital, Istanbul, Turkey, from 01/02/2014 to 01/02/2015, were included in this retrospective study. Ethical Committee permission was obtained from the local ethics committee (Protocol date and number: 12.01. 2015/2015.011.IRB2.005). A fall was defined as an event resulting in an individual suddenly and inadvertently coming to rest on the ground or a lower position. Medical records of included patients were retrieved from the archives and analysed. All falls, regardless of setting, were included in the present study. Analysed data included the demographic and health characteristics of patients, such as age, gender, concomitant diseases and medications. The residential status of patients, such living alone in their own home, with others or in a residential home, was recorded from the files.

High energy trauma (HET) was defined as trauma caused by a fall, which resulted in brain injuries, cervical fracture, thoracic trauma, abdominal trauma, lower extremity fractures or dislocations, facial fractures, aortic rupture, diaphragmatic rupture, spleen and liver rupture or pelvic and acetabular fractures (12). Low energy trauma (LET) was defined as a trauma, which resulted in minor injuries other than HET. Recurrent falls were defined as >2 falls within the last 6 months. The index event was defined as the fall leading to hospital admission. Patients were assigned to two groups as HET (Group 1) or LET (Group 2). The exclusion criteria of the present study were as follows: falls related to being pulled or pushed; any medical condition that may predispose to falls, such as myocardial infarction or ischemia, cognitive impairment; stroke or neurological

impairment, the being bedridden and visual impairment; alcohol intoxication or gastro intestinal bleeding.

The impact of variables on falls was analysed using Pearson Chi-square and Student's t-test. Further analyses were performed using Pearson Chi-square, the one-way analysis of variance (ANOVA), post-hoc analysis and Tukey's honest significant difference method. The impact of gender on the evaluation of falls was assessed using Pearson Chi-square and Student's t-test. The effect of retirement duration was evaluated using Pearson Chi-square, ANOVA and post-hoc analysis.

Results

A total of 976 patients with falls were admitted to the emergency department of the hospital during the study period. There were 166 (17%) patients aged >65 years who met the inclusion criteria. Of the 166 patients, 110 (66.3%) were female and 56 (33.7%) were male. The mean age of included patients was 86.2±7.6 (66–105) years. There were 98 (59%) patients with hyper tension, 10 (6%) with ischemic heart disease, 10 (6%) with valvular heart diseases, 8 (4.8%) with arrhythmia, 7 (4.2%) with chronic obstructive pulmonary disease, 6 (3.6%) with non-limiting dementia, 5 (3%) patients with cerebrovascular disease, 4 (2.4%) with lung cancer, 1 (0.6%) with metastatic lung cancer and 1 (0.6%) with epilepsy. The demographics of the patients are shown in Table 1.

All patients lived in their own homes, and no patients lived in a nursing home. Ten (6%) patients lived alone and 156 (94%) patients lived with others. There were 42(25.3%) patients who used assistive devices to stand and walk. Group 1 included 67 (40.3%) patients, whereas Group 2 included 99 (59.7%) patients. Elderly individuals aged >80 years were more likely to suffer from HET related to falls. There were 87 (52.4%) patients aged <80 years and 79 (47.6%) aged ≥80 years (x^2=9.48; p=0.00001). The incidence of HET was significantly higher in individuals aged ≥80 years (t=6.71; p=0.0054).

Table-1. Demographic characteristics

Variables		n	%
Gender	Male	56	33.7
	Female	110	66.3
Age	All	80.2±7.51	
	Male	79.5±7.68	
	Female	80.5±7.44	
Disease	Hypertension	98	59
	Ischemic Heart Disease	10	6
	Valvular Disease Of The Heart	10	6
	Arrythmia	8	4.8
	COPD	7	4.2
	Non-limiting Dementia	6	3.6
	CVD	5	3
	Lung Cancer	4	2.4
	Metastatic Lung Cancer	1	0.6
	Epilepsy	1	0.6
Lifestyle	Living Alone	10	6
	Living with Others	156	94
	Using Assisting Device	42	25.3

A strong significant association (p=0.003) was observed between gender and trauma energy. There were 24(14.4%) male and 43(26%) female patients who suffered from HET, and there were 32 (19.3%) male and 67 (40.3%) female patients who suffered from LET. HET risk was increased in the female gender (x^2=9.51; p=0.003).

The use of neuroleptic drugs was significantly higher in Group 2, whilst the use of angiotensin converting enzyme inhibitors (ACEI) and poly pharmacy was significantly higher in Group 1. The rates of drug use are shown in Table 2.

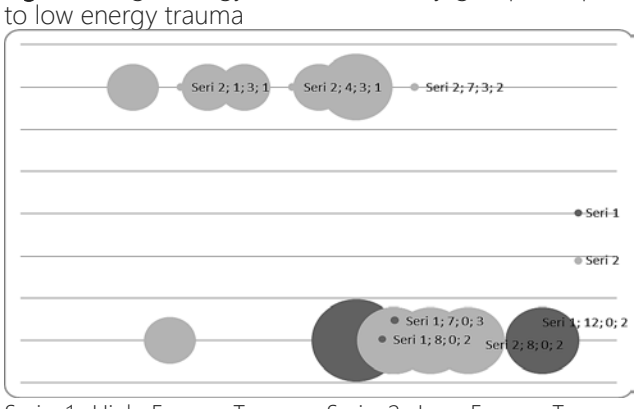
Table-2. Patients medications

Variables	Group 1		Group 2		Chi-square	P value
	%	n	%	n		
Antidepressants	14.6	34	10.1	14	9.61	0.052
Neuroleptics	11.1	35	11.5	36	8.01	0.049*
Other cardiac medicines	20.3	41	21.5	42	9.01	0.062
Polipharmacy	28.1	25	12.5	15	9.78	0.0001*
ACEI**	9.2	32	7.1	28	4.61	0.001*
ARB***	8.1	53	7.9	51	12.6	0.064
β blockers	5.6	21	4.2	15	7.61	0.08

* Statistically Significant Results
** ACEI: Angiotensin Converting Enzyme Inhibitors
*** ARB: Angiotensin Receptor Blockers

There were 76(58%) patients who had recurrent falls. The remaining 99 (42%) patients had no history of falls. The incidence of falls was significantly higher in patients with a history of falls (x^2=3.91, p=0.021). Multilogistic regression analysis identified gender as the only significant risk factor for falls. The risk of falls was five times higher in females than in males (odds ratio, 5.18; 95% confidence interval, 1.1–15; Figure 1). In addition, patients with HET were three times more likely to suffer subsequent falls than those with LET (95% confidence interval, 0.96–4.7).

Figure 1. High energy trauma in elderly group compare to low energy trauma



Serie 1: High Energy Trauma, Serie 2: Low Energy Trauma Hazard Ratios (HR) were estimated using a subdistribution proportional hazards regression model for competing risk analyses. The reference group was the group using more than 4 drugs and they are high density fall ones. Dots represent point estimates for HRs, the width of the horizontal lines represents the 95% CI, upper limits of 95% CIs exceed 3.

Discussion

The resent cross-sectional study found that the prevalence of falls in elderly people aged ≥65 years was 34.8% per year. American Hospital is a private hospital in the city centre of Istanbul with 340 beds. Majority of the patients have middle to high level income, but emergency department welcomes all patients regardless of their economic status, as in Turkey all emergency services are free according to the law. Therefore; we think that this rate reflects the general patient population. This rate is in accordance with the prevalence rates reported by previous studies (13, 14). The incidence of falls is known to be higher among individuals living in nursing homes. We are unable to assess the effect of living in a nursing home as subjects included in the present study lived independently at their own home or with relatives.

The results of the present study demonstrated that the risk of falls was highest in people aged ≥80 years. Moreover, the results demonstrated an association between female gender and falls. The incidence of falls was significantly higher in females than in males. This finding corroborates previous reports(15-19), Stevens et al.(5) showed that women are more likely than men to

be treated for fall injuries in hospitals and emergency departments. Aoyama et al. (17) noticed that women had a higher risk of falling than men. They showed that Motor Fitness Scale may be a significant predictor of falls in older women, Campbell and Robbins submit that there are various intrinsic factors that make women more prone to falls than men. These factors are osteoporosis, self confidence on falling, lower muscle strengh and worse physical performances.

An isolated fall is not always regarded as a sign of major disease or as an increased risk of subsequent falls. However, recurrent falls, defined as >2 falls in the preceding 6 months, is a well-known risk factor. We also observed an increased risk of falls in elderly individuals who had previously fallen more than once. Moreover, this risk was apparently higher in patients with falls resulting in HET (20-25). In our study population, the risk of a subsequent fall was significantly higher in the 67 elderly individuals who had suffered HET related to falls within the last 6 months prior to admission. Hence, we believe that the caregivers at nursing homes should be aware of the increased risk of falls in this population of individuals.

Similarly to many countries, life expectancy in Turkey has also noticeably increased. The expected life span is currently 73.7 years for men, 79.4 years for women and 76.3 years overall (26). An increased life span has led to a higher percentage of elderly individuals in the community and greater numbers of individuals receiving various kinds of medication due to the increased survival among patients with chronic diseases. Thus, the number and duration of pharmacotherapy and concomitant diseases in elderly individuals have concurrently increased. It is estimated that being maintained on one or more medications is a risk factor for falls in the elderly population. Polypharmacy, defined as the use of ≥4 drugs, is accepted as a risk factor for falls (27-28). The present study also found an association between pharmacotherapy and the frequency of falls, with the risk of recurrent falls found to be higher in poly pharmacy. This result confirms that polypharmacy is associated with the risk of falls in this frail population. Nevertheless, drug classes that are associated with falls in the elderly patients remain contro versial. The results of the study indicated an association between the use of antihypertensive drugs and falls.

Antihypertensive drugs may cause unexpected hypotension, thereby precipitating falls (29,30). Of all types of antihypertensive medications, ACEI were the strongest association with falls in the elderly group. However, the mechanisms underlying the association between falls the use of ACEI specifically has yet to be fully elucidated.

Logistic regression analysis identified female gender as the sole risk factor for falls in the elderly population of the present study (odds ratio, 5.18; 95% confidence interval, 1.1–15). This finding demonstrates female gender as an independent risk factor in this population, corroborating the results of previous studies. Nevertheless, not all findings of the present study were consistent with those reported by recent studies. We believe these discrepancies may be the consequence of the small number of patients included in the present study. A drawback of this study was that patients admitted to hospital due to falls were included, and as this was not a population-based study, we may have missed falls that did not lead to injuries necessitating hospital admission.

Conclusion

The risk of falls is particularly high in women aged >80 years and polypharmacy seems to be related to high energy falls. Healthcare providers should be aware of this fact to prevent high-energy falls leading to temporary or permanent injury in this population.

Ethical Statement

The Ethical Committee and Institutional Review Board of Koc University approved the study design with the number: 2015.011.IRB2.005

Conflicts of Interest

The authors declared no conflict of interest.

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List of abbreviations

HET, High-energy trauma
LET, Low-energy trauma
ACEI, Angiotensin converting enzyme inhibitors
ARB, Angiotensin receptor blockers

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How to cite?

Yardimci B, Ozkaya I, Bayrak Y. Female Gender and Polypharmacy Results in An Increased Risk of High-Energy Trauma Associated With Falls in Elderly People. Ulutas Med J. 2020;6(3):162-168

DOI: 10.5455/umj.20200610062305