

Epidemiological and Clinical Characteristics of Elderly Fall Patients Visit to the Emergency Department: A Comparison by Gender

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Purpose: This study was to analyze clinical and epidemiological characteristics of elderly patients who were admitted to the emergency department (ED) due to falls by separating male and female.

Methods: We retrospectively analyzed the fall patients aged 65 years or older from the data of the in-depth surveillance study of injured patients visit to the ED under the supervision of the Korea Centers for Disease Control and Prevention (KCDC) from 2011 to 2016 by separating male and female.

Results: A total of 361,588 elderly fall patients were analyzed and, among them, 14,429 (37.3%) were males and 24,208 (62.7%) were females. Male and female showed similar frequency of damage happening season. However, they showed falling accident mostly on winter. The time of injury occurrence is mostly from 12:00 to 18:00 with 4,949 (34.3%) male and 8,564 (35.4%) female. Most falls occurred in daily activities, accounting for 7,614 (52.8%) in males and 14,957 (61.8%) in females, respectively. Unintentional damage accounted for the most part and 7,395 (51.2%) of male and 15,343 (63.4%) of female were injured indoors. Head and neck were the most common site of injuring, with 8,392 (58.2%) in males and 7,851 (32.4%) in females. According to ED examination outcomes, most of the patients were discharged, while the majority of the hospitalized patients were admitted to the general patient room.

Conclusions: The elderly falls occurred mostly from 12:00 to 18:00, during winter and to elderly women. Also, they happened unintentionally indoors in everyday life, mostly. Proved clinical, epidemiological characteristics from this research will be used as useful indicator at validity research of development of prevent program of falling accident for elderly people.

Keywords: Elderly; Falls; Emergency; Injuries

INTRODUCTION

Fall refers to various situations that, unlike drops from a height difference, suddenly collapses or fail and being hurt regardless of their will. Although it can occur in all ages, the incidence rate in elderly people is especially high. The injury caused by trauma can leave a permanent sequela to the elderly [1]. Falling accident happens commonly in our life and it doesn't cause serious damage or injury. However, the fear, limitation of walking, losing confidence that elder people feel can cause lots of disability [2,3]. In Korea, there are many studies on patients who suffered falls and admitted in hospitals, while few studies on analyzing falling-related factors by separating male and female have been done [1,3]. This study was to analyze clinical and epidemiological characteristics of elderly patients who were admitted to the ED due to falls by separating male and female.

METHODS

Population

This study retrospectively analyzed data from in-depth surveillance study of patients with injured patients in the ED under the control of the KCDC. In-depth surveillance of patients with injured patients in the ED has been started since 2006, and 23 hospitals are currently participating in the surveillance. The data on emergency patients are collected and prospectively constructed to make data registry. This study analyzed data for 6 years from 2011 to 2016. The authors classified the patients who entered the fall in the common category and entered the fall as the deep category among 65 years and older by male and female. And the authors analyzed the data, we excluded insufficient or inaccurate data about the contents that the researcher want to analyse.

Data collection

Patients' gender and age, season, time of injury, means of visit, acting status, drinking status, result of examination, result of hospitalization, intentionality of injury, and place of occurrence were selected as variables. The elderly patients were classified as 65 years and older and

they were subdivided by 65-74, 75-84, and ≥ 85 years. The patient's condition was collected at the season and time of injury occurrence and the vital sign, consciousness status, damaged area at emergency room, and whether emergency operation was done were collected. When analyzing fall patients, we selected ground condition, type of ground and slope, jaw, lighting, brightness and concomitant disease among environmental factors. This study was approved by Chosun University Hospital Institutional Review Board (IRB No. 2018-08-026).

Statistical analysis

Statistical analysis was performed using SPSS version 20.0 (IBM Corp., New York, NY, USA). In order to test whether gender differences were significant, continuous variables were compared by Student's *t*-test. Categorical variables were compared by chi-squared test but Fisher's exact test was used when frequency value was below 5. *p*-value (importance level, α) of less than 0.05 was considered statistically significant.

RESULTS

A total of 1,538,260 patients were enrolled in the in-depth examination of patients with an injured patients in the ED from 2011 to 2016, of which 361,588 suffered falls in common items. Among the patients over 65 years, if the data recording of analysis requirements of this study is insufficient, we excluded insufficient or inaccurate data about the contents that the researcher want to analyse. Therefore, total 38,637 patients were analyzed in this study. Fourteen thousand four hundred twenty-nine (37.3%) of the males and 24,208 (62.7%) of the females were analyzed. According to the gender of the patients, the mean age was 75.3 ± 7.0 for males and 77.1 ± 7.3 for females. Among the women patients over 65 years, 75-84 accounted for the largest proportion (44.0%), and for men patients over 65 years, 65-74 accounted for the highest percentage (50.2%). When comparing season, winter is most frequent with 3,956 (27.4%) of males and 6,719 (27.8%) of females. The time of injury occurrence was mostly from 12:00 to 18:00 with 4,949 (34.3%) in males and 8,564 (35.4%) in females. In case of injured activities,

the majority of falls was in daily activities in both male and female. In the case of drinking status, male was 2,655 (18.4%), significantly more than female with 398 (1.6%). The intention of injuries was most common in unintentionality, and 14,383 (99.7%) of males and 24,159 (99.8%) of females were indoor condition when damage occurred

(Table 1).

Most patients used an ambulance when they visit ED. Major injured sites were head and neck in both male with 8,392 (58.2%) and female with 7,851 (32.4%). The next results were slightly different by the lower extremity with 2,187 (15.2%) in male and hip with 6,286 (26.0%) and

Table 1. Comparison of general characteristics of elderly fall patients

	Male (n=14,429)	Female (n=24,208)	p-value
Age (years)	75.3±7.0	77.1±7.3	<0.001
65-74	7,243 (50.2)	9,522 (39.3)	
75-84	5,568 (38.6)	10,649 (44.0)	
≥85	1,618 (11.2)	4,037 (16.7)	
Season of injury occurrence			0.031
Spring	3,421 (23.7)	5,642 (23.3)	
Summer	3,330 (23.1)	5,844 (24.1)	
Autumn	3,722 (25.8)	6,003 (24.8)	
Winter	3,956 (27.4)	6,719 (27.8)	
Time of injury occurrence (hours)			<0.001
0-6	1,858 (12.9)	3,226 (13.3)	
6-12	3,676 (25.5)	7,243 (29.9)	
12-18	4,949 (34.3)	8,564 (35.4)	
18-24	3,946 (27.3)	5,175 (21.4)	
Activity during injury occurrence			<0.001
Paid work	424 (2.9)	333 (1.4)	
Unpaid work	2,820 (19.5)	4,934 (20.4)	
Education	1 (0.0)	1 (0.0)	
Sports	366 (2.5)	320 (1.3)	
Leisure activity	2,791 (19.4)	3,038 (12.5)	
Daily activity	7,614 (52.8)	14,957 (61.8)	
Others	413 (2.9)	625 (2.6)	
Alcohol drinking	2,655 (18.4)	398 (1.6)	<0.001
Intentionality of fall			0.078
Unintentionality	14,383 (99.7)	24,159 (99.8)	
Suicide	3 (0.0)	0 (0.0)	
Violence	33 (0.2)	37 (0.2)	
Others	10 (0.1)	12 (0.0)	
Place of fall			<0.001
Indoor	7,395 (51.2)	15,343 (63.4)	
Outdoor	6,924 (48.0)	8,733 (36.1)	
Others	110 (0.8)	132 (0.5)	

Values are presented as number (%) or mean±standard deviation.

upper extremity with 4,305 (17.8%) in female. According to ED examination outcomes, most of the patients were discharged, while the majority of the hospitalized patients were admitted to the general patient room. Emergency surgery account for 5,039 (22.0%) of total treatment among female falls patients and 2,089 (16.4%) of total treatment among male falls patients. In the post-admission results, the number of patients who were discharged from the hospital was occupied a large proportion, but the patients who died were also examined by 244 (5.6%) in male and 226 (2.5%) in female (Table 2).

In the in-depth analysis data of six hospitals, only complete analysis data of this study were analyzed in patients with 'fall'. Among them, the data showed most fall in the normal ground condition and the concrete ground type was 1,466 (80.5%) of male and 2,336 (75.9%) of female. When environmental factors were analyzed, both male and female falls in place with no inclination, no jaws and place of illumination but those results have no significant value. In the simple comparison of the presence of concomitant disease, patients with no concomitant disease were more than those with concomitant disease (Table 3).

DISCUSSION

In Korea, the life expectancy of the elderly has increased and the elderly population has increased dramatically with the improvement of national health and medical services following the economic development and improvement of medical technology. In 2006, the elderly population aged 65 or older accounted for 9.5%, 14.3% in 2018, and in 2026 it is expected to exceed 20.8% and become an aged society [4]. In the statistics of death of patients, accidents account for 9.5% of all deaths in Korea, and fall accidents rank third after traffic accident and suicide [5]. Although there are many studies on the elderly trauma patients due to the increase of the elderly population, the proportion of trauma patients, especially fallen patients, is increasing in Korea [2,6]. In the United States, more than one-third of the elderly over 65 years experience falls at least once a year, and more than 50% of the elderly over 80 years are reported to have experienced falls [7,8]. In Korea and elsewhere, there are many analysis of elderly

fall patients. Fall experience rates of the elder are higher in female than in male and fractures due to falls occur twice as often in female while deaths due to falls occur more frequently in male than female [3,9]. In this study, the incidence of falls in women was higher than that in men, and no significant difference was found in the analysis factors. This is a result of the fact that the average life span of women is longer than that of men.

Of course, the reason for the elderly falls is due to the deterioration of the body function. Falls are caused by physical health problems such as diminished activity, side effects or interactions of drug use, alcohol consumption and behavioral problems, environmental factors [10,11]. In general, falls are caused by environmental factors such as slippery floor or uneven ground, and diminished adjusting ability due to weakness of the lower extremity or dysbasia because of aging, muscle weakness, orthostatic hypotension and dizziness [1,11].

In previous studies, there are many studies that have been reported that falls occur mostly in winter [1,6,7]. In this study, similar results were obtained in four seasons while slightly frequent in winter, and this suggests that the fall is due to slippery floors as the weather gets colder and seasonal fallout, which may lead to decreased concentration, leads to an increase in the incidence of falls.

Falling in the elderly is an important social problem that causes various serious injuries such as fracture, brain damage, and even death. Approximately 30% of elderly people aged 65 or older living in homes experience falls each year [8]. Twenty to thirty percent of the elderly suffering from falls experience severe injuries such as hip fracture and head injury, which limits their mobility and independence and the duration of treatment is prolonged, resulting in secondary complications and even death [6,12,13]. So, the physical and mental suffering of the patients and their family is serious and the economic loss is great. In the elderly, death from falls is 10 times of other age, hospitalization rate due to falls is close to eight times of other ages, and besides death due to falls, complication and inconvenience caused by long hospitalization result in severe noticeable decrease in quality of life [14,15]. The deaths from falls occurred in about 2% of patients aged 60 or older and the most common cause of death was cerebral hemorrhage (40.3%) followed by hip and thigh

Table 2. Comparisons of emergency department medical outcomes of elderly fall patients

	Male (n=14,429)	Female (n=24,208)	p-value
Blood pressure (mmHg)			<0.001
Systolic pressure	140.1±25.5	145.8±26.2	<0.001
Diastolic pressure	79.1±13.5	80.2±13.6	<0.001
Pulse rate (per minute)	80.6±14.2	80.3±13.3	0.037
Respiratory rate (per minute)	19.1±1.9	19.1±1.8	1.000
Body temperature (°C)	36.5±0.9	36.6±4.2	0.005
Consciousness at emergency room			<0.001
Alert	13,730 (95.2)	23,641 (97.6)	
Verbal response	452 (3.1)	402 (1.7)	
Pain	183 (1.3)	126 (0.5)	
Unresponsiveness	64 (0.4)	39 (0.2)	
Mode of arrival (%)			<0.001
Ambulance	8,013 (55.5)	12,276 (50.7)	
Private car	6,095 (42.2)	11,396 (47.1)	
On foot	267 (1.9)	458 (1.9)	
Others	54 (0.4)	78 (0.3)	
Major injury region			<0.001
Head and neck	8,392 (58.2)	7,851 (32.4)	
Thorax	795 (5.5)	1,470 (6.1)	
Abdomen	847 (5.9)	2,373 (9.8)	
Upper extremity	1,387 (9.6)	4,305 (17.8)	
Lower extremity	2,187 (15.2)	1,923 (7.9)	
Hip	821 (5.6)	6,286 (26.0)	
Disposition at emergency room			<0.001
Discharge	8,846 (61.3)	13,136 (54.2)	
DAMA	477 (3.3)	591 (2.4)	
Admission (ICU)	806 (5.6)	643 (2.7)	
Admission (general ward)	3,533 (24.5)	8,366 (34.6)	
Transfer	739 (5.1)	1,449 (6.0)	
Death	28 (0.2)	23 (0.1)	
Result of admission	4,339	9,009	<0.001
Discharge	3,406 (78.5)	7,633 (84.8)	
Self-discharge	48 (1.1)	76 (0.8)	
Transfer	641 (14.8)	1,074 (11.9)	
Death	244 (5.6)	226 (2.5)	
Emergency operation	2,089 (16.4)	5,039 (22.0)	<0.001

Values are presented as number (%) or mean±standard deviation.

DAMA: discharge against medical advice, ICU: intensive care unit.

Table 3. Comparisons of characteristics of elderly fall patients in the in-depth analysis items of 6 hospitals

	Male	Female	p-value
Ground condition	1,777	3,019	<0.001
Normal	1,519 (85.5)	2,421 (80.2)	
Water	194 (10.9)	458 (15.2)	
Ice	34 (1.9)	90 (3.0)	
Snow	25 (1.4)	43 (1.4)	
Others	5 (0.3)	7 (0.2)	
Ground type	1,820	3,079	<0.001
Concrete	1,466 (80.5)	2,336 (75.9)	
Soil	95 (5.2)	129 (4.2)	
Others	259 (14.3)	614 (19.9)	
Environmental factor			
Slope	2,172	3,595	0.102
None	1,822 (83.9)	3,073 (85.5)	
Exist	350 (16.1)	522 (14.5)	
Jaws	2,182	3,618	0.548
None	1,797 (82.4)	2,957 (81.7)	
Exist	385 (17.6)	661 (18.3)	
Illumination	2,210	3,683	0.444
None	491 (22.2)	787 (21.4)	
Exist	1,719 (77.8)	2,896 (78.6)	
Concomitant disease	1,817	3,132	<0.001
Yes	624 (34.3)	1,392 (44.4)	
No	1,193 (65.7)	1,740 (55.6)	

Values are presented as number (%).

damage (23.3%), back bone or pelvic injury (10.9%). There was more cerebral hemorrhage in elderly male, and hip fractures in elderly female [16,17]. Of the injured parts due to fall in the elderly over 65 years of age, the lower extremity damage has decreased since 2004 and the upper extremity, head and neck damage tend to increase [6]. In this study, head and neck injuries were the most common in male and female, followed by lower extremity injuries in male and hip injuries in female. Also, we are considering lots of mortality rates because there were lots of male's head damage on damaged parts and also there were lots of intensive care unit hospitalization patients.

Preventing is the top priority for elderly fall patients because the life of the patient can be threatened by the complications resulting from the deterioration of many

underlying diseases and the fast loss of muscle mass compared to young people. To prevent falls, it is important to know the preventable risk factors of falls and to eliminate them and it is necessary to educate people who are exposed to risk factors or in risk, and to investigate the possibility of falls [18,19]. Also, exercise programs should be provided according to age and gender by evaluating gait, balance, or muscle strength to prevent falls [20]. While it is impossible to prevent all injuries from falls, efforts to reduce the frequency and severity of falls in the risk group should be continued. Elderly fall and fall injuries will be reduced when information on where the fall occurs, the time, and the consequences of the damage are surveyed. Although there are many fall prevention programs for the elderly, applying it to all elderly people regardless of

method and gender may not be effective [21,22]. In the United States, elderly fall is an impairment which has significance on preventive activity so it collects effective fall prevention program and introduces an evidence-based specific community prevention program to all people. In order to present a more effective exercise program to the elderly, it is necessary to increase not only the physical strength factor but also ability to maintain the balance to the unexpected stimulus by training one's body core. And it is also important to know how to cope when a fall occurs [20,23].

The limitations of this study are retrospective studies that collected records of various hospitals based on the ED so it is possible that they are reported less than actual falls because they are data of fall patients among injured patients rather than fall only. And the authors could not provide a representative index for Korea because they excluded patients who showed a little more than the numerical value to the comparative analysis. Further continuing research is needed to develop specific preventive measures by sharing the results with the development and analysis of systematic, objective and prospective data collection methods for the elderly fall patients.

CONCLUSION

We examined the epidemiological features of the elderly fall patients who visited the ED of the several hospitals for 6 years. The elderly falls occurred mostly from 12:00 to 18:00, during winter and to elderly women. And it happened unintentionally indoors in everyday life, mostly. Proved clinical, epidemiological characteristics from this research will be used as useful indicator at validity research of development of prevent program of falling accident for elderly people.

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REFERENCES

1. Kim JM, Lee MS. Risk factors for falls in the elderly population in Korea: an analysis of the third Korea national health and nutrition examination survey data. *Korean J Health Edu Promot* 2007;24:22-39.
2. Jung HY, Kim SH, Lee SC, Kim S, Cho GC, Kim MJ, et al. Relating factors to severe injury from outdoor falls in older people. *Geriatr Gerontol Int* 2018;18:80-7.
3. Kim JM, Lee MS, Song HJ. An analysis of risk factors for falls in the elderly by gender. *Korean J Health Edu Promot* 2008;25:1-18.
4. Korea National Statistical Office. 2018 elderly people statistics [Internet]. Daejeon: KOrean Statistical Information Service (KOSIS) 2018 [cited 2018 Sep 28]. Available from: <http://kosis.kr/index/index.do>.
5. Korea National Statistical Office. 2017 cause of death statistics [Internet]. Daejeon: KOrean Statistical Information Service (KOSIS) 2017 [cited 2018 Sep 28]. Available from: <http://kosis.kr/index/index.do>.
6. Korea Centers for Disease Control and Prevention (KCDC). Epidemiologic characteristics of injured elderly inpatients in Korea: the results of the Korea National Hospital discharge survey, 2004-2013 [Internet]. Cheongju: Korea Centers for Disease Control and Prevention 2017 [cited 2018 Jun 21]. Available from: <http://www.cdc.go.kr>.
7. Bergen G, Stevens MR, Burns ER. Falls and fall injuries among adults aged ≥ 65 years - United States, 2014. *MMWR Morb Mortal Wkly Rep* 2016;65:993-8.
8. Centers for Disease Control and Prevention (CDC). Fatalities and injuries from falls among older adults--United States, 1993-2003 and 2001-2005. *MMWR Morb Mortal Wkly Rep* 2006;55:1221-4.
9. Duckham RL, Procter-Gray E, Hannan MT, Leveille SG, Lipsitz LA, Li W. Sex differences in circumstances and consequences of outdoor and indoor falls in older adults in the MOBILIZE Boston cohort study. *BMC Geriatr* 2013;13:133.
10. Kim SH. Risk factors for severe injury following indoor and outdoor falls in geriatric patients. *Arch Gerontol Geriatr* 2016;62:75-82.
11. Korea Centers for Disease Control and Prevention (KCDC). Epidemiological characteristics of injured inpatients in Korea, 2015 [Internet]. Cheongju: Korea Centers for Disease Control and Prevention 2015 [cited 2018 Jun 25]. Available from: <http://www.jtraumainj.org>

www.cdc.go.kr.

12. Stevens JA, Rudd RA. Circumstances and contributing causes of fall deaths among persons aged 65 and older: United States, 2010. *J Am Geriatr Soc* 2014;62:470-5.
13. Evans D, Pester J, Vera L, Jeanmonod D, Jeanmonod R. Elderly fall patients triaged to the trauma bay: age, injury patterns, and mortality risk. *Am J Emerg Med* 2015;33:1635-8.
14. Maresh J, Guse C, Layde P. National trends and coding patterns in fall-related mortality among the elderly in the United States. *J Public Health Policy* 2012;33:202-14.
15. Chippendale T, Gentile PA, James MK, Melnic G. Indoor and outdoor falls among older adult trauma patients: a comparison of patient characteristics, associated factors and outcomes. *Geriatr Gerontol Int* 2017;17:905-12.
16. Burns E, Kakara R. Deaths from falls among persons aged ≥65 years - United States, 2007-2016. *MMWR Morb Mortal Wkly Rep* 2018;67:509-14.
17. Korea Centers for Disease Control and Prevention (KCDC). Type of damage of fall injury 2010 [Internet]. Cheongju: Korea Centers for Disease Control and Prevention 2010 [cited 2018 Jun 21]. Available from: <http://www.cdc.go.kr>.
18. Tinetti ME. Clinical practice. Preventing falls in elderly persons. *N Engl J Med* 2003;348:42-9.
19. Dellinger A. Older adult falls: effective approaches to prevention. *Curr Trauma Rep* 2017;3:118-23.
20. Shier V, Trieu E, Ganz DA. Implementing exercise programs to prevent falls: systematic descriptive review. *Inj Epidemiol* 2016;3:16.
21. Taylor-Piliae RE, Peterson R, Mohler MJ. Clinical and community strategies to prevent falls and fall-related injuries among community-dwelling older adults. *Nurs Clin North Am* 2017;52:489-97.
22. Pfortmueller CA, Lindner G, Exadaktylos AK. Reducing fall risk in the elderly: risk factors and fall prevention, a systematic review. *Minerva Med.* 2014;105:275-81.
23. Guirguis-Blake JM, Michael YL, Perdue LA, Coppola EL, Beil TL. Interventions to prevent falls in older adults: updated evidence report and systematic review for the US Preventive Services Task Force. *JAMA* 2018;319:1705-16.