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Risk factors for severe injury following indoor and outdoor falls in geriatric patients

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ABSTRACT

Introduction: This study was performed to examine the characteristics of indoor and outdoor falls in older patients and the factors related to severe injury in the emergency department (ED).
Methods: In total, 26,515 patients fell indoors and 19,581 outdoors. The general and clinical characteristics were compared between the two groups and factors associated with severe injury following the falls were evaluated.
Results: Younger males fell more frequently outdoors than indoors. The common activities during outdoor falls were sports and leisure activities. Environmental hazards lead to more outdoor falls than indoor falls. Factors associated with severe injury after indoor falls were transport to the ED by public ambulance or from another medical facility rather than individual transportation, fall from stairs rather than fell over, and a head and neck injury rather than a lower extremity injury. Factors related to severe injury after outdoor falls were male sex, transport to the ED by public ambulance or from another medical facility or by another method rather than individual transportation, state employed, fall from stairs rather than fell over, head and neck or thorax or abdomen injury rather than a lower extremity injury.
Conclusion: Transport to the ED by public ambulance or from another medical facility, and head and neck injury were risks for severe injury following indoor and outdoor falls in elderly subjects. Efforts to identify the risk factors for severe injury and for falling itself are important to prevent and reduce fall injuries in elderly subjects.

1. Introduction

Fall-related injuries leading to hospital admission, long-term care facility admission, disability, and high mortality are a major concern in the geriatric population (American Geriatrics Society, 2001; Brauer, Coca-Perraillon, Cutler, & Rosen, 2009; Close et al., 2012; Hartholt, van Beeck et al., 2011; Hartholt et al., 2010; Panel on Prevention of Falls in Older Persons, 2011). Previous studies showed that fall-related mortality has increased among elderly people (Alamgir, Muazzam, & Nasrullah, 2012; Kannus, Parkkari, Niemi, & Palvanen, 2005). Many risk factors related to falling itself or to a serious fall, such as age, sex, race, education, marital status, health status, balance ability, physical ability, impaired vision, environment, medications, acute or chronic disease, and cognitive dysfunction have been studied (Almeida, Castro, Pedreira, Heymann, & Szejnfeld, 2011; American Geriatrics Society, 2001; Buchele et al., 2014; Chen et al., 2008; Chen, Peronto, & Edwards, 2012; Deandrea et al., 2013; Deandrea et al., 2010; Hu, Xia, Jiang, Zhou, & Li, 2015; Kelsey et al., 2010; Muraki et al., 2013; Panel on Prevention of Falls in Older Persons, 2011; Paul et al., 2013; Tinetti, 2003; Yamashita, Noe, & Bailer, 2012). Moreover, several studies have found that the characteristics of falling are differed between indoor and outdoor environments during fall (Boye et al., 2014; Duckham et al., 2013; Kelsey et al., 2010; Kelsey, Procter-Gray, Berry et al., 2012; Kelsey, Procter-Gray, Hannan et al., 2012; Li et al., 2006; Manty et al., 2009; Rapp, Becker, Cameron, Konig, & Buchele, 2012; Tan et al., 2015). Indoor falls are generally were common in inactive older people, whereas outdoor falls are more common in healthy older people (Duckham et al., 2013; Kelsey et al., 2010; Kelsey, Procter-Gray, Berry et al., 2012; Kelsey, Procter-Gray, Hannan et al., 2012; Li et al., 2006). Thus, strategies to prevent fall injuries in elderly people should be targeted more specifically based on specific characteristics or the environment.

The risk factors for fall injuries in elderly people and the definition for an injurious fall or a severe fall injury are not the same in previous studies, although the American Geriatric Society (AGS) and British Geriatric Society (BGS) have recommended a comprehensive risk factor assessment (American Geriatrics

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Table 1
General characteristics of indoor and outdoor fall injuries.

	Indoor (n = 26,515)	Outdoor (n = 19,581)	P
Average age, yrs	77.2 ± 7.4	74.4 ± 6.6	0.000
Age group, years old, (%)			0.000
65–74	10339 (39.0)	10822 (55.3)	
75–84	11501 (43.4)	7142 (38.3)	
≥85	4675 (17.6)	1617 (8.3)	
Sex, male (%)	8580 (32.4)	8490 (43.4)	0.000
Season of injury occurrence (%)			0.000
Spring (March–May)	6132 (23.1)	4112 (21.0)	
Summer(June–August)	6479 (24.4)	4251 (21.7)	
Autumn (September–November)	7013 (26.4)	4711 (24.1)	
Winter (December–February)	6891 (26.0)	6507 (33.2)	
Time of injury occurrence (%)			0.000
0–6 o'clock	4179 (15.8)	1116 (5.7)	
6–12 o'clock	7965 (30.0)	6300 (32.2)	
12–18 o'clock	7955 (30.0)	7936 (40.5)	
18–24 o'clock	6416 (24.2)	4229 (21.6)	
Location of injury occurrence (%)	n = 26449	n = 19404	0.000
Residential facility	21952 (83.0)	4101 (21.1)	
Medical facility	1308 (4.9)	114 (0.6)	
Sports facility	184 (0.7)	166 (0.9)	
Transportation area	521 (2.0)	11172 (57.6)	
Work place	83 (0.3)	573 (3.0)	
Public or commercial facility	2401 (9.1)	1209 (6.2)	
Other outdoor area	0 (0)	2069 (10.7)	
Activity during injury occurrence (%)	n = 26478	n = 19516	0.000
Paid work	223 (0.8)	681 (3.5)	
Unpaid work	3184 (12.0)	5176 (26.5)	
Sports or leisure activity	2462 (9.3)	5900 (30.2)	
Daily activity	20609 (77.8)	7759 (39.8)	
Others	190 (2.1)	54 (38.6)	
Alcohol ingestion, case n/total n (%)	1154/24416 (4.7)	2181/17919 (12.2)	0.000
Transportation to ED (%)	n = 26503	n = 19572	0.000
Public ambulance	10334 (39.0)	6566 (38.9)	
Individual transportation	11655 (44.0)	10377 (53.0)	
Other medical facility	4441 (16.8)	2556 (13.1)	
Others	73 (0.3)	73 (0.4)	
Education (%)	n = 4338	n = 2397	0.024
Uneducated or elementary school	2288 (52.7)	1171 (49.2)	
Junior high school	585 (13.5)	371 (15.6)	
High school	831 (19.2)	476 (20.0)	
≥ College	634 (14.6)	361 (15.2)	
Occupation (%)	n = 10227	n = 5723	0.000
Employed	534 (5.3)	764 (13.3)	
Unemployed	9684 (94.7)	4959 (86.7)	
Mechanism of fall (%)	n = 26515	n = 19581	0.000
Fall from stairs	2955 (11.1)	2685 (13.7)	
Slip down on same level	14889 (56.2)	9426 (48.1)	
Others including fall over	8671 (32.7)	7470 (38.1)	
Medical History (%)	n = 5519	n = 4144	
Hypertension	741 (13.4)	349 (8.4)	0.000
Diabetes mellitus	357 (6.5)	193 (4.7)	0.000
Hyperlipidemia	91 (1.6)	35 (0.8)	0.001
Cardiac disease	124 (2.2)	39 (0.9)	0.000
Stroke	214 (3.9)	78 (1.9)	0.000
Cancer	37 (0.7)	17 (0.4)	0.090
Lung disease	52 (0.9)	26 (0.6)	0.087
Alzheimer's disease	138 (2.5)	29 (0.7)	0.000
Psychiatric disease	41 (0.7)	20 (0.5)	0.110
Environment while occur fall			
Slope of surface (%)	n = 5548	n = 4173	0.000
Even	4912 (88.5)	3549 (85.0)	
Downward	636 (11.5)	622 (14.9)	
Elevated place of surface, case n/total n (%)	475/5551 (8.6)	425/4174 (10.2)	0.006
Condition of surface (%)	n = 5463	n = 4108	0.000
Water	743 (13.6)	157 (3.8)	
Snow	0 (0)	132 (32.2)	
Type of surface (%)	n = 2904	n = 1655	0.000
Concrete	1457 (50.2)	1431 (86.5)	
Earth	4 (0.1)	123 (7.4)	
Wood	848 (29.2)	50 (3.0)	
Others	595 (20.5)	51 (3.1)	

ED: emergency department; EMR-ISS: excess mortality ratio-adjusted injury severity score.