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Gender and Intentionality Disparities in the Epidemiology and Outcomes of Falls from Height in Korean Adults

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Purpose: This study investigated the characteristics of adult patients who had fallen from a height and presented to an emergency room (ER) according to gender and intentionality, with the goal of reducing the harm caused by these injuries.
Methods: A retrospective analysis was conducted of fall-from-height patients aged ≥19 years from the in-depth surveillance study of injured patients visiting ERs conducted under the supervision of the Korea Centers for Disease Control and Prevention from 2011 to 2016. Patterns were analyzed according to gender and intentionality.
Results: There were 29,838 men (68.5%) and 13,734 women (31.5%), with mean ages of 50.3±15.7 years and 57.2±19.9 years, respectively. The most common height of the fall was ≥1 m to 4 m in men (n=15,863; 53.2%) and <1 m in women (n=7,293; 53.1%). The most common location where the fall occurred was the workplace for men (n=10,500 male; 35.2%) and residential facilities for women (n=7,755; 56.5%). Most falls from height were unintentional (n=41,765; 97.1% vs. n=1,264; 2.9% for intentional falls). Suicide was the most frequent reason for intentional falls, and the age group of 19-30 years predominated in this category (n=377; 29.9%). For intentional falls, the most common interval before presentation to the ER was 0-6 hours (n=370; 29.3%) and the most common height was ≥4 m (n=872; 69.0%).
Conclusions: Among men, falls from height most often occurred from ≥1 m to 4 m, at the workplace, and during the course of paid work, whereas among women, they were most common from <1 m, in residential facilities, and during daily activities. Intentional falls most often occurred with the purpose of suicide, in the age group of 19-30 years, with an interval of 0-6 hours until treatment, from ≥4 m, and in residential facilities. Alcohol consumption was more common in intentional falls.

Keywords: Fall; Height; Gender; Intentional

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INTRODUCTION

As the number of high-rise buildings and the suicide rate have risen in modern society, the damages caused by falls from height from inadvertent or sudden accidents are increasing, including accidental falls from height from worksites on higher floors of buildings. Especially compared to other causes of injury, the mortality caused by falls from height is difficult to overlook, but survivors may also be severely disabled, resulting in a tremendous social and economic burden [1].

Since most falls from height do not have witnesses, it is often difficult to determine the conditions of the accident; in particular, the actual height of the fall and the cause of the fall are often unclear, especially in patients who present to an emergency room (ER) with a severe injury [2,3]. In comparison with disease, injuries may be of particular significance for public health, in that they can be prevented more easily by aggressive initial interventions [1]. Although several national preventive policies exist for traffic accidents, there is a lack of precise data on injuries caused by falls from height, and insufficient preventive measures have been implemented for such injuries. This study aimed to provide basic data that can be used to establish preventive policies for falls from height by analyzing the characteristics of adult patients who presented to an ER after experiencing a fall from height.

METHODS

Period and population

In total, 23 hospitals participated in an in-depth investigation of injury patients treated in the ER under the supervision of the Korea Centers for Disease Control and Prevention (KCDC). A data registry was established, and prospective data were collected on patients who presented to the ER. This study analyzed 6 years of data, from 2011 to 2016. The subjects of this study comprised adult patients (19 years or older) presenting to the ER for whom 'fall from height' was entered as a common item; furthermore, data from six hospitals that entered 'fall from height' as an in-depth item were analyzed to obtain additional insights into the specific circumstances of falls as they related to gender and intentionality.

Data collection

Adult patients (19 years or older) were classified by age group, season, time, height, level of education, mode of arrival, activity during which the injury occurred, whether they had been drinking, location of injury occurrence, insurance type, treatment outcome, and intentionality of the fall, all of which were analyzed as variables in this study.

Patients' status was assessed in terms of vital sign and consciousness, the Glasgow coma scale (GCS), the excess mortality ratio-adjusted injury severity score (EMR-ISS), and the ISS. Additionally, data on the major injury region, the disposition at the ER, the admission outcome, and whether an emergency operation was performed were collected and analyzed according to gender and intentionality using data from 23 hospitals. Environmental factors–including ground condition, type, slope, the presence of a jaw in the ground, and the presence of lighting–were analyzed based on the in-depth analysis data from six hospitals. This study was approved by the Chosun University Hospital Institutional Review Board (IRB no. 2019-08-013).

Statistical analysis

For the statistical analysis, SPSS version 20.0 (IBM Corp., Armonk, NY, USA) was used. To test whether differences according to gender were significant, continuous variables were compared using the independent *t*-test and categorical variables were compared using the chi-square test. However, if the frequency count was less than 5, the Fisher's exact test was conducted. For statistical significance, α was set to 0.05.

RESULTS

In total, 1,538,260 patients were registered in the in-depth investigation of injury patients presenting to an ER between 2011 and 2016, of whom 43,572 (2.8%) were adults (19 years or older) with 'fall from height' listed as the cause of injury in the common items. These patients were analyzed. There was a higher proportion of men

Table 1. General characteristics of patients who experienced a fall from height

	Male (n=29,838)	Female (n=13,734)	*p*-value
Age (years)	50.3±15.7	57.2±19.9	<0.001
19–30	3,679 (12.3)	1,791 (13.0)	
31–40	4,166 (14.0)	1,344 (9.8)	
41–50	6,331 (21.2)	1,651 (12.0)	
51–60	7,807 (26.2)	2,388 (17.4)	
61–70	4,504 (15.1)	2,083 (15.2)	
71–80	2,427 (8.1)	2,622 (19.1)	
≥81	924 (3.1)	1,855 (13.5)	
Season of injury occurrence			0.124
Spring (March–May)	7,308 (24.5)	3,453 (25.1)	
Summer (June–August)	8,086 (27.1)	3,596 (26.2)	
Autumn (September–November)	8,330 (27.9)	3,805 (27.7)	
Winter (December–February)	6,114 (20.5)	2,880 (21.0)	
Time of injury occurrence			<0.001
0:00–6:00	3,866 (13.0)	3,079 (22.4)	
6:00–12:00	8,873 (29.7)	3,609 (26.3)	
12:00–18:00	12,025 (40.3)	4,096 (29.8)	
18:00–24:00	5,074 (17.0)	2,950 (21.5)	
Height of fall			<0.001
<1 m	6,349 (21.3)	7,293 (53.1)	
≥1 m to 4 m	15,863 (53.2)	3,704 (27.0)	
≥4 m	4,649 (15.6)	1,090 (7.9)	
Others	2,977 (9.9)	1,647 (12.0)	
Education	5,146	1,793	<0.001
No formal education or elementary school	785 (15.3)	687 (38.3)	
Junior high school	829 (16.1)	259 (14.4)	
High school	2,300 (44.7)	528 (29.5)	
≥College	1,232 (23.9)	319 (17.8)	
Mode of arrival			<0.001
Ambulance	17,954 (60.2)	7,246 (52.8)	
Private car	11,019 (36.9)	5,983 (43.6)	
On foot	807 (2.7)	472 (3.4)	
Others	58 (0.2)	33 (0.2)	
Activity during injury occurrence			<0.001
Paid work	13,600 (45.6)	1,246 (9.1)	
Unpaid work	3,017 (10.1)	2,018 (14.7)	
Education	54 (0.2)	35 (0.3)	
Sports or leisure activity	5,099 (17.1)	2,520 (18.4)	
Daily activities	6,211 (20.8)	6,573 (47.8)	
Others	1,857 (6.2)	1,342 (9.7)	

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Table 1. Continued

	Male (n=29,838)	Female (n=13,734)	*p*-value
Alcohol consumption at the time of injury	2,968 (0.1)	1,028 (0.7)	<0.001
Location of injury occurrence			<0.001
Residential facility	7,211 (24.2)	7,755 (56.5)	
Medical facility	476 (1.6)	632 (4.6)	
Sports facility	1,102 (3.7)	472 (3.4)	
Transportation area	2,866 (9.6)	1,156 (8.4)	
Work place	10,500 (35.2)	798 (5.8)	
Public or commercial facility	3,329 (11.1)	1,423 (10.4)	
Other outdoor area	4,354 (14.6)	1,498 (10.9)	
Type of insurance			<0.001
Health insurance	24,556 (82.3)	12,261 (89.2)	
Personal insurance	12 (0.1)	1 (0.1)	
Automobile insurance	148 (0.5)	43 (0.3)	
Industrial accident	777 (2.6)	35 (0.3)	
Medical aid	1,020 (3.4)	759 (5.5)	
Others	3,325 (11.1)	635 (4.6)	
Intentionality of fall			<0.001
Unintentional	28,862 (96.7)	12,903 (94.0)	
Intentional	651 (2.2)	613 (4.5)	0.122
Suicide	575 (88.3)	561 (91.5)	
Violence	55 (8.4)	41 (7.3)	
Others	21 (3.3)	11 (1.8)	
Unknown	325 (1.1)	218 (1.5)	

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

(n=29,838; 68.5%) than women (n=13,734; 31.5%). The mean age of the men was 50.3±15.7 years, while that of the women was 57.2±19.9 years. The most common time of injury occurrence was between 12:00 and 18:00 (i.e., during the workday), which accounted for 12,025 (40.3%) falls in men and 4,096 (29.8%) in women. The most widespread height of the fall was ≥1 m to 4 m for men, whereas it was <1 m for women (n=15,863; 53.2% and n=7,293; 53.1%, respectively). Nonetheless, the exact height was unclear in many cases. Paid work was the most frequent activity at the time of injury in men, whereas it was daily activities in women (n=13,600; 45.6% and n=6,573; 47.8%, respectively). Alcohol drinking at the time of injury was found be slightly more common in women (n=2,968; 0.1% in men and n=1,028; 0.7% in women). The most common location of falls was the workplace for men (n=10,500; 35.2%), whereas it was residential facilities for women (n=7,755; 56.5%). Unintentional falls were more common than intentional falls (n=41,765; 97.1% vs. n=1,264; 2.9% for intentional falls), and the most common purpose of intentional falls was suicide in both men and women (n=575; 88.3% and n=561; 91.5%, respectively) (Table 1).

In terms of the initial status of patients in the ER, the GCS scores were similar between the genders, whereas the mean EMR-ISS was 17.9±16.7 in men and 14.2±12.7 in women and the mean ISS was 8.0±8.4 in men and 6.5±8.0 in women. When unknown sites of injury were excluded, the most common major injury site was the head and neck (n=10,538; 37.4% in men and n=4,778; 36.6% in

Table 2. Clinical characteristics of patients who experienced a fall from height

	Male (n=29,838)	Female (n=13,734)	*p*-value
Blood pressure (mmHg)			
Systolic pressure	130.6±31.6	130.2±36.2	0.242
Diastolic pressure	78.0±19.9	75.2±22.7	<0.001
Pulse rate (beats/minutes)	79.8±19.1	79.2±23.4	0.005
Respiratory rate (breaths/minutes)	18.9±4.3	18.7±11.3	0.008
Body temperature (℃)	35.9±4.8	35.8±5.0	0.046
Consciousness at emergency room	24,743	11,590	<0.001
Alert	22,462 (90.8)	10,667 (92.0)	
Verbal response	890 (3.6)	367 (3.2)	
Pain	633 (2.5)	209 (1.8)	
Unresponsiveness	758 (3.1)	347 (3.0)	
Glasgow coma scale	17,862	8,423	<0.001
	14.3±2.6	14.4±2.4	
EMR-ISS	29,513	13,559	<0.001
	17.9±16.7	14.2±12.7	
Injury severity scale	4,792	1,903	<0.001
	8.0±8.4	6.5±8.0	
Major injury region	28,217	13,062	<0.001
Head and neck	10,538 (37.4)	4,778 (36.6)	
Thorax	2,860 (10.2)	856 (6.6)	
Abdomen	2,053 (7.3)	699 (5.4)	
Spine	3,608 (12.7)	1,588 (12.2)	
Upper extremity	3,613 (12.8)	2,023 (15.4)	
Lower extremity	5,143 (18.2)	2,803 (21.4)	
Hip	402 (1.4)	315 (2.4)	
Disposition at emergency room	29,802	13,722	<0.001
Discharge	12,340 (41.4)	7,476 (54.4)	
DAMA	652 (2.2)	282 (2.1)	
Admission (ICU)	3,816 (12.8)	824 (6.0)	
Admission (general ward)	9,384 (31.5)	3,708 (27.0)	
Transfer	2,806 (9.4)	1,000 (7.3)	
Death	804 (2.7)	432 (3.2)	
Outcome of admission	13,064	4,490	<0.001
Discharge	9,636 (73.7)	3,551 (79.1)	
Self-discharge	153 (1.2)	51 (1.1)	
Transfer	2,778 (21.3)	737 (16.4)	
Death	497 (3.8)	151 (3.4)	
Emergency operation	4,011 (13.4)	1,447 (10.5)	<0.001

Values are presented as mean±standard deviation or number (%).
EMR-ISS: excess mortality ratio-adjusted injury severity score, DAMA: discharge against medical advice, ICU: intensive care unit.

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women). In total, 804 (2.7%) men and 432 (3.2%) women expired. Discharge was the most common outcome after hospitalization, although emergency surgery was performed in 4,011 (13.4%) men and 1,447 (10.5%) women (Table 2).

An analysis of the in-depth data from six hospitals showed that the most common condition of the ground was normal for both genders and that concrete was the most common type of ground (n=4,726; 78.6% in men and n=1,966; 75.8% in women). In terms of environmental factors, conditions with lighting but no slope or jaws were most common, but no statistically significant patterns were found (Table 3).

Unintentional falls accounted for the vast majority of cases (n=41,765; 97.1% vs. n=1,264; 2.9% for intentional falls). In the cases of unintentional falls, 9.928 (23.8%) patients were between 51 and 60 years of age, and most common time of fall was 12:00–18:00, during which time 15,666 (37.5%) falls occurred. The most common height of the fall was ≤1 m to 4 m (n=19,246; 46.1%). Paid work was the most common activity at the time of the fall (n=14,835; 35.5%), and residential facilities were the most common location of falls from height (n=13,704; 32.8%). In the cases of intentional falls, 377 (29.9%) patients were between 19 and 30 years of age, 377 (29.9%) of the falls occurred in the summer, and 370 (29.3%) occurred between 12:00 and 18:00. The most common height of intentional falls was ≥4 m (n=872; 69.0%) and the most common location was residential facilities (n=939; 74.3%). Alcohol consumption was involved in 3,603 (8.6%) unintentional falls, but in 302 (23.9%) intentional falls, indicating that alcohol consumption was more frequent in cases of intentional falls (Table 4).

Patients with intentional falls had more adverse findings in terms of vital signs, the GCS, the EMR-ISS, and the ISS than patients who had experienced unintentional falls. Discharge was the most common treatment outcome in the ER for unintentional falls, while death was most common among cases of intentional falls (n=19,652; 47.1% and n=503; 39.9%, respectively). The most common outcome after admission (among the 17,374 patients who were admitted) was discharge (n=12,793; 75.8% for cases of unintentional falls and n=296; 60.3% for cases of in intentional falls), but many patients were transferred to another hospital (Table 5).

Table 3. Characteristics of falls from height based on the in-depth analysis items gathered by six hospitals

	Male (n=6,017)	Female (n=2,594)	*p*-value
Ground conditions			0.155
Normal	5,819 (96.7)	2,531 (97.6)	
Water	125 (2.1)	45 (1.7)	
Ice	10 (0.2)	1 (0.1)	
Snow	14 (0.2)	3 (0.1)	
Others	49 (0.8)	14 (0.5)	
Ground type			<0.001
Concrete	4,726 (78.6)	1,966 (75.8)	
Soil	869 (14.5)	277 (10.7)	
Others	416 (6.9)	350 (13.5)	
Environmental factors			
Slope			<0.001
None	4,559 (75.8)	2,172 (83.7)	
Present	1,458 (24.2)	422 (16.3)	
Hole			<0.001
None	5,445 (90.5)	2,440 (94.1)	
Present	572 (9.5)	154 (5.9)	
Lighting			0.029
None	1,472 (24.5)	578 (22.3)	
Present	4,545 (75.5)	2,016 (77.7)	

Values are presented as number (%).

DISCUSSION

According to the 2016 cause-of-death statistics published by the National Statistical Office, 28,218 (10.0%) of 280,827 total deaths were caused by external factors other than disease, and 2,603 (0.93%) deaths were caused by fall from height [4]. In 2017, 9.5% (27,154) of the 285,534 total deaths were caused by external factors other than disease. The proportion of deaths caused by external factors per 100,000 population was 530 (0.53%), which decreased by 4.0% from the previous year. The most common cause of death by an external factor was suicide (24.3%), followed by transportation accidents (9.8%) and falls

Table 4. Comparison of demographic characteristics between patients who experienced intentional and unintentional falls

	Unintentional (n=41,765)	Intentional (n=1,264)	*p*-value
Age (years)	52.9±17.3	43.8±18.4	<0.001
19–30	4,958 (11.9)	377 (29.9)	
31–40	5,183 (12.4)	244 (19.3)	
41–50	7,658 (18.3)	225 (17.8)	
51–60	9,928 (23.8)	175 (13.8)	
61–70	6,439 (15.4)	100 (7.9)	
71–80	4,888 (11.7)	102 (8.1)	
≥81	2,711 (6.5)	41 (3.2)	
Season of injury occurrence			0.031
Spring (March–May)	10,314 (24.7)	314 (24.8)	
Summer (June–August)	11,137 (26.6)	377 (29.9)	
Autumn (September–November)	11,677 (28.0)	314 (24.8)	
Winter (December–February)	8,637 (20.7)	259 (20.5)	
Time of injury occurrence			<0.001
0:00–6:00	6,425 (15.4)	370 (29.3)	
6:00–12:00	12,058 (28.9)	285 (22.5)	
12:00–18:00	15,666 (37.5)	309 (24.5)	
18:00–24:00	7,616 (18.2)	300 (23.7)	
Height of fall			<0.001
<1 m	13,575 (32.5)	53 (4.2)	
≥1 m to 4 m	19,246 (46.1)	214 (16.9)	
≥4 m	4,586 (11.0)	872 (69.0)	
Others	4,358 (10.4)	125 (9.9)	
Education	6,645	232	<0.001
No formal education or elementary school	1,444 (21.7)	21 (9.1)	
Junior high school	1,061 (16.0)	22 (9.5)	
High school	2,672 (40.2)	125 (53.8)	
≥College	1,468 (22.1)	64 (27.6)	
Mode of arrival			<0.001
Ambulance	23,515 (56.3)	1,178 (93.3)	
Private car	16,904 (40.5)	70 (5.5)	
On foot	1,265 (3.0)	8 (0.6)	
Others	81 (0.2)	8 (0.6)	
Activity during injury occurrence			<0.001
Paid work	14,835 (35.5)	0 (0.0)	
Unpaid work	5,020 (12.0)	1 (0.1)	
Education	89 (0.2)	0 (0.0)	
Sports or leisure activity	7,590 (18.2)	3 (0.2)	
Daily activity	12,625 (30.2)	38 (3.0)	
Others	1,606 (3.9)	1,222 (96.7)	

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Table 4. Continued

	Unintentional (n=41,765)	Intentional (n=1,264)	*p*-value
Alcohol consumption at the time of injury	3,603 (8.6)	302 (23.9)	<0.001
Location of injury occurrence			<0.001
Residential facility	13,704 (32.8)	939 (74.3)	
Medical facility	1,053 (2.5)	32 (2.5)	
Sports facility	1,573 (3.7)	0 (0.0)	
Transportation area	3,869 (9.3)	104 (8.2)	
Work place	11,274 (27.0)	12 (1.0)	
Public or commercial facility	4,583 (11.0)	107 (8.5)	
Other outdoor area	5,709 (13.7)	70 (5.5)	
Type of insurance			<0.001
Health insurance	35,452 (84.8)	940 (74.4)	
Personal insurance	9 (0.1)	4 (0.3)	
Automobile insurance	187 (0.5)	4 (0.3)	
Industrial accident	812 (1.9)	0 (0.0)	
Medical aid	1,629 (3.9)	107 (8.5)	
Others	3,676 (8.8)	209 (16.5)	

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

from height (5.2%). The mortality rates from intentional self-injury (-5.0%) and transportation accidents (-2.6%) in 2017 decreased compared to the previous year, while the mortality rates from fire accidents (13.5%) and falls from height (2.4%) increased [5].

According to the Eighth National Injury Fact Book 2015-2016, which was published in 2018, in a weighted analysis of 28,356 cases surveyed in the 2015 data, 396,237 (36.0%) of 1,100,952 injury cases were caused by falls from height. The in-depth investigation of injury patients presenting to an ER similarly reported that 86,723 (30.6%) of 283,422 cases of injuries were caused by falls from height, suggesting that the proportion of fall injury patients is on the rise and accounts for a large proportion of all injury patients [6]. In 2012, fall accidents ranked seventh among external factors other than disease in terms of disability-adjusted life years, whereas traffic accidents ranked ninth and suicide ranked 10th [7]. It has been reported that injuries caused by falls from height account for the second largest proportion of multiple trauma patients who present to the ER, after traffic accidents. Bhoi et al. [8] likewise reported that 57.16% of traumatic cardiac arrest patients were injured in traffic accidents, while 18.52% were injured by falls from height; furthermore, among traumatic deaths, falls from height were one of the most common causes, after traffic accidents, suggesting that patients who present to the ER due to falls from height account for a large proportion of trauma patients with severe injuries [3,9].

Causes of falls from height include environmental factors such as the workplace and indoor environment, equipment-related factors such as risk prevention devices and parapet installation, and personal factors such as age and health status [10]. Falls from height are one of the most common causes of blunt injury in the ER. In infants, accidents are the most common cause of falls from height, while suicides and accidents are the most common causes in adults. Among men, falls from height in the workplace often occur due to workers' carelessness, and high rates of intentional falls from height are being reported as the suicide rate increases both in Korea and across the world [1,11,12]. In this study, falls from height among men were most prevalent at ages younger than 70, and falls often occurred in the workplace. In addition, many patients

Table 5. Comparison of clinical characteristics between patients who experienced intentional and unintentional falls

	Unintentional (n=42,164)	Intentional (n=1,311)	*p*-value
Blood pressure (mmHg)			
Systolic pressure	132.9±28.6	72.7±68.3	<0.001
Diastolic pressure	78.5±17.7	43.8±50.9	<0.001
Pulse rate (beats/minutes)	80.3±17.3	64.6±59.5	<0.001
Respiratory rate (breaths/minutes)	19.1±3.8	14.4±37.1	<0.001
Body temperature (℃)	36.2±3.6	29.1±14.4	<0.001
Consciousness at emergency room	34,892	1,011	<0.001
Alert	32,526 (93.2)	460 (45.5)	
Verbal response	1,132 (3.2)	87 (8.6)	
Pain	721 (2.1)	71 (7.0)	
Unresponsiveness	513 (1.5)	393 (38.9)	
Glasgow coma scale	25,193	797	<0.001
	14.6±2.0	9.1±6.0	
EMR-ISS	41,273	1,259	<0.001
	16.3±15.2	26.9±19.8	
Injury severity scale	6,484	150	<0.001
	7.2±7.6	19.0±17.1	
Major injury region	39,742	1,042	<0.001
Head and neck	14,786 (37.2)	329 (31.6)	
Thorax	3,428 (8.6)	203 (19.5)	
Abdomen	2,546 (6.4)	158 (15.2)	
Spine	5,015 (12.6)	140 (13.4)	
Upper extremity	5,566 (14.0)	49 (4.7)	
Lower extremity	7,783 (19.5)	133 (12.8)	
Hip	681 (1.7)	30 (2.8)	
Disposition at emergency room	41,760	1,262	<0.001
Discharge	19,652 (47.1)	119 (9.4)	
DAMA	906 (2.2)	56 (4.4)	
Admission (ICU)	4,203 (10.1)	309 (24.5)	
Admission (general ward)	12,844 (30.7)	192 (15.2)	
Transfer	3,679 (8.8)	83 (6.6)	
Death	476 (1.1)	503 (39.9)	
Outcome of admission	16,883	491	<0.001
Discharge	12,793 (75.8)	296 (60.3)	
Self-discharge	182 (1.1)	20 (4.1)	
Transfer	3,331 (19.7)	133 (27.1)	
Death	577 (3.4)	42 (8.5)	
Emergency operation	5,245 (12.4)	155 (11.8)	<0.001

Values are presented as mean±standard deviation or number (%).
EMR-ISS: excess mortality ratio-adjusted injury severity score, DAMA: discharge against medical advice, ICU: intensive care unit.

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were engaging in paid work at the time of the accident. In contrast, among women, falls occurred most often in patients older than 70, and most frequently occurred during activities of daily life. This can be explained in terms of gender-specific differences in environments that reflect gender-specific occupational characteristics; in particular, men more frequently work on higher floors, such as at construction sites. While many cases of non-intentional falls were reported, suicide accounted for a high proportion of intentional falls (89.9%), and falls from heights of 4 m or more were common in the younger population (19-30 years), suggesting that more measures are needed to reduce the suicide rate, especially in the younger population, as well as to comply with safety rules in the workplace.

Injuries from falls from height often manifest as a blunt injury at the affected site that comes into contact with the surface after the fall, and is therefore affected by the vertical deceleration injury. Head, spine, and limb injuries are frequently reported in falls from height. The severity of injury can be predicted from the height of the fall, and a close examination of the injury site is necessary [3,13.14]. Since sufficient evidence does not exist regarding the correlation between the height of a fall and the injury site, a general examination is usually conducted of all painful sites, which can often cause delays in the confirmation of problems.

Atanasijević et al. [15] analyzed the injury site and operations in patients who had experienced a fall injury and reported that the most common clinical features of the patients were limb injuries, followed by spine and head injuries, and that most of the operations were performed on limb injuries. Kingma and Ten Duis [16] reported specific injury sites according to patients' age, and found that lower limb injuries were most common among patients aged 15-44 years. Furthermore, the injury site varied according to the height of fall and intentionality. Intentional falls had a tendency to result in high mortality and a high incidence of head and neck damage [1,17]. In this study, the most common injury sites were the head and neck, followed by the limbs. In patients who experienced intentional falls, the neck, chest, and abdomen were the most common injury sites. The height of fall also tended to be higher in intentional falls, resulting in more deaths.

The height of the fall, the conditions of the ground during the collision, the collision site, and the age of the patient have significant effects on the severity of injury and the survival rate. Unlike other causes of accidents, patients who are injured by a fall are often found after the accident, making it difficult to establish their exact status at the time of the fall. In addition, since patients' chief complaint often focuses on blunt injuries caused by the direct collision at the time of contact with the surface, clinicians should carefully consider the possibility of damage to internal organs caused by acceleration and deceleration that is not superficially evident [18]. According to the US Consumer Product Safety Commission, falling on a floor with shock-absorbing properties is less likely to cause brain damage than falling on a hard floor, suggesting that ER physicians should consider the characteristics of the surface in cases of falls from height [19]. Furthermore, fractures readily occur in old age due to decreased physical abilities, and the risk of death due to fractures may cause age to influence mortality after falls from height. Alizo et al. [20] suggested that the height of the fall can be a useful factor for predicting the severity of the injury and the prognosis of the patient. Ong et al. [21] reported that as the height of the fall increased, the risk of hypotension and neurological damage increased, and the duration of hospital stay, frequency of operations, and mortality rate increased in proportion to the height of the fall. According to Sterling et al. [22], falls from height account for about half of elderly trauma patients, and even in cases with the same height of the fall, the mortality and ISS were found to be higher in older patients, suggesting that it is necessary to carefully examine the intentionality of a fall, the nature of the surface, the site of collision, and the age of the patient.

This study may have some limitations in that there may have been slight deviations across the hospitals due to the retrospective analysis of the medical records collected by the KCDC. In addition, all of the data were based on statements made by patients and witnesses, and the number of participants may have differed for non-mandatory items. Further studies should include detailed classifications of the residential environment, injury site, and ground materials. Korea has recently made several efforts to reduce the mortality rate of severe trauma patients to

the level of developed countries, including developments in institutional strategies and improvements in intensive care for trauma patients. However, preventive efforts should be made to reduce the occurrence of severe trauma. and a program should be developed and implemented to prevent injuries caused by falls from height from higher stories, which account for a large proportion of severe trauma patients and have a high mortality rate.

CONCLUSION

In this study, it was found that in men who fell from a height, the most common height was ≥1 m to 4 m, and that most falls occurred during paid work. In contrast, among women, falls from a height of <1 m were most common, and most falls occurred daily activities in residential facilities. The most common reason for intentional falls was suicide, and intentional falls were most common among younger adults aged 19-30. Furthermore, intentional falls were more likely to be accompanied by alcohol consumption, and most commonly occurred between 12 AM and 6 AM. For intentional falls, the most common location was residential facilities, with a height of ≥4 m, and the most common outcome of treatment in the ER was death.

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