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Consequences of Inpatient Falls in Acute Care: A Retrospective Register Study

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Aims: The objectives of this study were (1) to explore the consequences of falls; (2) to find out time and place of the fall events; and (3) to explore the impact of falls on the length of hospital stays in adults' inpatient acute care.

Background: In hospitals, falls are the most common accidents that can occur to a patient during hospitalization. Injuries resulting from serious falls can cause lifelong harm to the patient due to loss of well-being and independence.

Design: A retrospective, cross-sectional, register study based on the data from electronic patient records was conducted.

Methods: The data included 114,951 inpatients, of which 743 had fallen. Data was collected between January 2014 and December 2016.

Results: One-third of falls caused injury. Most injuries were to the head area, and the most common injuries were pain or confusion. The falls usually occurred at the beginning of the treatment in the patient's room or on the way to the toilet. Falls in the hospital increased the length of stay.

Conclusions: A large proportion of falls occur at the beginning of treatment, so it is important to start fall prevention measures as soon as the patient arrives at the hospital.

Key Words: fall, injury fall, quality of care, nursing, acute care

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Patient safety is a global issue, and 1 in 10 patients will suffer an adverse event during hospitalization. The proportion of adverse events that are falls varies from 2% to 40%.[1] Fall rates in acute care vary from 1 to 9 per 1000 patient days (PDs) (injury fall rates 0.4–2.0/1000 PDs), depending on the types of units and patients' characteristics and diseases.[2–8] One-third of patients fall more than once during hospitalization and about 25 to 50% of fallers suffer injuries.[5,6] Falls in acute hospital settings cause injuries, increase mortality, and prolong hospital stays.[9]

The World Health Organization has defined a fall to be an unexpected event in which a patient unintentionally comes to rest on the floor or against some other lower level with or without injury. Falls are described as slips, trips, being lowered, loss of balance, and legs giving out.[10] The studies vary as to the most typical consequences of falls. According to some studies, falls most often result in an open wound.[5,8] Similarly, hematoma and pain have also been identified as common results of a fall.[11]

The timing of falls has also been investigated to determine whether the falls are related to the day of the week or the time of day. The day of falls varies in different studies.[7,8,12–15] The time of falls may vary depending on patient diagnosis group or on different symptoms like cognitive impairment or nocturia.[14] In Zhao et al's[7] study, shift change periods were associated with increased inpatient falls.

There are previous studies on the subject, but the results vary. Thus, there is a need to explore the consequences of falling among patients in acute care. The objectives of the study were 1) to explore the consequences of falls in acute care, 2) to determine the time and place of fall events, and 3) to explore the impact of falls on the length of hospital stay in adult inpatient acute care.The information can be used to design clinical guidelines and to implement preventive measures aimed at minimizing the number of falls in the hospital.

METHODS

A retrospective, cross-sectional, register study was conducted in Helsinki University Hospital (HUS). The HUS is a large hospital system with 23 hospitals, providing specialized medical care for approximately 1.7 million inhabitants in southern Finland. In all, the hospital system has nearly 3,000 beds.

Clinical data included adult patients (≥18 years) treated in the inpatient units from January 1, 2014, to December 31, 2016. All patients under 18 y of age and those treated in pediatric units were excluded from the study, as well as outpatients, obstetric patients, and day surgery patients.

The data was obtained retrospectively from the electronic patient records (EPRs) consisting of documentation by health care personnel. The data consisted of patients' background information, treatment information, reason for admission, medical specialty, diagnoses, falls [documented by nurses in a structured format indicating injury or no injury fall and description of the fall], surgical operations, length of hospital stay [LOS], discharge information [date and service], and death. In addition, the data included a description of the fall event in daily progress notes and discharge summaries recorded by physicians.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and the ethical principles of the Finnish humanities.[16] The study was approved by the University Hospital Ethical Review Board in 2016 (80/13/03/00/2016) before the study was initiated, and study permission was given by the hospital authorities (HUS/53/2016 and HUS/466/2019). Confidentiality of the participants was maintained because no identifying information was recorded since personal identification was removed from the data before the analysis.

Data Analysis

The personal identity code was replaced with a unique record number to anonymize the patients. Fallen patients were identified in the data by official documentation of a fall event that nurses

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recorded in the EPRs. The documentation indicated whether the fall resulted in injury or not. Based on the description recorded by the nurse, fall events were classified for the level of injury: none (no injuries resulting from the fall), minor (resulted in application of, for example, a dressing, ice, cleaning of a wound, medication), moderate (for example, fall resulted in suturing, joint strain), major (for example, fall resulted in surgery, required neurological consultation, or resulted in internal injury), and death (i.e., death as a result of injuries from the fall).[17] In addition, falls were recorded by the type and location of injury, scene of fall, mechanism of the fall and the time of the fall.

Frequencies, percentages, and means were used to describe the participants' background variables. Cross-tabulation, a χ^2, Fisher's exact test, and Mann-Whitney *U* test were used to analyze the association between falls, injury falls, and variables. Fall rates were expressed as the number of falls per 1,000 PDs. The number of PDs was calculated using the actual treatment length (hours) in the EPR data. In the rate analysis, all fall events were used (n = 859).

For the length of stay analysis, a control group score matching was determined for those who fell. Propensity score matching was conducted to minimize the effect and control for potential confounding factors. The total group of fallers matched at a 1:1 (743:743) ratio by propensity score were enlisted to take part in the study based on age, gender, mode of arrival, reason for admission, and medical specialty. The Mann-Whitney *U* test was used for analysis of LOS.

The tests were conducted using IBM SPSS Statistics for Windows, Version 25.0 (Armonk, NY: IBM Corp) and Microsoft Excel.

RESULTS

The data contained 114,951 patients, of which 743 had fallen (0.6%). The mean age of patients was 59 (range from 18 to 104, SD 18.0) years, half were female, and the average LOS was in somatic 3.4 (±SD 5.8) and psychiatry 37.0 (±SD 57.1) days.

There were 743 fallers with 859 falls in the data. Table 1 reports demographics and of fallers with and without injury. Statistical significance was found between injury fallers and no-injury fallers between all demographics and ($P < 0.05$). Of the fallers, 12% fell 2 or more times during hospitalization. In psychiatry, there were statistically significantly more multifallers (23%) than in somatic care (11%, $P = 0.001$).

The mean LOS of the fallers was 50.0 days (SD ±49) in psychiatry and 7.9 days (SD ±7.6) in somatic care. In somatic units, 23% of falls occurred on the day of admission and 24% on the second day of care (median of 3.0 days and mean 5.4, SD ±6.7). Correspondingly, in psychiatric units, 12.7% of falls occurred on the day of admission and 31.8% of falls occurred during the first week of care (median of 15.8 days and mean 26.4, SD ±30.0).

One-third of falls caused injury (29% in somatic care and 50% in psychiatry, $P < 0.001$). Table 2 describes the levels of injuries and fractures. Of the major injury fallers, 90% were over 65 years (mean age 78 y) and 68% were female. Ninety percent of the fallers with a major injury arrived at the hospital from home, but only one of them was discharged to home from the hospital.

More than one injury was experienced by 5% (n = 38) of fallers. Major injuries occurred more often (3%) in somatic care than in psychiatry (1%). Minor injuries were experienced by 21% of somatic injury fallers and by 40% of psychiatric injury fallers ($P < 0.001$). Table 3 describes consequences of falls, types of injuries. Most injuries were in the head area (41%), and the next most common location was the upper body and arms (26%). The most common injuries were pain or confusion (30%) and wounds (27%). The injury level was statistically significantly associated with injury location ($P = 0.01$). Of the major injuries 36% were in the pelvic, hip, or femoral area. Half (50%) of moderate injuries were in the head area. Of the minor injuries, 39% were in the head area and 36% were in the arm and shoulder area. Gender was the only factor statistically associated with injury type ($P < 0.01$). Males had more wounds (69%), while females had more pain and confusion (74%) and fractures (63%).

The scene of the fall was documented for 59% of all falls. Most commonly, falls occurred in patient rooms (40%), half of the fallers were on their way to the toilet, and 3% had climbed over the bedrails. The type of fall was documented in 21% of fallers. In 1% of falls, staff were present, and most often the patient was either found during the round (6%) or another patient called for help (6%).

The fallers' median length of hospital stay (LOS) was 8 days (average 7.9, range from 1 to 62) in somatic care and 4 days (average 5.2, range from 1.0 to 61.9) in the control group (in somatic care). Mann-Whitney *U* test indicated that in somatic care the difference between the fallers and the control group was statistically significant ($Z = -8.82$, $P < 0.001$). In psychiatry, the fallers' LOS median was 42.0 days (average 50, range from 1 to 365), and in the psychiatric control group, it was 24.7 days (average 36.8, range from 1 to 380). Also in psychiatry, Mann-Whitney *U* test indicated that the difference between the fallers and the control group was statistically significant ($Z = -2.94$, $P = 0.003$). No statistical significance was observed between the LOS of the no-injury fallers and the LOS of the injury fallers.

In all data (n = 114,951 patients), the fall rate was 1.5 1000 PDs (injury fall rate 0.4/1000 PDs). In somatic care, the fall rate was 1.7/1000 PDs (injury fall rate 0.6/1000 PDs), and in psychiatric care, the fall rate was 0.8/1000 PDs (injury fall rate 0.3/1000 PDs). There was a variation in falls in the total data on a monthly basis, with the highest rate of falls in December 1.8/1000 PDs and the lowest rate in January 0.8/1000 PDs. Regarding the weekdays, the highest fall rates were on Wednesdays 1.5/1000 PDs and the lowest on Saturdays 1.2/1000 PDs. In relation to nurses' shifts, most of the falls occurred during the morning shift (37%). Observing falls at every hour in the whole dataset, the highest numbers of falls occurred at 2:00 P.M. (7%), at 4:00 P.M. (7%), and at 9:00 P.M. (6%). Figure 1 describes the falls by day of the week.

DISCUSSION

The objective of this research was to study inpatient fall consequences and, in addition, to describe fall events by time and scene in acute care. The three quarters of fallers were over 65 years of age. The result is in line with previous studies indicating that falls are a particular problem for older patients in acute care.[5,18,19] In the present study, falls caused injury for a third of fallers in somatic care and for half of the fallers in psychiatric care. In previous studies in somatic care, injury rates have ranged from 20% to 50%.[5,6,8] In an extensive psychiatric study, one-fifth of the falls resulted in injury, which is significantly less than in our study.[6] In the same study, the number of falls ranged from 3.0 to 8.6 falls per 1000 PDs depending on the unit type, and these rates were correspondingly higher than in the present study (0.6 falls/1000 PDs). A possible explanation may be that the falls that did not cause injury may not have been recorded in the EPRs. In the present study, there were also statistically significantly more multifallers in psychiatry than in somatic care. This is probably explained by the fact that the LOS in psychiatry was on average more than 40 days longer than in somatic care.

In our study female gender, higher age, elective mode of arrival, and medical specialty of psychiatry were statistically significantly associated with injury falls. In previous studies, there was no clear difference between gender and injury falls, while studies

TABLE 1. Demographics of Fallers With and Without Injury

Variables	All Fallers (*n* = 743)	Noninjury Fallers (*n* = 506)	Injury Fallers (*n* = 237)	*P* Value
Gender *n (%)*				
Male	363 (100.0)	263 (72.4)	100 (27.6)	0.020[c]
Female	380 (100.0)	243 (63.9)	137 (36.1)	
Age group, y *n (%)*				
18–64	185 (100.0)	137 (74.1)	48 (25.9)	0.204[a]
65–74	213 (100.0)	140 (65.7)	73 (34.3)	
75–84	228 (100.0)	154 (67.5)	74 (32.5)	
≥85	116 (100.0)	74 (63.8)	42 (36.2)	
Missing	1	1		
Age mean (*SD*)	71.66 (14.64)	70.8 (15.1)	73.4 (13.5)	0.039[b]
Mode of arrival *n (%)*				
Elective	121 (100.0)	72 (59.5)	49 (40.5)	0.020[a]
Emergency care	521 (100.0)	372 (71.4)	149 (28.6)	
Hospital transfer	93 (100.0)	59 (63.4)	34 (36.6)	
Missing	8	3	5	
Reasons for admission *n (%)*				
Treatment and exam of a somatic disease	612 (100.0)	436 (71.2)	176 (28.8)	<0.001[a]
Treatment and exam of a psychiatric disease	106 (100.0)	53 (49.5)	53 (50.5)	
Accident	25 (100.0)	17 (68.0)	8 (32.0)	
Medical specialty *n (%)*				
Internal medicine	331 (100.0)	226 (68.3)	105 (31.7)	<0.001[a]
Surgical	128 (100.0)	93 (72.7)	35 (27.3)	
Obstetrics and gynecology	23 (100.0)	19 (82.6)	4 (17.4)	
Ophthalmology and otolaryngology	15 (100.0)	11 (73.3)	4 (26.7)	
Oncology	18 (100.0)	15 (83.3)	3 (16.7)	
Psychiatry	110 (100.0)	55 (50.0)	55 (50.0)	
Neurology	118 (100.0)	87 (73.7)	31 (26.3)	
Length of stay, days *n (%)*				
0–3 days	219 (100.0)	157 (71.7)	62 (28.3)	
4–7 days	204 (100.0)	148 (72.5)	56 (27.5)	0.014[a]
8–14 days	157 (100.0)	108 (68.8)	49 (31.2)	
>15 days	153 (100.0)	87 (56.9)	66 (43.1)	
Missing	10	6	4	
Length of stay, days mean (*SD*)	14.1 (25.3)	12.1 (22.0)	18.6 (33.2)	<0.002[c]
Further treatment *n (%)*				
Home	143 (100.0)	91 (63.6)	52 (36.4)	
Housing service	22 (100.0)	19 (86.4)	3 (13.6)	0.030[a]
Institutional long-term care or hospital	462 (100.0)	323 (69.9)	139 (30.1)	
Death	22 (100.0)	10 (45.5)	12 (54.5)	
Missing	94	63	31	

Note. Pearson chi-square = [a], The Mann-Whitney *U* test = [b], Fisher's exact test = [c].

have shown that age is related to the locations of the injuries and to more serious injuries.[7,18] In the present study, gender and age were not associated with injury location or level of injury. However, statistical significance was found between gender and injury type; for example, females were more likely to have fractures than males. Fractures have been more common in women In previous studies.[18,20] The higher susceptibility of women to injury can be explained by the fact that the women who fell were statistically significantly older than the men who fell.

In the present study, 8% of injuries were major injuries, all of which were fractures. In the study of Trinh et al,[5] 11% of injuries were severe, of which 74% were fractures and 24% were intracranial injuries. There were no major intracranial injuries in the present data, although the head and face area were the most common locations of injury. Previous studies have also found that the most common injuries are in the head area.[2,5]

In our study, one-tenth of fallers fell out of bed, of which a third had climbed over the bedrails. All of those who climbed over the bedrails were injured. The rate is lower than in the study of Zhao et al,[7] where the proportion of those who fell out of bed ranged from 15% to 50%. There are no evident guidelines for the use of handrails, as the research results are not consistent. In their systematic review, Marques et al[21] did not find scientific evidence when comparing the use of bedrails in preventing falls to no use of bedrails or any type of physical restraints in acute care. Similarly, the results of a systematic review of fall prevention in

TABLE 2. Level of Injury and Fractures

Injury Level	*n (%)*
No injury	506 (68.1)
Minor injury	176 (23.7)
Moderate injury	41 (5.5)
Major injury	19 (2.6)
Death	1 (0.1)
Total	743 (100.0)
Fractures	
Hip	2 (10.5)
Femur	7 (36.8)
Knee, tibia, or ankle	4 (21.1)
Facial bones	1 (5.3)
Rib or clavicle	2 (10.5)
Hand area	3 (15.8)
Total	19 (100.0)

nursing homes by Huynh et al[22] showed that the use of handrails does not affect fall rates.

In this study, help for a faller was most commonly alerted by another patient, or the staff found the faller when they entered the room. In the Finnish healthcare, a major renovation of hospital buildings is underway, and one aim is that the patient rooms will be single rooms. It is important to recognize that single rooms have many benefits, but in terms of falls, they may increase the cases.[23] Single rooms should be equipped with technology that detects fallers, for example, using machine vision or video monitoring.[24]

TABLE 3. Consequences of Falls and Types of Injuries

Variables	Injury Fallers *n* (%)	All Fallers *n* (%)
Level of injury		
No injury		506 (68.1)
Minor injury	177 (71.4)	177 (23.7)
Moderate injury	41 (17.2)	41 (5.5)
Major injury	19 (8.0)	19 (2.6)
Death	1 (0.4)	1 (0.1)
Total	237 (100.0)	743 (100.0)
Type of injury		
Pain, confusion	70 (29.5)	74 (10.0)
Wound, laceration	63 (26.6)	63 (8.5)
Hematoma, swelling, abrasion	54 (22.8)	54 (7.3)
Fractures of pelvis, hip, or femur	11 (4.6)	11 (1.4)
Other fractures	8 (3.4)	8 (1.1)
Unknown	31 (13.1)	533 (71.7)
Total	237 (100.0)	743 (100.0)
Location of injury		
Head, face	96 (40.5)	112 (15.0)
Hand, arm, shoulder	61 (25.7)	75 (10.1)
Leg, foot, knee	40 (16.9)	48 (6.5)
Pelvis, hip, femur	25 (10.5)	26 (3.5)
No injury/unknown	15 (6.4)	482 (64.9)
Total	237 (100.0)	743 (100.0)
Type of fall		
Falls from the bed	22 (9.3)	55 (7.4)
Climbs over the bed rails	26 (11.0)	26 (3.5)
Slips	9 (3.8)	47 (6.4)
Falls on floor	13 (5.5)	26 (3.5)
Pushes	1 (0.4)	4 (0.5)
Unknown	166 (70.0)	585 (78.7)
Total	237 (100.0)	743 (100.0)

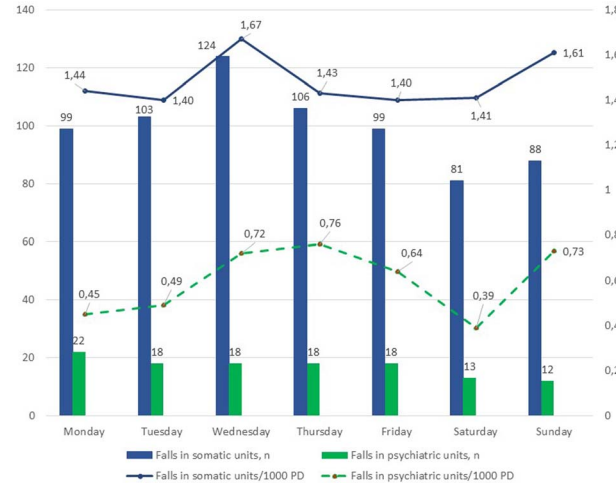

FIGURE 1. The number of falls (n) and falls rate/1000 PDs every day of the week in somatic and psychiatry units.

Half of fallers in somatic care fell within 3 days after admission, and in psychiatry, half of the falls occurred within 16 days after admission. According to the study by Satoh et al,[11] many of the falls occurred during the first 2 days of admission, and in García-Hedreraet al's[2] study, the falls happened with a median of 4.75 days since hospital admission. It is important to assess the risk of falling at the beginning of the patient's treatment because the environment is unfamiliar, and possible acute illness and medication changes can increase the risk of falling.[25,26]

In our study, peak levels of falls occurred in December and June. These months are characterized by holiday periods with an increase in temporary personnel who are unfamiliar with practice methods for specific units. There is some evidence that temporary staffing is associated with increased patient falls.[27] In addition, a positive correlation has been found between overcrowding and falls.[12] In the present study, most falls occurred on Wednesdays, when patient turnover is often the highest. In Staggs et al's[4] study, high-fall units had a higher patient volume than low-fall units. This could also explain the findings of the present study where falls occurred on the busiest day. In the present study, it was found that the morning shifts in somatic care and night shifts in psychiatric care had most of the falls, but no statistical significance was found between shifts. Results of fall rates in shifts have been found inconsistent in previous studies.[2,14]

Falls were associated with a longer LOS. The LOS of fallers was on average 3.9 days longer than nonfallers in somatic care and 13.2 days in psychiatric care, respectively. However, no statistical difference was found between injurious falls and noninjurious falls for LOS. A control group was used for comparison of LOS and several variables were used for propensity score matching. Not all variables that could have explained the differences in the LOS, such as nutritional status, were available in this data. Previous studies have also shown that falls prolong the LOS.[6]

Limitations

The present study depicts real-life situations where health care workers observe and document falls in different ways, thus

affecting the reliability of the data. In addition, the descriptions of falls were insufficient; for example, it was not possible to classify the level of injury. Lastly, falls were probably underreported in the present study. The study organization began the structural recording of falls in 2013; since then, the number of falls has increased. In addition, some falls are only recorded anonymously in the Patient Safety Reporting System, in which the patient cannot be identified and connected to the study data. Finally, the International Classification of Diseases-10 diagnosis code was noted on very few falls.

In the present study, the investigator classified the fall events based on narrative records. The reliability of the results may be affected by any misinterpretation of the staff's documentation.

CONCLUSIONS

In this study, one-third of inpatient falls caused injuries, and almost one-tenth of injuries were considered major injuries, all of which were fractures. Most injuries were to the head area, and the most common injuries were pain or confusion. The falls usually occurred at the beginning of the treatment, and those falls increased the length of hospital stay. The information from this study can be used to design clinical guidelines and patient instructions. They can also be used to implement preventive measures to minimize the number of falls in the hospital.

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