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Incidence and Risk Factors for Subsequent Adverse Events among Outpatients after an In-Hospital Fall

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Background: Information is limited on the incidence and risk factors for further serious conditions after an in-hospital fall. Using data from the incident-accident reports, we assessed the incidence and risk factors for subsequent adverse events (SAEs) among outpatients after in-hospital falls.

Methods: Incident-accident reports from April 2017 to March 2024 at Nippon Medical School Tama Nagayama Hospital were reviewed to identify outpatient falls. Data on patient characteristics and fall-related details were collected. Multivariable logistic regression analysis was performed to identify risk factors for SAEs.

Results: We analyzed data from 118 outpatients with in-hospital falls (mean age: 76.4±11.7 years; male: 56.8%): 39 (33.1%) experienced SAEs, including 5 fractures (4.2%), 13 functional disorders (11.0%), 17 surgical procedures (14.4%), and 17 admissions (14.4%). Multivariable analysis showed that males had a significantly higher odds ratio (OR) for SAEs than females, even after adjusting for age (OR, 2.80; 95% CI, 1.21-6.48; P=0.016). For each SAE, the floor of the fall, number of previous falls, and site of the fall were significantly associated with a subsequent fracture, functional disorder, and surgical procedure after an in-hospital fall, respectively.

Conclusions: The incidence rate of SAEs among outpatients with in-hospital falls was 33.1%. Male sex was the only significant risk factor for SAEs, and factors contributing to individual SAE types were distinct. To prevent further adverse outcomes after in-hospital falls, medical staff should pay more attention to patients with these risk factors. (J Nippon Med Sch 2025; 92: 349–359)

Key words: in-hospital fall, outpatient, risk factor, adverse event, safety management

Introduction

Falls are one of the most common inpatient accidents[1,2]. Because falls often lead to further serious complications, including physical and emotional disorders, diminished quality of life, reduced activities of daily living (ADL), surgical procedures, hospital admission, extended hospitalization, and increased medical costs[3,4], they are frequently reported as incidents or accidents in hospitals. The Nippon Medical School Tama Nagayama Hospital is a 405-bed teaching hospital in suburban Tokyo that serves 500-700 outpatients daily. In 2023, among the 72 incident-accident reports involving outpatients, falls accounted for 21 (29.2%) of cases, making it the most common incident, followed by sudden accidents, patient errors, and medication errors. On average, 17 falls were reported annually between 2017 and 2023, and fall prevention has been recognized as an essential aspect of patient and medical safety management for four decades[1]. In our previous study, we assessed fall incidence and identified potential risk factors for inpatient falls in our hospital using routine medical information[5]. Age (≥51 years), length of stay (≥15 days), absence of surgical procedures, and

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admission to surgery, orthopedics, neurosurgery, or urology services were independent risk factors for inpatient falls[5]. These findings emphasized the need for targeted fall-prevention programs for high-risk patients[5]. On the basis of those results[5], the Department of Medical Safety Management has implemented measures to reduce falls. However, falls continue to occur monthly, underscoring the challenge of complete prevention. In addition, among outpatients, subsequent adverse events (SAEs) after in-hospital falls, such as fractures, functional disorders, surgical procedures, and hospital admissions, often result in conditions more serious than the fall itself. Similar to our report[5], numerous studies have evaluated fall incidence among inpatients and identified associated risk factors[6–10]. However, few examined in-hospital falls among outpatients[11–14] and the risk factors for SAEs after such falls[15–17]. In acute-care hospitals like ours, obtaining comprehensive information, including background, medical history, ADL, and medications, immediately after a hospital visit is more challenging for outpatients than for inpatients. Further research is needed to explore the characteristics of outpatient falls and to clarify the risk factors for SAEs after in-hospital falls[9,17]. Therefore, using data from the incident-accident reports, we assessed the incidence of SAEs after in-hospital falls among outpatients and identified risk factors for SAEs. This study is based on the belief that, in addition to preventing falls, a pivotal task is to avoid further serious sequelae after an in-hospital fall.

Methods

This study was conducted at the Nippon Medical School Tama Nagayama Hospital and approved by the institutional review board of our university hospital (approval number: F-2024-120). Our hospital incident-accident reports from fiscal years 2017 through 2023 (1 April, 2017 to 31 March, 2024) were reviewed to identify in-hospital falls among outpatients. Duplicate reports from multiple sections for the same patient were counted as a single case.

Evaluation of Incident-Accident Reports and Definition of SAEs

First, we investigated the characteristics of outpatient falls and fall-related information at our hospital. Demographic and clinical data for each patient were extracted from incident-accident reports and medical records. An in-hospital fall was defined as an incident when a patient suddenly and involuntarily came to rest on the ground or another surface[18] on the hospital premises, including the entrance, traffic circle, and Grace Garden (a small yard outside the hospital building). Characteristics of outpatient falls included patient age (continuous and categorical), sex (male or female), attendance (absent or present), mobility aids (none, stick [cane], walker, wheelchair, or attendant), clinical department (internal medicine or surgery), clinical diagnosis (cancer, cerebrospinal disease, orthopedic disease, or other non-cancer conditions), consultation status (reserved, non-reserved, in-admission, or ambulance), time of day (morning [8:00-12:00], afternoon [12:00-17:00], or night [17:00-8:00]), and consultation time (before, during, or after consultation or other [non-patient]). Fall-related information included number of previous falls (0-6), floor of the fall (1st-3rd floor, underground, or outside the hospital building), site of the fall (waiting room/reception, consultation/examination/treatment room, restroom, elevator, staircase, corridor, cash register, entrance, or traffic circle), and incident-accident level (0.01-3b). "Incident" and "accident" are defined as levels of 0.01-2 and ≥3, respectively. After the initial analysis, additional variables were included, including excretory behavior (none, upon falling), timing of falls (before reception, before/during examination, or after consultation), and nurse presence (always, sometimes, or none).

The primary outcome was the incidence of any SAE, including 1) fall-related fracture, 2) fall-related functional disorder, 3) surgical treatment after a fall, and 4) hospital admission after an in-hospital fall. For admitted patients, outcomes classified as discharged, during hospitalization at the time of analysis, and death were recorded. Additionally, cause of death was investigated to assess the direct association between falls and death. Secondary outcomes were the abovementioned individual SAEs after an in-hospital fall. The incidence rate of SAEs after in-hospital falls was calculated by dividing the number of SAEs by the total number of falls. Furthermore, to identify the characteristics of patients experiencing SAEs after falls, we compared all patient characteristics and fall-related information between patients with and without SAEs. Sex differences were also evaluated.

Risk Factors for SAEs after In-Hospital Falls

We used univariable and multivariable analyses to assess risk factors for SAEs after in-hospital falls (primary outcome). The risk factors for individual SAEs (secondary outcomes) were identified separately because risk factors for each SAE might be distinct from those for the primary outcome of SAEs.

Statistical Analysis

Data are presented as numbers (percentages) or mean

± standard deviations (SD). To compare patient characteristics between two groups (patients with and without an SAE; males and females), the chi-square test or Student t-test was used for categorical and continuous variables, as appropriate. Univariable and multivariable logistic regression analyses were performed to identify associations of clinical characteristics with SAEs after an in-hospital fall. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated for each variable, in relation to the appropriate reference. Explanatory variables for multivariable analysis were age, sex, and variables that were significant (P<0.05) in univariable analysis. As potential confounders, age and sex were included in all multivariable models as covariates. A two-tailed P-value of <0.05 was considered statistically significant. All statistical analysis was performed using SPSS software (version 23.0; IBM Corporation, Armonk, NY, USA).

Results

Of all incident-accident reports, 118 outpatients with in-hospital falls (age 76.4±11.7 years; males, 56.8%) were included in this study (**Table 1**). Among these patients, 39 (33.1%) experienced SAEs, including 5 fractures (4.2%), 13 functional disorders (11.0%), 17 surgical procedures (14.4%), and 17 admissions (14.4%) (**Table 2**). Among admitted patients, the numbers of patients classified as discharged, during hospitalization, and death were 12, 1, and 4, respectively (**Table 2**). Information on the four deaths is summarized in **Table 3**. Recurrent subdural hematoma after a fall was directly related to the death of one female patient. **Tables 1 and 2** show the characteristics of outpatients with falls and detailed information on the falls. Of the characteristics assessed, only sex differed significantly between patients with and without SAEs (P =0.021) (**Table 1**). Regarding fall-related data, accidents classified as an incident-accident level ≥3 were significantly more frequent in patients with SAEs than in those without SAEs (P<0.001) (**Table 2**). Other variables did not differ between the groups. **Tables 4 and 5** provide detail on SAE characteristics and fall-related data. When comparing patient characteristics and fall-related information between sexes, only the timing of falls differed (**Supplementary Table 1, 2**: https://doi.org/10.1272/jnms.JNMS.2025_92_407). Regarding specific SAEs, the admission rate was higher for males than for females, but the difference was not significant (19.4% vs. 7.8%, P= 0.076) (**Supplementary Table 2**).

Univariable analysis revealed no association of age, whether as a categorical or continuous variable, with SAEs (**Table 6**). However, the ORs for experiencing SAEs were significantly higher for males than for females, even after adjusting for age (OR, 2.80; 95% CI, 1.21-6.48; P= 0.016) (**Table 6**). The results of univariable and multivariable analyses of specific SAEs are summarized in **Table 7**. The floor where the fall occurred was associated with fracture. Falling outside the hospital building (OR, 31.55; 95% CI, 1.38-721.72; P=0.031) and underground (OR, 59.01; 95% CI, 1.89-1,845.60; P=0.020) were significant risk factors for fracture, as compared with falls on the first floor. A past history of two falls was a significant risk factor for functional disorders, as compared with no history of falls. For surgical procedures, falls at sites such as cash registers, entrances, and traffic circles were significantly associated with increased risk (OR, 9.84; 95% CI, 1.68-57.80; P=0.011), as compared with falls in waiting rooms or receptions. Fracture was also a significant risk factor for subsequent surgical procedures (OR, 10.28; 95% CI, 1.29-82.19; P=0.028). No patient characteristic was associated with risk of hospital admission; however, undergoing a surgical procedure was significantly associated with subsequent admission (OR, 4.84; 95% CI, 1.36-17.17; p=0.015) (**Table 7**).

Discussion

This study found that 33.1% of outpatients who fell experienced further serious conditions and that male sex was significantly associated with SAEs. Risk factors for specific SAEs varied and were not necessarily identical to those associated with fall incidence.

Incidence of SAEs in Outpatients with Falls

In the present study, 33.1% of outpatients with in-hospital falls experienced SAEs. Previous studies reported that approximately 25%-35% of falls result in minor-to-severe physical injury[2,6,11] and that 2%-8% of falls lead to serious injuries such as hematomas and open wounds[6,19]. The overall rate of SAEs was similar to those in previous reports, whereas the rates of surgical procedures and hospital admission in the present study (both 14.4%) were slightly higher than in previous studies[6,19]. Fall-related fracture occurred in only 4.2% of patients, which was similar to the rate in a previous study[15]. This suggests that beyond fractures, other unevaluated factors such as cognitive status and dementia may contribute to subsequent serious patient complications[16].

Characteristics of Outpatients with Falls

Older age is a significant risk factor for falls[7,20]. Among the 118 outpatients experiencing falls, 90.7% were ≥60 years of age and 78.0% were ≥70 years of age. Our previ-

Table 1 Characteristics of outpatients with falls

	Overall	Subsequent adverse event*		P-value**
		(–)	(+)	
Number	118	79	39	
Age, years	76.4±11.7	75.6±12.1	78.2±10.9	0.421
Age group				0.086
<60 years	11 (9.3)	7 (8.9)	4 (10.3)	
60-69 years	15 (12.7)	14 (17.7)	1 (2.6)	
70-79 years	39 (33.1)	26 (32.9)	13 (33.3)	
80-89 years	46 (39.0)	26 (32.9)	20 (51.3)	
≥90 years	7 (5.9)	6 (7.6)	1 (2.6)	
Sex				0.021
Male	67 (56.8)	39 (49.4)	28 (71.8)	
Female	51 (43.2)	40 (50.6)	11 (28.2)	
Attendance				0.849
Absent	65 (55.1)	44 (55.7)	21 (53.8)	
Present	53 (44.9)	35 (44.3)	18 (46.2)	
Excretory behavior				0.976
None	97 (82.2)	65 (82.3)	32 (82.1)	
Upon falling	21 (17.8)	14 (17.7)	7 (17.9)	
Mobility aids				0.735
None	69 (58.5)	43 (54.4)	26 (66.7)	
Stick (cane)	25 (21.2)	19 (24.1)	6 (15.4)	
Walker	5 (4.2)	4 (5.1)	1 (2.6)	
Wheelchair	16 (13.6)	11 (13.9)	5 (12.8)	
Attendant	3 (2.5)	2 (2.5)	1 (2.6)	
Clinical department				0.378
Internal Medicine	45 (38.1)	33 (41.8)	12 (30.8)	
Surgery	72 (61.0)	45 (57.0)	27 (69.2)	
Non-patient (visitor or attendant)	1 (0.8)	1 (1.3)	0 (0)	
Clinical diagnosis				0.378
Cancer	35 (29.7)	24 (30.4)	11 (28.2)	
Cerebrospinal disease	18 (15.3)	9 (11.4)	9 (23.1)	
Orthopedic disease	5 (4.2)	3 (3.8)	2 (5.1)	
Other non-cancer conditions	60 (50.8)	43 (54.4)	17 (43.6)	
Consultation status				0.188
Reserved	89 (75.4)	59 (74.7)	30 (76.9)	
Non-reserved	22 (18.6)	16 (20.3)	6 (15.4)	
In-admission	2 (1.7)	0 (0)	2 (5.1)	
Ambulance	5 (4.2)	4 (5.1)	1 (2.6)	
Time of day				0.233
Morning (8:00-12:00)	65 (55.1)	44 (55.7)	21 (53.8)	
Afternoon (12:00-17:00)	48 (40.7)	30 (38.0)	18 (46.2)	
Night (17:00-8:00)	5 (4.2)	5 (6.3)	0 (0)	
Consultation time				0.104
Before	66 (55.9)	43 (54.4)	23 (59.0)	
During	14 (11.9)	10 (12.7)	4 (10.3)	
After	36 (30.5)	25 (31.6)	11 (28.2)	
Other (non-patient)	2 (1.7)	1 (1.3)	1 (2.6)	

Data are numbers (%). Age is mean ± SD.

* Including fracture, functional disorder, surgical procedure, and admission after an in-hospital fall

** Patients with and without adverse events after a fall were compared by the chi-square test. Age was compared by Student t-test.

Table 2 Fall-related information

	Overall	Subsequent adverse event*		P-value**
		(–)	(+)	
Number	118	79	39	
Fall History	36 (30.5)	21 (26.6)	15 (38.5)	0.187
Past history of falls				0.188
0 times (no history of fall)	82 (69.5)	58 (73.4)	24 (61.5)	
1 time	14 (11.9)	9 (11.4)	5 (12.8)	
2 times	15 (12.7)	6 (7.6)	9 (23.1)	
3 times	3 (2.5)	3 (3.8)	0 (0)	
4 times	3 (2.5)	2 (2.5)	1 (2.6)	
6 times	1 (0.8)	1 (1.3)	0 (0)	
Floor of fall				0.921
1st	70 (59.3)	46 (58.2)	24 (61.5)	
2nd	23 (19.5)	15 (19.0)	8 (20.5)	
3rd	20 (16.9)	15 (19.0)	5 (12.8)	
Underground	2 (1.7)	1 (1.3)	1 (1.3)	
Outside hospital building	3 (2.5)	2 (2.5)	1 (2.6)	
Site of fall				0.244
Waiting room/reception	33 (28.0)	26 (32.9)	7 (17.9)	
Consultation/examination/treatment room	30 (25.4)	18 (22.8)	12 (30.8)	
Restroom	14 (11.9)	8 (10.1)	6 (15.4)	
Elevator, staircase, or corridor	21 (17.8)	16 (20.3)	5 (12.8)	
Cash register, entrance, or traffic circle	20 (16.9)	11 (13.9)	9 (23.1)	
Timing of fall				0.206
Before reception	20 (16.9)	15 (19.0)	5 (12.8)	
Before/during examination	65 (55.1)	39 (49.4)	26 (66.7)	
After consultation	33 (28.0)	25 (31.6)	8 (20.5)	
Nurse presence†				0.822
Always	44 (37.3)	29 (36.7)	15 (38.5)	
Sometimes	12 (10.2)	9 (11.4)	3 (7.7)	
None	62 (52.5)	41 (51.9)	21 (53.8)	
Incident-accident level				<0.001
0.01	2 (1.7)	1 (1.3)	1 (2.6)	
1	28 (23.7)	26 (32.9)	2 (5.1)	
2	61 (51.7)	46 (58.2)	15 (38.5)	
3a	23 (19.5)	6 (7.6)	17 (43.6)	
3b	4 (3.4)	0 (0)	4 (10.3)	
Outcomes after falls				
Any adverse event*	39 (33.1)	-	39 (100)	
Fracture	5 (4.2)	-	5 (12.8)	
Functional disorder	13 (11.0)	-	13 (33.3)	
Surgical procedure	17 (14.4)	-	17 (43.6)	
Admission	17 (14.4)	-	17 (43.6)	
Discharged	12	-	12	
During hospitalization	1	-	1	
Death	4	-	4	

Data are numbers (%).

* Including fracture, functional disorder, surgical procedure, or admission after an in-hospital fall

** Patients with and without adverse events after a fall were compared by the chi-square test.

† Always (waiting room, treatment room, and explanation counter), Sometimes (consulting room and infection-specific consulting room), and None (restroom, staircase, corridor, elevator, Grace Garden, cash register, entrance, and traffic circle)

Table 3 Characteristics of nonsurvivors

Case	Age	Sex	Hospital-ization period	Clinical department	Underlying conditions	Comorbidities	Fall-related Complication	Direct cause of death	Direct relation to fall
1	83	Male	5 days	Orthopedic surgery	Osteoporosis Lumber compression fracture	Heart failure CKD	Femoral neck fracture	Septic shock	No
2	83	Male	33 days	Urology	Prostatic cancer	Bone metastasis Cerebral infarction Diabetes mellitus	No	Pneumonia	No
3	55	Male	3 days	Gastrointestinal surgery	Esophageal cancer	Bone metastasis	No	Terminal stage of cancer	No
4	90	Female	2 days	Orthopedic surgery	Traumatic SDH Rib fracture	Atrial fibrillation Rectal ulcer	Acute SDH (recurrence)	SDH	Yes

CKD, chronic kidney disease; SDH, subdural hematoma.

ous study showed that, as compared with persons aged <51 years, the age groups 51-70 years (OR, 2.4; 95% CI, 1.3-4.7) and 71-90 years (OR, 4.2; 95% CI, 2.4-8.1) had a significantly higher risk of falls[5]. However, the age distribution did not significantly differ between the two groups in the present study (P=0.086), although the proportion of patients aged 80-89 years was higher for those with SAEs than for those without an SAE (**Table 1**).

The proportion of males was the only factor that significantly differed between the groups: 71.8% of patients with SAEs were male (**Table 1**). Rates of individual SAEs were also higher in males than in females, which was consistent with the overall trend (**Table 4**).

Among the 118 incident-accident reports on falls, 27 cases (22.9%) were classified as accident level 3a (requiring simple procedures and treatments) or 3b (requiring complex procedures and treatments). Unsurprisingly, the distribution of incident-accident levels differed significantly between the groups, as 43.6% of patients with SAEs required surgical procedures and/or hospital admission (**Table 2**).

Unexpectedly, other variables in the patient characteristics (**Table 1**) and fall-related information (**Table 2**) were similar between the groups, despite previous reports suggesting that falls occur more frequently outdoors and in the morning[15]. Therefore, information on excretory behavior, timing of falls, and nurse presence was collected in addition to the prespecified variables. No significant differences were observed in these added variables between patients with and without SAEs. However, the site of the fall may be a notable exception. Specifically, 41.2% of patients who required subsequent surgical procedures had fallen at cash registers, entrances, or traffic circles on the first floor (**Table 5**). Although families are recommended to assist the patient and encourage wheelchair use in these high-risk locations, falls in these areas remain frequent.

Risk Factors for SAEs after In-Hospital Falls

Logistic regression analyses were performed to identify risk factors for SAEs after in-hospital falls. Significant variables in univariable analysis, in addition to age and sex, are shown in **Tables 6 and 7**. Although the OR for age 80-89 years (1.35) was slightly higher than that for age <60 years, the difference was not significant.

After adjusting for age, only male sex was associated with an increased risk of SAEs (OR, 2.80; 95% CI, 1.21-6.48; P=0.016) (**Table 6**). The rates of all specific SAEs were higher in males than females (**Supplementary Table 2**), and adjusted ORs for males all exceeded 1.0 (1.98, 1.13, 2.05, and 2.88) (**Table 7**). Therefore, all SAE types may have contributed to the significant sex difference in the incidence of SAEs. Hospital admission was the strongest contributor to the sex difference observed in the primary outcome of SAEs, with the highest OR of 2.88. When patient characteristics and fall-related information were compared between sexes, only the timing of falls differed significantly: falls before or during examination were more frequent in males than females (**Supplementary Table 1, 2**). However, we could not determine the precise reasons for the apparent vulnerability of males to SAEs in the present study. A previous study of age-related changes in physique and physical fitness, and sex differences in those characteristics, in adults aged ≥65 years[21] reported significant differences in muscular strength, balance, and flexibility. Muscular strength and balance in older participants were better in males than in

Table 4 Characteristics of outpatients with falls, by adverse event

	Subsequent adverse event			
	Fracture	Functional disorder	Surgical procedure	Admission
Number	5	13	17	17
Age, years	78.4±13.3	82.9±5.0	79.0±9.7	76.6±13.6
Age group				
<60 years	1 (20.0)	0 (0)	1 (5.9)	3 (17.6)
60-69 years	0 (0)	0 (0)	1 (5.9)	0 (0)
70-79 years	0 (0)	4 (30.8)	6 (35.3)	5 (29.4)
80-89 years	4 (80.0)	8 (61.5)	8 (47.1)	8 (47.1)
≥90 years	0 (0)	1 (7.7)	1 (5.9)	1 (5.9)
Sex				
Male	3 (60.0)	8 (61.5)	11 (64.7)	13 (76.5)
Female	2 (40.0)	5 (38.5)	6 (35.3)	4 (23.5)
Attendance				
Absent	4 (80.0)	4 (30.8)	12 (70.6)	11 (64.7)
Present	1 (20.0)	9 (69.2)	5 (29.4)	6 (35.3)
Excretory behavior				
None	5 (100)	11 (84.6)	15 (88.2)	14 (82.4)
Upon falling	0 (0)	2 (15.4)	2 (11.8)	3 (17.6)
Mobility aids				
None	5 (100)	7 (53.8)	13 (76.5)	12 (70.6)
Stick (cane)	0 (0)	4 (30.8)	2 (11.8)	0 (0)
Walker	0 (0)	1 (7.7)	1 (5.9)	1 (5.9)
Wheelchair	0 (0)	1 (7.7)	0 (0)	4 (23.5)
Attendant	0 (0)	0 (0)	1 (5.9)	0 (0)
Clinical department				
Internal Medicine	2 (40.0)	4 (30.8)	6 (35.3)	3 (17.6)
Surgery	3 (60.0)	9 (69.2)	11 (64.7)	14 (82.4)
Non-patient (visitor or attendant)	0 (0)	0 (0)	0 (0)	0 (0)
Clinical diagnosis				
Cancer	2 (40.0)	3 (23.1)	5 (29.4)	5 (29.4)
Cerebrospinal disease	0 (0)	5 (38.5)	3 (17.6)	5 (29.4)
Orthopedic disease	1 (20.0)	0 (0)	1 (5.9)	2 (11.8)
Other non-cancer conditions	2 (40.0)	5 (38.5)	8 (47.1)	5 (29.4)
Consultation status				
Reserved	4 (80.0)	12 (93.3)	13 (76.5)	11 (64.7)
Non-reserved	1 (20.0)	1 (7.7)	4 (23.5)	3 (17.6)
In-admission	0 (0)	0 (0)	0 (0)	2 (11.8)
Ambulance	0 (0)	0 (0)	0 (0)	1 (5.9)
Time of day				
Morning (8:00-12:00)	4 (80.0)	9 (69.2)	9 (52.9)	7 (41.2)
Afternoon (12:00-17:00)	1 (20.0)	4 (30.8)	8 (47.1)	10 (58.8)
Night (17:00-8:00)	0 (0)	0 (0)	0 (0)	0 (0)
Consultation time				
Before	4 (80.0)	9 (69.2)	9 (52.9)	9 (52.9)
During	1 (20.0)	2 (15.4)	1 (5.9)	1 (5.9)
After	0 (0)	2 (15.4)	6 (35.3)	7 (41.2)
Other (non-patient)	0 (0)	0 (0)	1 (5.9)	0 (0)

Data are numbers (%). Age is mean ± SD.

Table 5 Fall-related information, by adverse event

	Subsequent adverse event			
	Fracture	Functional disorder	Surgical procedure	Admission
Number	5	13	17	17
Fall history	1 (20.0)	7 (53.8)	6 (35.3)	5 (29.4)
Past history of falls				
0 times (no history of fall)	4 (80.0)	6 (46.2)	11 (64.7)	12 (70.6)
1 time	0 (0)	0 (0)	3 (17.6)	3 (17.6)
2 times	1 (20.0)	6 (46.2)	2 (11.8)	1 (5.9)
4 times	0 (0)	1 (7.7)	1 (5.9)	1 (5.9)
Floor of fall				
1st	2 (40.0)	6 (46.2)	12 (70.6)	11 (64.7)
2nd	1 (20.0)	3 (23.1)	3 (17.6)	3 (17.6)
3rd	0 (0)	3 (23.1)	1 (5.9)	2 (11.8)
Underground	1 (20.0)	0 (0)	0 (0)	0 (0)
Outside of hospital building	1 (20.0)	1 (7.7)	1 (5.9)	1 (5.9)
Site of fall				
Waiting room/reception	1 (20.0)	2 (15.4)	2 (11.8)	3 (17.6)
Consultation/examination/treatment room	1 (20.0)	7 (53.8)	3 (17.6)	5 (29.4)
Restroom	0 (0)	2 (15.4)	1 (5.9)	3 (17.6)
Elevator, staircase, or corridor	2 (40.0)	1 (7.7)	4 (23.5)	2 (11.8)
Cash register, entrance, or traffic circle	1 (20.0)	1 (7.7)	7 (41.2)	4 (23.5)
Timing of fall				
Before reception	0 (0)	1 (7.7)	4 (23.5)	2 (11.8)
Before/during examination	3 (60.0)	10 (76.9)	9 (52.9)	11 (64.7)
After consultation	2 (40.0)	2 (15.4)	4 (23.5)	4 (23.5)
Nurse presence*				
Always	1 (20.0)	7 (53.8)	4 (23.5)	4 (23.5)
Sometimes	1 (20.0)	1 (7.7)	2 (11.8)	2 (11.8)
None	3 (60.0)	5 (38.5)	11 (64.7)	11 (64.7)
Incident-accident level				
0.01	0 (0)	1 (7.7)	0 (0)	0 (0)
1	0 (0)	2 (15.4)	0 (0)	0 (0)
2	0 (0)	7 (53.8)	1 (5.9)	7 (41.2)
3a	3 (60.0)	2 (15.4)	14 (82.4)	7 (41.2)
3b	2 (40.0)	1 (0)	2 (11.8)	3 (17.6)
Outcomes after falls				
Any adverse event	5 (100)	13 (100)	17 (100)	17 (100)
Fracture	5 (100)	1 (7.7)	3 (17.6)	3 (17.6)
Functional disorder	1 (20.0)	13 (100)	3 (17.6)	2 (11.8)
Surgical procedure	3 (60.0)	3 (23.1)	17 (100)	7 (41.2)
Admission	3 (60.0)	2 (15.4)	7 (41.2)	17 (100)
Discharged	2	1	5	12
During hospitalization	0	0	0	1
Death	1	1	2	4

Data are numbers (%).

* Always (waiting room, treatment room, and explanation counter), Sometimes (consulting room and infection-specific consulting room), and None (restroom, staircase, corridor, elevator, Grace Garden, cash register, entrance, and traffic circle)

Table 6 Factors associated with subsequent adverse events after an in-hospital fall*

Variables	Univariable**		Multivariable	
	Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value
Age (per 1-year increase)	1.02 (0.99-1.06)	0.263	1.03 (0.99-1.06)	0.171
Sex (male)	2.61 (1.14-5.96)	0.023	2.80 (1.21-6.48)	0.016
Age group (vs.<60 years)				
60-69 years	0.13 (0.12-1.34)	0.086	-	
70-79 years	0.88 (0.22-3.54)	0.851	-	
80-89 years	1.35 (0.35-5.24)	0.668	-	
≥90 years	0.29 (0.35-5.24)	0.324	-	

CI, confidence interval.
* Including fracture, functional disorder, surgical procedure, or admission
** Non-significant variables in univariable analysis are not shown, except age.

Table 7 Factors associated with individual adverse events after an in-hospital fall

Variables	Univariable*		Multivariable	
	Odds ratio (95% CI)	P-value	Odds ratio (95% CI)	P-value
Fracture				
Age (per 1-year increase)	1.02 (0.93-1.11)	0.703	1.06 (0.95-1.18)	0.291
Sex (male)	1.15 (0.19-7.14)	0.882	1.98 (0.21-18.94)	0.554
Floor (vs. 1st)				
2nd	1.55 (0.13-17.88)	0.727	1.17 (0.09-14.51)	0.904
3rd	0.00	0.998	0.00	0.998
Outside hospital	17.00 (1.05-274.57)	0.046	31.55 (1.38-721.72)	0.031
Underground	34.00 (1.52-760.85)	0.026	59.01 (1.89-1,845.60)	0.020
Functional disorder				
Age (per 1-year increase)	1.09 (1.01-1.18)	0.036	1.10 (0.99-1.22)	0.070
Sex (male)	1.25 (0.38-4.07)	0.714	1.13 (0.30-4.25)	0.858
Past history of falls (vs. 0 times) **				
2 times	8.44 (2.24-31.80)	0.002	8.66 (2.13-35.21)	0.003
≥4 times	6.33 (0.50-80.33)	0.154	2.42 (0.17-34.63)	0.514
Surgical procedure				
Age (per 1-year increase)	1.03 (0.97-1.08)	0.333	1.02 (0.97-1.08)	0.409
Sex (male)	1.47 (0.51-4.29)	0.478	2.05 (0.61-6.88)	0.248
Site of fall (vs. Waiting room/reception)				
Consultation/examination/treatment rooms	1.72 (0.27-11.09)	0.567	2.03 (0.30-13.84)	0.470
Restroom	1.19 (0.10-14.33)	0.890	1.46 (0.12-18.26)	0.771
Elevator, staircase, or corridor	3.65 (0.60-22.01)	0.158	3.62 (0.50-26.00)	0.201
Cash register, entrance, or traffic circle	8.35 (1.53-45.67)	0.014	9.84 (1.68-57.80)	0.011
Fracture	10.61 (1.63-69.15)	0.014	10.28 (1.29-82.19)	0.028
Admission				
Age (per 1-year increase)	1.00 (0.96-1.05)	0.958	1.00 (0.95-1.05)	0.937
Sex (male)	2.83 (0.86-9.27)	0.086	2.88 (0.79-10.45)	0.109
Fracture	10.61 (1.63-69.15)	0.014	6.47 (0.78-53.82)	0.084
Surgical procedure	6.37 (1.99-20.44)	0.002	4.84 (1.36-17.17)	0.015

CI, confidence interval.
* Nonsignificant variables in univariable analysis are not shown, except age and sex.
** There was no case of functional disorder in a patient with 1 or 3 previous falls.

females, but flexibility was better in females[21]. Muscular weakness and balance disorders might be associated with fall incidence, and a decrease in flexibility might increase SAE risk after in-hospital falls. Although these previous results cannot be readily extrapolated to another cohort because of differences in patient characteristics, the above study[21] and our study both mainly included older adults (age of present patients: 76.4±11.7 years).

Our results suggest that the risk factors for SAEs after falls are not identical to those for falls *per se*. Furthermore, to identify the differences in risk factors for specific SAEs after in-hospital falls, the same analysis was performed for each SAE. The floor on which fall occurred (underground or outside the hospital), history of prior falls (two times), and site of the fall (cash register, entrance, or traffic circle) were significantly associated with the incidences of subsequent fractures, functional disorders, and surgical procedures, respectively (**Table 7**). Additionally, fractures due to falls significantly increased the risk of subsequent surgical procedures, and undergoing a surgical procedure was associated with a 4.8-fold risk of subsequent admissions (**Table 7**). These results are consistent with our experience in actual clinical settings.

The present results suggest that, to prevent further serious conditions, medical staff, particularly nurses in outpatient offices, should focus on patients with these risk factors. Recently, falls have garnered attention, not only in Neurology, Orthopedics, and Medical Safety Management but also in managing patients with non-valvular atrial fibrillation. The All Nippon AF In the Elderly (ANAFIE) Registry[22] reported that a history of falls was independently associated with increased risks of stroke/systemic embolism, major bleeding, and all-cause death. While numerous fall-prevention programs, such as a structural multifactorial interventions, have been developed[9,12,23,24], these programs reduce fall incidence, but do not necessarily prevent injurious falls[9]. Accordingly, fall-prevention programs by the Department of Medical Safety Management in each hospital should include strategies to avoid further serious patient conditions after in-hospital falls, in addition to the prevention of falls *per se*.

Limitations

This study had several limitations. First, as it was conducted in a single hospital, the results may not be generalizable to other hospitals. Second, owing to the study's retrospective and observational design, causality and mechanisms cannot be inferred. Specifically, the precise reasons for the apparent vulnerability of males to SAEs could not be determined. Third, it is unclear whether the present grouping of variables is appropriate. For example, the site of a fall can be classified in multiple ways. Finally, the sample size (118 outpatients with in-hospital falls) and limited numbers of total and individual SAEs may have resulted in β-errors due to the low statistical power of the analysis. Non-significant results should thus be interpreted with caution.

Conclusions

Among outpatients with in-hospital falls, 33.1% experienced SAEs. Male sex was the only significant risk factor for SAEs. The floor on which the fall occurred (underground and outside the hospital building), prior falls (twice), and the site of the fall (cash register, entrance, or traffic circle) were significantly associated with increased risks of subsequent fractures, functional disorders, and surgical procedures, respectively. Thus, further measures to reduce the incidence of falls and serious fall-related conditions are warranted.

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