Clinical and Experimental Health Sciences

Investigation of The Incidence and Risk Factors of Falls, An Undesirable Incident in Hospitals: A Retrospective Study of Eight Years

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ABSTRACT

Objective: Falls are undesirable incidents that must be reported in hospitals. Duration of hospital stay and cost of treatment may increase due to post-fall injuries. Therefore, it is very important to investigate the incidence and risk factors of falls to prevent them. The aim of the study was to investigate the incidence and risk factors of falls.

Methods: The retrospective descriptive study was conducted in one of the largest medical faculty hospitals located in the western of Türkiye. The study data of 160,119 cases of falls between 2012 and 2019 were examined retrospectively using a "Socio-demographic Information Form" and "HARIZMI" and "ITAKI" Fall Risk Scales.

Results: Statistically significant differences were found between fall rates by year ($p < .05$). It was detected that the risk of falls in adults was 2.3 times higher than in children (95% CI: 1.86-2.89); the risk of falls in men was 1.2 times higher than in women (95% CI: 1.04-1.43), and the risk of falls in internal medicine units was 4.2 times higher than in surgical units (95% CI: 3.57-5.06).

Conclusion: The falls mostly occurred in internal medicine units. The risk of falls was higher in internal medicine units than in surgical units. The risk of falls was higher in adults than in children and men than in women. Necessary precautions should be taken for adult ve men patients who are at risk of falls. Institutional procedures and flowcharts should be established to rapidly evaluate cases of falls and make the necessary interventions. Warning signs should be placed in the rooms of patients who are at risk of falling.

Keywords: Care quality, fall, fall incidence, fall risk, nursing, patient safety.

1. INTRODUCTION

A fall is defined as "an event that results in a person coming to rest inadvertently on the ground or floor or other lower levels" by the World Health Organization (WHO). Globally, falls are a major problem of public health. Fall injuries can be fatal or often non-fatal. An estimated 684,000 fatal falls are known to occur each year and falls are counted as the second leading cause of unintentional injury deaths, after road traffic injuries (1). Approximately 30-50% of falls harm patients in some way and the most severe cases can result in death (2). Falls in hospital environments cause worsening in patients' clinical conditions, prolonging hospital stay due to patients' limitations and physical disabilities, increased cost of treatment, and ethical and legal problems for the institution (2,3).

More than 80% of deaths due to falls occur in middle or low-income countries. Sixty percent of these deaths occur in the West Pacific and South East Asia. All over the world, fall-related death rates are highest among adults aged over 60 years (1). The financial burdens resulting from fall injuries are significant. The average healthcare cost per fall injury for people aged 65 years or older in the Republic of Finland and Australia is 3611 USD and 1049 USD, respectively (1). Baris et al. (4) calculated the additional hospital cost and labor loss in Turkey caused by severe fall injuries as 3,303,60 USD and 14.61 days. Therefore, the prevention of falls is a worldwide concern and also one of WHO's international patient safety goals. Countries around the world have started prevention programs to decrease the risk of patient harm caused by falls (2). A fall is an indicator of nursing care and preventing them is one of the primary responsibilities of nurses.

Inpatient falls are among the most common undesirable incidents in hospitals that must be reported (3,5). Causes of falls are categorized into two groups related to internal and external factors (3,6). Internal factors include a history of falls,

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agitation, stroke, neurologic-cardiac problems, problems in walking and movement, and urinary incontinence. External factors include an increase in urinary frequency, not removing bed frames, insufficient lighting, wet or slippery floors, and difficult access to the call bell (7).

The presence of additional chronic diseases along with falls leads to serious problems due to being dependent on others for physical activities, especially at older ages. The incidence of falls in hospitals worldwide is reported to be approximately 2-1.7% per patient/day (7).

Identifying the incidence and risk factors of falls, which cause severe harm in hospitalized patients, is significantly important to shorten hospitalization times by eliminating the risk of falls, decreasing the cost of fall-related treatments, and reducing labor loss and the workload of healthcare professionals. Based on these facts, answers to the following questions were sought in the study:

- What is the distribution of the number of falls according to demographic characteristics, ward, year and month of hospitalization?
- What are the characteristics related to fall?
- What are the characteristics related to the time of the fall and the practices performed after the fall?
- What are the risk factors that affect falls?

2. METHODS

2.1. Ethical Considerations

The Human Rights Declaration of Helsinki was abided by throughout the study. Written ethical board consent was obtained from İstanbul University İstanbul Faculty of Medicine Ethics Committee (permission date and no. 18/12/2020-31).

2.2. Design and Aim of The Study

This retrospective, descriptive study was conducted to investigate the incidence and risk factors of falls.

2.3. Population and Sample

The study was conducted in one of the largest medical faculty hospitals located in the western Turkey. The study was conducted with 160,119 patients who fell during hospitalization in clinics between 2012 and 2019.

2.4. Measures

In the hospital where the research was conducted, all patients admitted to inpatient units are evaluated for the risk of falls, with no exception. For evaluating the risk of falls, the HARIZMI Fall Risk Scale was used for the patients aged 0-16 years, and the ITAKI Fall Risk Scale was used for patients aged over 16 years. A socio-demographic information form, and the HARIZMI and ITAKI Fall Risk Scales were used for data collection.

2.4.1. Socio-demographic and Fall-related Information Form: This form investigates socio-demographic information such as age, sex, inpatient clinic, fall risk score, fall status, number of falls, the time between falling and being admitted to the clinic, time of fall, day of fall, site of fall, place/moment of fall, type of fall, mental health status before fall, presence of a companion during the fall, interventions after the fall, use of drugs that increase fall risk, fall risk evaluation, and fall-related information such as implementation of fall protocols, being in the fall protocol, presence of a healthcare professional at the time of the fall, and whether the fall occurred when the room was lit.

2.4.2. HARIZMI Fall Risk Scale: Thescale was developed by the Ministry of Health in Turkey (8). It consists of nine items questioning the risk of falls (neurologic diseases/symptoms, change in oxygenation, specific disease/symptom in terms of fall risk, being in a suitable bed, visual impairment, equipment connected to the patient, need for physical support while walking/standing, being in the post-op period and use of risky drugs). Two risk levels, low and high, were determined over the total score obtained by evaluating the risk factors. If the total score was below 15, the fall risk of the patient was considered low, and if the total score was 15 and above, the fall risk of the patient is considered high (9). The scale is used for the assessment of fall risk in pediatric patients.

2.4.3. ITAKI Fall Risk Scale: The scale was developed by the Ministry of Health in Turkey (8). It consists of 19 risk factors that can cause patients to fall. Risk factors are categorized as minor and major; minor risk factors are given 1 point and major risk factors are given 5 points. There are a total of 11 minor and eight major risk factors. Two risk levels, low and high, were determined over the total score obtained by evaluating the risk factors. If the total score is below 5, the fall risk of the patient is considered low, and if the total score is 5, the fall risk of the patient is considered high (10). The scale is used for the assessment of fall risk in adult patients.

2.5. Data Collection

In the hospital where the research was conducted, following the risk evaluation, all the adult patients with an ITAKI fall risk score of 5 and above and all the pediatric patients with a HARIZMI fall risk score of 15 and above are accepted as at risk of fall. Fall risk is evaluated in four different situations (the postoperative period, when the patient falls, in case of a change of unit, and a change in the patient's conditions). Therefore, patients are evaluated for each admission to the hospital and the changes are recorded. Data related to the patients are sent to the Department of Nursing Services at the end of each month and analyses are performed by the department. The research was conducted using data

obtained from the patients accepted as at-risk and patients who were not at-risk at admission but fell nonetheless. The data of the research were obtained from the data sent to the Department of Nursing Services.

2.6. Data Analyses

The NCSS (Number Cruncher Statistical System) 2007 (Kaysville, Utah, USA) program was used for statistical analyses. Descriptive statistical methods (average, standard deviation, median, frequency, rate, minimum, maximum) were used for evaluating the study data. Pearson's Chi-square test and the Fisher-Freeman-Halton test were used for the comparison of qualitative data. Logistic regression analysis was used to investigate the risk factors that affect falls. The significance level was accepted as $p < .05$.

3. RESULTS

The results of the research were investigated under four headings:

3.1. Distribution of The Number of Falls According to Demographic Characteristics, Ward, Year and Month of Hospitalization

Accordingly, no statistically significant differences were found between patients who fell once or more than twice in terms of age groups, sex, hospitalization unit, ward unit, and the month in which the fall occurred ($p > .05$). However, a statistically significant difference was detected between patients who fell in terms of the years in which the falls occurred ($p < .05$). When the fall rates were compared by years, statistically significant differences were found between fall rates by years ($p < .05$). It was determined that there was a decrease in falls in the period from 2012 to 2019 (Table 1).

When the distribution of the fall rates according to the department and ward unit was investigated, it was determined that falls mostly occurred in internal medicine units (Table 1).

3.2. Distribution of Characteristics Related to Falls

It was detected that 0.04% (n=616) of the patients included in the assessment fell and the average number of falls was 1.12±0.57 (Min=1, Max=6). It was also detected that the majority of the falls occurred between 00:00-08:00 (n=234, 38%) and within working hours during weekdays (n=447, 72.6%), in patient rooms (n=384, 62.3%), while the patients were on the movement (n=351, 57.0%), and in the form of fainting/collapsing (n=258, 41.9%) (Table 2).

The average fall risk score of patients who fell was 13.14±6.77 (Min=0, Max=45). The mental status of the majority of the patients who fell was oriented/cooperate (n=514, 83.4%), 64.9% (n=400) of the patients did not have a companion at the time of the fall, 73.5% (n=453) were given medical attention following the fall, and 56.8% (n=350) of the patients did not use drugs that increase the risk of falling (Table 2).

Table 1. *Distribution of the number of falls according to demographic characteristics, ward, year and month of hospitalization*

Variables		1 fall (n=571)	≥2 falls (n=45)	%
Age group 1	Newborn	2 (100)	0 (0)	[b].526
	1 month-1 year	22 (100)	0 (0)	
	1-5 years	51 (92.7)	4 (7.3)	
	6-10 years	14 (100)	0 (0)	
	11-16 years	8 (100)	0 (0)	
	17-25 years	21 (95.5)	1 (4.5)	
	26-35 years	33 (100)	0 (0)	
	36-45 years	44 (95.7)	2 (4.3)	
	46-55 years	68 (88.3)	9 (11.7)	
	56-65 years	114 (92.7)	9 (7.3)	
	66 years and above	194 (90.7)	20 (9.3)	
Age group 2	Newborn	2 (100)	0 (0)	[b].317
	Child	95 (96.0)	4 (4.0)	
	Adult	474 (92.0)	41 (8.0)	
Sex	Female	246 (95.0)	13 (5.0)	[a].063
	Male	325 (91.0)	32 (9.0)	
Unit	Internal	393 (92.7)	31 (7.3)	[a].993
	Surgical	178 (92.7)	14 (7.3)	
Ward-Unit	Emergency	33 (97.1)	1 (2.9)	[b].529
	Intensive care	27 (90.0)	3 (10.0)	
	Ward	511 (92.6)	41 (7.4)	
Year of hospitalization	2012	94 (92.2)	8 (7.8)	[b].006**
	2013	85 (89.5)	10 (10.5)	
	2014	97 (100)	0 (0)	
	2015	72 (88.9)	9 (11.1)	
	2016	65 (91.5)	6 (8.5)	
	2017	58 (87.9)	8 (12.1)	
	2018	60 (96.8)	2 (3.2)	
	2019	40 (95.2)	2 (4.8)	
Month of hospitalization	January	58 (96.7)	2 (3.3)	[b].729
	February	48 (90.6)	5 (9.4)	
	March	61 (95.3)	3 (4.7)	
	April	57 (91.9)	5 (8.1)	
	May	45 (93.8)	3 (6.3)	
	June	46 (92.0)	4 (8.0)	
	July	42 (97.7)	1 (2.3)	
	August	41 (89.1)	5 (10.9)	
	September	39 (92.9)	3 (7.1)	
	October	49 (94.2)	3 (5.8)	
	November	42 (89.4)	5 (10.6)	
	December	43 (87.8)	6 (12.2)	

[a]*Pearson Chi-Square Test* [b]*Fisher-Freeman-Halton Test*

Table 2. *Distribution of characteristics related to falls (N=160.119)*

		n	%
Status of fall	Yes	616	0.4
	No	159,503	99.6
Number of falls (n=616)	*Min-Max (Median)*	1-6 (1)	
	Avg±SD	1.12±0.57	
	1 time	571	92.7
	≥2 times	45	7.3
Time between fall and hospitalization (days) (n=616)	*Min-Max (Median)*	1-240 (8)	
	Avg±SD	14.24±20.87	
Time of fall (n=616)	08:00-16:00	196	31.8
	16:00-24:00	186	30.2
	00:00-08:00	234	38.0
Day of fall (n=616)	Weekday	447	72.6
	Weekend/Public Holiday	169	27.4
Area of fall (n=616)	Patient room	384	62.3
	Hallway	56	9.1
	Bathroom/Toilet	137	22.3
	On the way to surgery	11	1.8
	Place of surgery	26	4.2
	Intensive care	2	0.3
Place/moment of fall (n=616)	From bed/stretcher/table	220	35.7
	While on the move	351	57.0
	During replacement/ transfer	45	7.3
Type of fall (n=616)	Slipping	50	8.1
	Tripping	40	6.5
	Fainting/Collapsing	258	41.9
	Mistakes during transfer	50	8.1
	Falling from high	218	35.4
Fall risk score (n=616)	*Min-Max (Median)*	0-45 (12)	
	Avg±SD	13.14±6.77	
Mental status before fall (n=616)	Oriented/Cooperative	514	83.4
	Disoriented	56	9.1
	Confused	46	7.5
Presence of an accompanist at the moment of fall (n=616)	Yes	216	35.1
	No	400	64.9
Intervention after fall (n=616)	Yes	453	73.5
	No	163	26.5
Use of medication that increase the risk of fall (n=616)	Yes	266	43.2
	No	350	56.8

**Total number of fall cases reported*

3.3. Characteristics Related to The Time of The Fall and Distribution of The Practices Performed After The Fall

The distribution of the characteristics regarding fall risk, the moment of fall, and surgeries performed following the fall and its consequences are given in Table 3. According to Table 3, 95.5% (n=588) of the patients did not have a healthcare professional with them at the time of the fall, 84.7% (n=522) had the lights turned off in their room, and the floor was not wet or slippery in 98.2% (n=605) of the patients' rooms. Radiologic procedures were performed following 38.5% (n=237) of the falls, 3.2% (n=20) of the patients underwent blood tests, 47.6% (n=293) were monitored for vital signs, 7.1% (n=44) were asked for consultation after falls, and 50.5% (n=53) had minor injuries due to the fall (Table 3).

Table 3. *Characteristics related to the time of the fall and distribution of the practices performed after the fall (N=616)*

Variables		n	%
Fall risk assessment	Yes	475	77.1
	No	141	22.9
Fall protocol application	Yes	220	35.7
	No	396	64.3
Characteristics of patients at the time of fall			
Presence of a healthcare professional	Yes	28	4.5
	No	588	95.5
Lights being turned on in the room	Yes	94	15.3
	No	522	84.7
Wet or slippery room floors	Yes	11	1.8
	No	605	98.2
Characteristics of the applications performed after falls			
Radiological operations	Yes	237	38.5
	No	379	61.5
Blood test	Yes	20	3.2
	No	596	96.8
Vital sign monitoring	Yes	293	47.6
	No	323	52.4
Consultation	Yes	44	7.1
	No	572	92.9
Fall-related problems	Yes	105	17.0
	No	511	83.0
Level of problem*	Severe damages	36	34.3
	Intermediate damages	16	15.2
	Minor damages	53	50.5

**Calculations were made on 105 patients who developed fall-related problems.*

3.4. Logistic Regression Analysis Results of The Risk Factors Affecting Falls

Among the risk factors affecting falls, department, age group (2), and sex were evaluated using enter logistic regression analysis. The explanatory coefficient of the model was found to be 99.6%, which indicates a good level. According to the model, unit, age, and sex had significant effects on falls. Fall risk was 4.2 times higher in internal medicine units than in surgical units (95% CI: 3.6-5.1). Fall risk in adults was 2.3 times higher than in children (95% CI: 1.9-2.9). Fall risk was 1.2 times higher in males than in females (95% CI: 1.04-1.43) (Table 4).

Tablo 4. *Logistic regression analysis of risk factors affecting falls*

	%	ODDS RATIO	95% CI	
			Lower	Upper
Unit (Internal)	.001**	4.251	3.569	5.064
Age group (Child)	.001**			
Age group (Newborn)	.352	1.948	0.478	7.935
Age group (Adult)	.001**	2.322	1.862	2.895
Sex (Male)	.015*	1.220	1.039	1.432

**p< .05 **p< .01*

4. DISCUSSION

In the study, falls, which are one of the quality indicators and undesirable events that must be reported in inpatient treatment institutions, were retrospectively analyzed. Among a total of 160,119 patients who were hospitalized between 2012 and 2019, a total of 616 patients were found to have fallen. In another study conducted in Brazil, the incidence of falls between 2011 and 2015 was found as 1.7 per 1000 patients per day (11).

In the study, it was found that most of the falls occurred in female patients, patients aged over 66 years, and in internal medicine units. Similar results were obtained in another study (7). In a study conducted by Lee et al. (12), it was found that in a risk group of 2227 patients with an average age of 61±15.04 years, 309 of them fell. It is stated that fall risk increases with age due to comorbidities (7,13). However, another study stated that demographic variables such as age and sex were not risk factors for falls (14). It has also been found that the majority of falls occur in emergency units and psychiatric clinics (11).

By investigating cases of falls in our study by year, a significant decrease was observed in the number of falls between 2012 and 2019. This decrease may be related to the fact that the quality indicator studies in the research hospital have not accelerated since 2012 and records of falls have been kept more regularly since then.

Similar to some studies in the literatüre (7,14,15), our study found that most falls occurred during night shifts. Contrary to these results, some studies stated that fall incidence was higher during day shifts because more personnel caused increased activity among patients (16,17). As stated by Türkmen (18), the number of patients per nurse on night shift is quite high in Turkey (1:25). Therefore, this result of our study may be associated with the inability to closely monitor patients due to the limited healthcare personnel working night shifts.

In the study, it was detected that falls occurred in the patient's room while patients were on the movement and in the form of fainting/collapsing. Contrary to the result of our study, some other studies (14,19) reported that patients mostly fell from a chair/couch or a bed.

In the study, similar to other studies in the literatüre (14,20), it was found that most of the patients who fell were alone at the time of the fall and there were no accompanists or healthcare personnel with them (21). Therefore, interventions are suggested such as scheduled toilet times, regular nurse rounds, admitting fall-prone patients to rooms that are directly visible from or close to the nursing stations (14), routine hourly nurse visits, fall alarm sensors in beds, and installing video cameras in patient rooms (22). As a result, nursing activities can be planned to prevent patient falls. In another study conducted on this subject, it was found that the majority of nurses' preventive nursing activities for individual falls included assessing the patient's visual status (99.2%), reviewing the medications used by the patient (99.2%), evaluating the patient's fall history (99%), communicating effectively with the healthcare team (99%) and knowing the risky medications used by the patient (99%). It was determined that the intervention that the nurses stated that they practiced the least was having the patient perform walking-balance-strengthening exercises (58.5%) (23).

In the study, the mental status of the majority of patients who fell was good. Similar to the result of our study, Najafpour et al. (14) stated that most patients who fell were conscious and well-oriented; disorientation, confusion, or agitation did not increase the risk of falling. In another study, a strong relationship was found between concentration difficulties and falls (22). Relationships between mental disorders and concentration difficulties can be further investigated in studies examining falls.

In the study, it was found that the patients who fell were not using any medication that would increase the risk of falling. It was stated that there was no relationship between medication and fall risk (24). Contrary to this, in another study, it was emphasized that medication played an important role in in-hospital falls and the Medication Fall Risk Score could be used to identify patients who are at high risk of falling (25). In the study by Najafpour et al. (14) the use of sedative drugs, anti-convulsant drugs, anti-diabetic drugs, benzodiazepine, angiotensin-converting enzyme (ACE) inhibitors, anti-infective agents, antihistamine, and chemotherapy drugs was associated with a higher probability of falling. In the study, the relationship between the fall risk and the medication used by patients who fell was not tested. Further studies should investigate the relationships between medication use and fall risk.

In the study, the ITAKI and HARIZMI Fall Risk Scales were used to determine fall risk. According to the results of our study, the average fall risk score of the patients who fell was normal for the adult patients and high for the pediatric patients. In the present study, patients with a score of five and above on the fall risk scale were included in the evaluation. The primary purpose of fall risk assessment is to identify patients with a high risk of falling and prevent them from falling by making interventions specific to the risk factors of the patients (9). Therefore, it is very important to use valid and reliable risk assessment tools in all inpatient treatment institutions.

In the study, it was identified that the lights were mostly off in the patients' rooms and the floor was not wet or slippery at the time of falling. Visual impairment is seen as a factor

contributing to falls in hospitals (26). It may be beneficial to perform eye examinations on patients by nurses and to warn staff about patients who are at risk of falling due to poor vision to implement preventive measures. On the other hand, it is known that the floor in the patient room is an extrinsic factor that increases the risk of falls (27-29). Therefore, attention should be paid to ensuring that the patient's room and other places used by the patient (e.g. toilet, bathroom) are not wet or slippery. In this regard, regular training should be given to cleaning personnel in the hospital. Employees should be warned about the patient is at risk of falling by placing warning symbols in the rooms of patients at risk of falling.

In the study, it was identified that patients who fell usually developed minor fall-related injuries, and 34.3% (n=36) had severe injuries. Hitch et al. (20) reported that 42% of falls resulted in injuries. In another study, it was found that 8% (n=109) of all falls resulted in severe injuries and the most common were fractures, concussion, lacerations, and hematoma (3). Moreover, other studies also stated that more than 63% of falls were associated with mild to severe injuries (14). Serious health problems may develop after a fall. Patient falls both increases the time of hospitalization and the cost of care, and lawsuits may be filed as a result of complaints due to injuries. Therefore, it can be suggested to broadly examine injuries after a fall and investigate how the fall occurred and its related factors by conducting qualitative interviews with the patients to facilitate developing specific preventive measures in hospitals.

In the study, it was determined that vital signs follow-up and blood tests were performed, radiologic procedures were performed, and consultation was requested in patients who fell. Patients who fall should be evaluated for their consciousness levels, vital signs, presence of pain, and visible injuries in line with the local policy and incident/accident intervention procedures, without being moved after the fall. Nurses should be aware of the patients' medical history, laboratory results, and prescription drugs that can increase the risk of injury (e.g. warfarin) due to falls (28). In addition, after a fall, patients with cardiovascular disease should undergo electrocardiography (ECG) and their peripheral oxygen saturation levels should be checked. Blood glucose levels of patients with diabetes should be measured. Anti-coagulant or anti-thrombotic drugs are particularly risky for patients with head trauma after a fall because of the risk of cerebral hemorrhage or other types of internal bleeding (30,31). Patients who fall should be evaluated rapidly through physical examinations and consultation should be requested from other disciplines if needed.

In the study, it was found that age groups, sex, and the unit of hospitalization had significant effects on falls. One study reported that the male sex was a significant predictor of severe fall injuries (3). By contrast, another study found that patients who fell were mostly female (7). Similar to our study, age, sex, and unit were reported among the factors that affected falls (12).

The major limitations of the research included conducting the research at a single center and obtaining data retrospectively from fall report forms. In addition, not being able to examine injuries in detail following falls and not being able to obtain qualitative data related to falls were among the limitations of the research. Another limitation is that pediatric and adult patients were evaluated in the same study.

5. CONCLUSION

As a result of this retrospective study, which included a total of 8 years, falls decreased in number by the year. The majority of the falls occurred during night shifts, in the patients' rooms, when the patient was on the movement, and when they were alone. In addition, male sex, adult patients and internal medicine units were significant factors that increased the risk of falls. To prevent falls, it is very important to conduct further studies to investigate the incidence of falls and their risk factors. The prevention of falls is an important subject that needs to be handled seriously in healthcare institutions. The functionality and quality of life of patients can change substantially as a result of falling. Nurses play an important role in the prevention of falls. Nurses should evaluate each patient in terms of fall risk using a valid and reliable scale. To prevent falling, necessary safety precautions should be taken, especially for male adult patients, and patients in unaccompanied departments. Night lamps should be used in patient rooms during the night.

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