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The Effect of falls on Medical Costs among Elderly Inpatient; A Case-Study in Iran

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ABSTRACT

Objective: Falls are the main cause of injuries and death among the elderly and lead to using medical services. This study aimed to assess the effect of falls on medical costs among elderly inpatients.

Methods: This retrospective cross-sectional study was done in a public hospital (heart center) in Qazvin, Iran. In this study, 79 medical records of the elderly who had experienced in-hospital falls and 79 medical records in control group with similar characteristics who had not experienced in- hospital falls during 2016-2019. The data, including the elderly age, sex, fall characteristics, and all hospital costs related to falls were gathered from hospital accident forms, medical records, nursing reports, and official data banks. The overall costs of services provided for fallen elderly were compared with the control group. The data were analyzed by SPSS software, version 22, using Chi-square and paired sample t-test. $P<0.05$ was considered statistically significant.

Results: Total cost of all services provided for the elderly during their hospitalization was 106.596$ (base year: 2019, $1=42500 IRR), of this amount 8.600$ (8.06%) was related to the services due to in-hospital falls. The highest costs were related to treatment services (40%), diagnostic services (33%), visits (21%) and consultation (6%). The difference between the case and control groups was 7.310$. The elderly falls significantly increased medical costs by 8.06% ($P\leq0.01$).

Conclusions: Even falls that do not lead to serious injuries waste medical services and increase hospital costs by making changes in treatment methods and increasing the length of hospital stay.

Keywords: Elderly; fall; Cost; Medical services

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Introduction

Aging would become a major global and national challenge for the healthcare system in future decades. Falls are among the most common and serious causes of disability, hospitalization, and death among the elderly leading to personal and social problems, reduced quality of life, and need for care, and impose health and medical costs (1,4). According to the National Health Service (NHS), falls are among the 28 accidents that should never occur in hospitals (5). The percentage of people over the age of 60 years will increase from 12% in 2015 to 22% (1.2 billion) in 2050 worldwide (6). An increasing number of falls was also seen in Iran's elderly population (from 3.8% in 1966 to 6.1% in 2012) (7).

About 28% - 35% of the elderly (almost about one third of those over the age of 65 years) fall each year. For individuals over the age of 70, this percentage increases to about 32%-42%, and further increases for those over the age of 80. About 30-50% of the elderly residing in nursing homes fall once and about 40% of them experience recurrent falls, and more than 50% of inpatients comprise individuals over the age of 65 years (8). Falls are the results of interactions between biological, behavioral, environmental, social, and economical factors (8). In a study in Iran, 46.9% of the elderly had fallen three times, 33.8% twice and 9.4% once (9).

Although it seems impossible to fall in hospitals, in addition to physicians and healthcare workers (10), falls are very common among inpatients. According to the patients fall index (a tool for assessing care quality and calculating financial burden on the country's medical health system), 3.7 to 7 falls occur among every 1000 patients per day which is equal to 6-14% of hospital admissions (11-13).

In hospital falls comprise 26% (324000 cases) of accidents that endanger people's lives yielding an annual cost of two billion pounds (14).

Many factors increase the occurrence of falls, such as depression, cognitive, situational, visual, and musculoskeletal impairments, use of motor-aid instruments, history of previous fall, medical conditions, such as cardiovascular diseases, infection, Parkinson's disease, stroke, osteoarthritis, depression, use of medication, female sex, and old age (15,16).

The simultaneous existence of several risk factors would further increase this possibility (17).

Falls worsen public health conditions because of physical complications, such as hematoma, bruise, hemorrhage, fracture, and death, and also metal problems, such as post-fall syndrome characterized by dependence, confusion, immobility, depression, and limited daily activity (18,8,11,13). Ten to 15% of falls lead to severe injury, 5-10% causes various types of fracture, and 30% lead to death (19,20,11). In 2002, more than 12900 elderly lost their lives due to falls (20). In addition to the abovementioned consequences, the long-term effects and costs of falls among inpatients not only affect the elderly, but also place a considerable burden on hospitals and the healthcare system (21,15). It consumes medical services and as a result increases medical costs (22,23). These costs include hospitalization and treatment services, surgical procedures, radiographs, diagnostic services, and rehabilitation measures (11,17).

Various studies have been done to calculate the financial burden of falls in the elderly worldwide. The NHS has estimated the treatment and hospitalization costs of falls more than 630 million pounds which is equal to 87% of all treatment costs (5).

In Finland and Australia, the average health system cost per one fall injury episode was 3611 US$ and 1049 US$ (24). Moreover, studies in America have shown that this number was 11 million dollars in 2010 (25).

Cost estimates are necessary for making a correct decision for resource allocation and prioritizing healthcare decisions (26).

The comparison of international studies is difficult due to differences in healthcare systems, different populations, and use of different research designs, data collection, and cost estimates. Despite these challenges, researchers agree that considering the increasing trend of the elderly

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population throughout the world, the financial burden imposed on the health system and treating these patients is on the rise (21).

Considering the importance of this issue and lack of studies assessing fall costs in Iranian elderly, we aimed to assess the effects of falls among elderly inpatients on medical costs in one of the hospitals in Qazvin, Iran, from March 2016 to February 2019.

Materials and Methods

In this cross-sectional study, all 115 records of people who had experienced in-hospital falls and never events were gathered from hospital accident forms from March 2016 to February 2019 in Booali hospital in Qazvin, The inclusion criteria were: age over 60 years, experiencing fall in sitting, standing and lying position (falling off the bed), medical procedures were performed for these fallen elderly, and Availability of complete costs and payment information during hospitalization. Among the elderly entered the study, those with the mentioned characteristics were excluded from the study: age less than 60 years (8 cases), lack of cooperation (two cases), no medical action taken and only nurse examination performed (5 cases), death (because of no control for comparison, 5 cases), other never events than fall (19 cases). By omitting the above mentioned cases, the sample consisted of 79 elderly who had experienced at least one type of fall and one medical procedure has been performed for them. With the permission of hospital authorities and removing the names of those in the case group for confidentiality, data were gathered from hospital accident forms, medical records, daily reports of nursing stations and official data banks. During the assessment the demographic and payment information was gathered from fallen elderly's record. Table 1 show the information from patients' record.

Table 1. Information extracted from fallen elderly's records

Patient information
- Age and sex
- Mode of admission
- Patient's state of consciousness upon admission
- Final diagnosis of illness
- Admitted ward
- Received medication 24hours before the accident
- Mental state and consciousness 24 hours before the accident

Details of fall
- Type of fall
- Method of diagnosis
- Day and hour of fall
- Place of fall
- Preventive measures taken before the fall
- Measures taken during the first minutes after the fall
- Type and severity of injury
- Medical procedures done after the fall with respect to revisits, specialist consultation, diagnostic procedures, and treatment actions

Cost information
- Type of insurance
- Cost of provided services (revisits, specialist consultation, diagnostic procedures, and treatment actions
- Total costs

Some factors that affect falls, such as the elderly's musculoskeletal power, the effect of education on the patients' and their families' knowledge, and the nurses' level of awareness (15,17,22,27,28), could not be assessed; since the patient, his/her family, and the nurse in charge at the time of fall were not available. The type and severity of trauma were categorized as follows

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after being visited again: 1) Minor injury: inflammation, itching, pain, minor bleeding, 2) Moderate injury: bleeding that requires bandage, bruise needing stitches, trauma to the head and forehead, 3) Major injury: splinting, a variety of fractures leading to plaster, severe trauma to the skull and heart attack.

All provided services, cost of each service, and total paid expenses were extracted from the records. The provided services due to falls were separated from other services and classified into four categories, including visit, counseling, diagnosis, and treatment. After subtracting costs related to falls, each person's bill was prepared based on the final diagnosis and categorized into the main groups (cardiovascular, nervous, and infectious) for different types of disease. This method insured suitable categorization and data integrity. Moreover, a suitable control was found for each patient matched with respect to final diagnosis of the disease, age, sex, provided services, and total costs. The control group had not experienced any falls or accidents. The required data for comparison were extracted from the records of the elderly in the control group.

The data were analyzed by SPSS software, version 22 using Chi-square and paired sample t-tests. $P<0.05$ was considered as statistically significant. Moreover, all costs were converted based on the CPI index provided by Iran's National Statistics Center for the year 2019.

Results

The research findings were divided into three sections, including patient information, details of falls, and cost information.

Patient information: demographic and characteristics of the elderly who had fallen

As shown in Table 2, the mean age of the elderly was 73.85 years and falls were 1.32% more prevalent in women ($P<0.044$). The highest rate of falls was observed in the elderly patients with cardiovascular diseases (43/79: 54.44%) and in the cardiology ward (22/79:27.85%).

Table 2. Demographic characteristics of elderly patients who had fallen and circumstances of falls: Base-year: 2019

Patients' characteristics	Inpatients Who Fell (N=79) n (%)	p*
Age (mean age)	73.85	
Sex		≤0.044
• Female	45 (56.96%)	
• Male	34 (43.03%)	
Mode of admission		≤0.001
• Ambulance	12 (15.18%)	
• In person	67 (84.82%)	
Patient's state of consciousness upon admission		≤0.004
• Conscious	54 (68.35%)	
• Semi-conscious	16 (20.25%)	
• Unconscious	9 (11.4%)	
Final diagnosis of illness		≤0.047
Cardiovascular disease		
• Cardiac disorders	**43 (54.42%)**	
• Hypertension	19 (24.05%)	
• Stroke	11 (13.93%)	
• Asthma	8 (10.12%)	
Neurological diseases	5 (6.32%)	
• Limb numbness	**19 (24.05)**	
• Convulsion	11 (13.93%)	
Infectious disease	8 (10.12%)	
• Fever and shivering	**17 (21.53%)**	
• Nausea and poisoning	11 (13.93%)	
	6 (7.6%)	

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Patients' characteristics	Inpatients Who Fell (N=79) n (%)	p*
Inpatient ward		≤0.048
• Internal	18 (22.79%)	
• Surgery	5 (6.33%)	
• Neurology	13 (16.45%)	
• Cardiology	22 (27.85%)	
• CCU, ICU	8 (10.12%)	
• Infectious	13 (16.46%)	
Received medication 24 hours before the accident		≤0.006
• Receiving medication effective on level of consciousness**	62 (78.47%)	
• Not receiving medication effective on level of consciousness	11 (13.93%)	
• Unclear	6 (7.6%)	
Mental state and consciousness 24 hours before the accident		≤0.009
• Conscious	29 (36.7%)	
• Semi-conscious	50 (63.3%)	
Type of fall		≤0.513
• Same level falls	40 (50.63%)	
• Fall from elevation	39 (63.49%)	
Method of diagnosis		≤0.014
• Reported by nurse/nurse aide/ward personnel	47 (59.49%)	
• Reported by patient companion	20 (25.31%)	
• Reported by patient (self-report)	12 (15.18%)	
Day of fall		≤0.009
• 1-4 days after admission	58 (73.41%)	
• 5-10 days after admission	21 (18.98%)	
• 11 days or more after admission	6 (7.59%)	
Hour of fall		≤0.034
• From 7 AM to 6:59 PM	31 (39.24%)	
• From 7 PM to 6:59 AM	48 (60.75%)	
Place of fall		≤0.007
• Patient's room	54 (68.35%)	
• Bathroom or restroom	9 (11.39%)	
• Hallway or yard of hospital	12 (15.18%)	
• Other places (laboratory and radiology ward)	4 (5.06%)	
Reason of fall		≤0.0019
• Sleeping/turnover on bed	7 (8.86%)	
• Sitting on/getting of the bed/ movements	41 (51.9%)	
• Confusion/fainting	11 (1.92%)	
• Loss of balance/slipping/slippage	20 (25.31%)	
Preventive measures taken before the fall		≤0.009
• Training patient/companion	62 (78.48)	
• Using bedside sleeper	79 (100)	
• Maximize sleep environment (light, fences, etc.)	51 (64.55)	
• Alarm	-	
• Drug monitoring	16 (20.25)	
• Sleep and rest supervision policy	56 (70.88)	
Measures taken during the first minutes after the fall		≤0.006
• Keep the patient immobilized and ask for a house call doctor immediately.	53 (63.29%)	
• Transfer patient to visit a doctor in less than 2 hours after fall.	26 (36.7%)	
Type of injury		≤0.002
• Upper limbs injured (head, neck, shoulder)	36 (45.57%)	
• Middle limbs injured (hand/abdomen/chest/uterus)	16 (20.25%)	
• Lower limbs injured (pelvis, leg)	27 (34.18%)	

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Patients' characteristics	Inpatients Who Fell (N=79) n (%)	p*
Severity of injury		≤0.247
• Mild	32 (40.5%)	
• Moderate	24 (30.39%)	
• Severe	23 (29.11%)	
Medical procedures done after the fall		≤0.121
• Re-visit	79 (100%)	
• Specialist consultation	41 (51.9%)	
• Diagnostic procedures	70 (88.6%)	
• Treatment actions	79 (100%)	

* P≤ 0.05 considered statistically significant.

** These medicines, such as sedatives, painkillers, sleeping drugs, insulin, hypotensive drugs, etc. have side effects, such as decreased consciousness, dizziness, drowsiness, loss of balance, rapid hypotension, and etc.

Description of falls

Table 2 reveals the rate of reporting falls by the ward personnel and those accompanying the patients was 5.5% more than the self-reports. Most falls occurred 3.2 days after admission from 7 P.M to 7 A.M (60.75%, n=48). With respect to the place of falls, the patient's room was the most prevalent place (68.35%, n=54) and the bed was the most important factor contributing to falls, so that 60.76% of the falls were due to "fall from bed" during sleep or when awake.

Of the 48 (60.76%) cases of bed fall, 5 elderly (10.41%) fell during sleep, 27 (56.25%) while getting off the bed (for going to the rest room of getting on a wheelchair, etc.), 12 (25%) while trying to sit on the bed, 2 (4.17%) when trying to turnover on the bed, and 2 (4.17%) when trying to take something off the bedside. Use of bedside (n=79, 100%), training (n=62, 78.48%), and monitoring the patient during sleep and rest (n=56, 70.88%) were the most prevalent preventive measures.

The highest rate of trauma was head injury, hematoma, bruises requiring stitches, forehead fracture, trauma to the shoulder and clavicle (n=36, 45.57%), injury to the lower limbs, including fracture of the thumbs and pelvis, knee injury (n=27, 34.18%) and injury to the upper limbs, such as fracture of the fingers, injury to the wrist, elbow, and chest (n=16, 20.25%). 29.11% (n=23) of these traumas were severe and led to splinting, plastering, and surgery. In 24 (30.39%) of the patients, injuries led to hemorrhage and stitching. Minor bruises and inflammation were seen in 32 (40.5%) patients. In 41 (51.9%) patients, consultations were done with a neurologist, orthopedic surgeon, ophthalmologist, and internal specialist. Diagnostic methods (CT scan, radiography, Sonography, EEG, and ECG) were taken for 70 (88.6%) patients and some underwent more than one diagnostic method (Table 3).

Table 3. Type and number of diagnostic procedures

Type of diagnostic procedures	N (%)	p
Diagnostic procedures	**423 (100%)**	
CT Scan	**132 (31.22%)**	≤0.048
• Spiral brain	38 (28.78%)	
• Lung and mediastinum	17 (12.88%)	
• Abdomen and pelvis	34 (25.76%)	
• 3D face and body scan	12 (9.1%)	
• Limbs	28 (21.21%)	
• Others	3 (2.27%)	
Radiography	**169 (39.96%)**	≤0.032
• Chest	35 (20.71%)	
• Pelvis	44 (26.3%)	
• Skull	29 (17.16%)	
• Shoulder	11 (6.5%)	
• Limbs (hands/legs)	36 (21.31%)	
• Others	14 (8.29%)	
Sonography	**90 (21.27%)**	≤0.018
• Abdomen and pelvis	29 (32.22%)	
• Neck	14 (15.55%)	
• Abdomen	9 (10%)	
• Liquid in pylorus	12 (13.33%)	
• Pelvis	15 (16.66%)	
• Uterus and ovaries	7 (7.8%)	
• Others	4 (4.44%)	
Electrocardiogram (ECG)	**18 (4.25%)**	
Electroencephalogram (EEG)	**14 (3.3%)**	

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Minor and major treatment measures were taken for all patients. The most prevalent and cheapest treatment approach was prescribing medication and serums and minor wound healing based on the location and severity of injury. Forty seven (59.5%) patients received more than one type of treatment. The most expensive and least prevalent treatment was surgery which accounted for 77% of the healthcare service costs. Hip fracture surgery was the most prevalent surgery (n=5/9, 55.5%) (Table 4).

Cost information

The cost information extracted from the patients' medical records is shown in Table 6. The cost of medical services provided to the elderly due to fall-related injuries is 8.06% of the total treatment costs of the elderly during the hospitalization period. Moreover, 72.53% of the provided services due to falls were related to diagnosis and treatment. As shown in Table 5, the highest amount was related to treatment services 3.409 US$ (39.63%) and the lowest related to consultation 599 US$ (6.96%).

Table 6 shows the characteristics of the control group, which were matched with the case group.

Table 4. Type and number of treatment actions

Type of treatment actions	N(%)
Take medicine/ointment /serum	79 (100)
Compression/ Superficial Treatment of wounds	9 (11.39)
Bandage	23 (29.11)
Stitches and gauze	24 (30.37)
Splinting	11 (13.92)
Plastering	14 (17.72)
Surgery	9 (11.39)
Physiotherapy	35 (44.3)

Table 5. The financial information of case group invoice: base year: 2019

Patients characteristics	Inpatients who had fallen (N=97) n(%)	p
Type of insurance		≤0.011
• Health services	28 (35.44)	
• Social security	47 (59.5)	
• Others	4 (5.06)	
Cost of provided services due to fall	8.600$ (365,461,250 IRR, 8.06)	≤0.041
• Visits	1.764$ (74,968,630 IRR, 20.51)	
• Specialist consultation	599$ (25,463,020 IRR, 6.96)	
• Diagnostic procedures	2.828$ (120,175,850 IRR, 32.9)	
• Treatment actions	3.409 (144,853,750 IRR, 39.63)	
Total costs (including fall costs)	106.596$ (4,530,304,580 IRR)	
Total costs if no fall occurred	97.996$ (4,164,843,230 IRR)	
Costs of fall	8.600$ (365,461,250 IRR)	

To assess the effects of falls on medical costs and to compare case and control groups, independent t test was used. Initially, the fall-related costs were subtracted from the total hospital expenses of the elderly and then the total costs of both groups were compared, which showed no significant difference between the two groups (P>0.05, Table 7).

Then, t-test was performed again for the total cost of the case group (including the cost of fall-related services) as well as the control group. As shown in Table 7, the mean difference between the two groups in case of falls and receiving related services was 7.310 US$ (310,651,500 IRR) which showed that falls significantly increased medical service costs in the hospital (P≤0.01, CI:0.99).

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Table 6. Characteristics of elderly who did not fall (control group): base year: 2019

Characteristics	N=79 n(%)	P-value
Age (mean)	74.01	
Sex		≤0.043
• Male	32(40.5)	
• Female	47(59.49)	
Type of disease		≤0.038
Cardiovascular disease	**43 (54.44)**	
• Heart disorders	20 (25.32)	
• Hypertension	10 (12.66)	
• Stroke	10 (12.66)	
• Asthma	3 (3.8)	
Neurological disease	**19 (24.05)**	
• Limb numbness	10 (12.65)	
• Convulsion	9 (11.4)	
Infectious disease	**17 (21.51)**	
• Fever and shivering	11 (13.92)	
• Nausea and poisoning	6 (7.6)	
Total cost paid	**99.286$ (4,219,653,080 IRR)**	

Table 7. The comparison between the total costs base year: 2019

		The comparison between the total cost of the case group (excluding the cost of services provided due to falls) and the control group		The comparison between the total cost of the case group (including the cost of services provided after falls) and the control group	
F		3.663		2.345	
P-Value		0.473		0.473	
T		4.48	4.48	3.26	3.26
Degrees of freedom		26	26	26	26
p-value		0.138	0.138	0.001	0.001
Mean difference		5480975	5480975	310651500	310651500
Standard error difference		7.168	7.168	4.082	4.082
95% confidence interval of the difference	Upper	6.162	6.197	3.107	3.223
	Lower	9.163	9.144	5.132	5.024
Mean	Case	Fall cases	4164843230 IRR (97996$)	fall cases	4530304580 IRR (106596$)
	Control	Cases had not fallen	4219653080 IRR (99286$)	Cases had not fallen	4219653080 IRR (99286$)

* P≤0.01 considered statistically significant.

Discussion

Elderly's falls are among the serious and common hospital complications (13). These falls impose a considerable financial burden on hospitals each year and leave a negative effect on the limited resources of counties' healthcare system due to the services they consume, length of stay (LOS) and costs (15,23). The results of the study showed that increasing rates of falls in the hospital, especially among the female elderly and those with chronic diseases, would increase the cost of medical services.

The World Health Organization (WHO) states that "age over 60 years" and "female gender" are two biological factors that increase the possibility of falls (8). Many studies have shown that falls are more prevalent in elderly women (4-17-20-22-30). Hartholt found that women fall 2-3 times (58%) more than men (22). It was found that 56.96% of the falls were related to women and 43 % related to

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men, showing 1.32% increase in the rate of falls in women. According to the WHO reports, the rate of life-threatening falls increased with age in both sexes and the highest rate was seen in individuals over 85 years. Moreover, falls leading to death were more prevalent in men while falls occurred more in women (8).

A study in 2015 showed that, about 64% of admitted elderly experienced falls, 54% of which led to death (35). In the present study, 79.74% of personal referrals in the elderly led to falls and 89.86% of the falls led to severe injury. This rate would increase as the number of elderly increases in the society. Osteoporosis, especially in women leads to lower ability to maintain balance and increased incidence of severe fatal falls. Stevens studied the effect of underlying diseases in increasing the risk of falls (20). Studies have shown the effect of cardiovascular disease on the risk of falls in the elderly (15,36,37). The chance of falling increases with a history of myocardial infarction (18). In the current study, the highest number of falls and fall-related costs were due to cardiovascular diseases, so that the elderly with such diseases comprised 54.42% of the falls and 64% of the fall-related costs (5.505 US$). This could be attributed to the use of heart medications that cause a sudden decrease in blood pressure, blurred vision and loss of balance. Sudden change of mood (from supine to standing) could also be effective in causing falls.

Neurological diseases, such as stroke (89%), Parkinson's disease (77%), epilepsy (57%), headache (28%), delusion (60%), multiple sclerosis, and migraine increase the rate of falls (16,38,39). Another study also showed that Parkinson's disease, syncope, and other neurological diseases increased the possibility of falls by 62%, 57%, and 48% in the elderly, respectively. Stroke, Parkinson's disease, chronic pain, dizziness, loss of balance, and weak eye sight increase the risk of falling (19). It was also found that elderly patients with neurological diseases comprised 24.05% of falls with a cost of 1.729 US$ (20.10%). Most of these falls were due to taking certain medicine, sudden neurological attacks, and related cognitive and environmental disorders leading to lack of balance and falling.

Some studies have shown that the elderly with a history of infectious disease (influenza, pneumonia, etc.) have a higher chance of falling (22). In the present study, the elderly with a history of infectious disease comprised 21.53% of falls with a cost of 1.366 US$ (15.89%). Considering the wide range of infectious diseases that affect different body organs and have various complications, should be carefully monitored in patients with a history of fall. Infectious diseases present with symptoms, such as fever, diarrhea, dizziness, and the side effects of medications (dizziness, low muscle power, etc.) contribute to increase the risk of falling.

Most falls occur at night (13,40) which is in line with the present study in which 60.75% of falls occurred during 7 PM to 7 AM ($P \leq 0.034$). Visual disorders increase the chance of falls and people with these disorders are more vulnerable in the dark and when tired. Other causes of falls in these hours include consumption of several drugs and their effect on the brain and level of consciousness, being unfamiliar to the environment and existence of physical obstacles, frequent visits to the toilet during the night, the incorrect culture of not requesting help due to shame, and lack of supervision on the nurses' behalf.

Most falls were in room and due to falling from the bed (13). A study showed that 51% of the falls result from sitting and getting out of bed leading to minor (95%) and major (5%) injuries (41). Other studies have also indicated that the bed is an important factor leading to falls (13,42-44). It was found that 60.76% of the falls were related to the bed and 68.35% occurred in patients' rooms. Given the elderly spend most of the time in their room, prolonged rest reduces their muscle strength leading to imbalance. Falling off the bed could be due to wearing tight or loose clothing (and in our country wearing veils during rest), fear of sleeping on the bed, location of the bed, and its height. Some falls were the result of dislocation of the bedside, not being able to lower it, and attempting to get of the bed while the bedside is still up. It is

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necessary to add physiotherapy to the daily preventive programs of patients at risk to increase their muscle power and help them gain balance. Moreover, the correct method of using the bedside should be simple and clearly explained.

In this study, 91.13% of the patients had fallen when they were conscious or semi-conscious which was consistent with another study (13). However, two other studies did not find such results (45,46). The contradictory findings could be attributed to chance and it seems that conscious patients reported more falls or they were more aware of their injuries and described injuries better. Ten-20% of falls lead to serious injury and fracture (20) and 20-30% of falls lead to hip and head trauma (18). Moreover, hip fracture is the most prevalent trauma and comprises 70% of the costs (24). In the present study, the most prevalent injury was head injury and fractures and surgeries comprised more than 77% of medical costs.

With respect to the costs of falls in the elderly, many studies have been done. The difference between the costs mentioned in different studies is related to the different healthcare systems, different participation plans of insurance companies, different types of injuries, and treatment plans, the advanced technologies available in some countries, different sample sizes, different data collection and analysis methods, which complicate comparison (21,26,35). What all studies have in common is that fall-related costs impose a considerable financial burden on the hospitals and healthcare systems of all countries. This amount would further increase as the number of the elderly increases (15,21,22). The cost of falls in the elderly has been studied extensively in America. In America and England the cost of fatal and non-fatal falls adds up to 23.3 and 1.6 billion dollars, respectively, each year. The mean cost of falls is 3.476 dollars per person and it can increase to 10.749 dollars in falls leading to injury and 26.483 dollars for those requiring admission (41). In 1997, 9% of the American elderly fell yielding a cost of 6.2 million dollars (2.039 dollars per person) and this amount increased to 7.8 million dollars in 2022 (2.591 dollars per person) (17). In 2000, 10300 fatal falls and 2.6 million non-fatal falls leading to injury occurred in America (42% in hospitals and 50% at home). The cost of fatal and non-fatal falls has been estimated to be 0.2 and 19 billion dollars, respectively, 63% of which were for admission services and hospital stay (12 billion dollars), 21% for visits and consultation (4 billion dollars) and 16% for treatment services. In 2010, the cost of falls in healthcare centers of America was 11 million dollars (25). In 2012, 616.5 million dollars was spent for fatal falls and 30.3 billion dollars for non-fatal falls; which increased to 637.5 million and 31.3 billion dollars in 2015 (20,21,34). Twelve percent of American elderly reported falling in 2015 which means 80 million falls (37.2 falls for every 100 person) and 9.9 million led to injury (4.38 per 100 person) (25). In 2015, fatal and non-fatal falls cost 50 billion dollars in America (15). In the same year, treatment costs (surgery, radiography, etc.) for patients who had fallen was 4200 dollars more than costs for patients who had not fallen (11). In England, the cost of falls (treatment, admission, and litigation) comprised 87% of total treatment costs (2.3 billion pounds (5). Annually, more than 2 billion pounds are spent on fall-related injuries. Hospital falls comprise 26% of accidents (324000 cases) (14). In Finland and Australia, the mean cost of each injury due to falls is 1.049 to 3.611 dollars. The mean admission costs for each fall leading to injury in the hospital is 6.646 to 14.483 dollars (24). In 2001 and 2002, falls cost 498 million dollars. The mean financial burden on the healthcare system was 6500 dollars for each fall (47). In 2006 and 2007, 507000 falls occurred in the New South Wales leading to 143000 medical procedures and a cost of 558.5 million dollars. Eighteen percent of costs were related to admission and 84.5% related to medical services (26). In Australia, of the 27026 admitted patients, 966 experienced falls and 313 were injured. These rate increased hospitals stay for up to eight days and imposed 6669 dollars on hospitals (23). Fall-related costs have been estimated to be 43.8 billion dollars in 2020 (37).

Limitations

The most important limitation of the study is that it was a single-center study. Also, cost

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calculations were difficult due to price fluctuations and inflation. Due to lack of information, the effect of falls on the LOS could not be considered. Moreover, assessing primary and secondary state of consciousness could differ based on the nurse's knowledge and experience. The effect of factors, such as physical characteristics, BMI, muscular strength, history of previous fall, severity of illness, amount of care, and insurance support could not be assessed. Lack of similar national studies for comparison was also a big challenge.

Conclusion

The results of this study showed that even falls that do not lead to serious injury, waste medical services and leave negative effects on hospital resources and the healthcare system and increase hospital costs by 8.06%. This increase in costs could be due to changes in treatment methods and increase the LOS. It indicates the necessity of existence and implementation of fall prevention programs in hospitals, emphasizing supervision, control, and training. This is not only necessary for reducing fall-related injuries, but also for reducing hospital costs. Intervention strategies reduce falls and as a result decrease the cost of health services.

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Author's contribution

All authors contributed to this project and article equally.All authors read and approved the fainal manuscript.

Conflict of Interest

No potential conflict of interest was reported by the authors.

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