

Exploring Effective Factors in Reducing the fall of Hospitalized Patients: A Systematic Review

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Abstract

Background and Objectives: Patient's fall is one of the factors threatening a patient's health in hospitals and medical centers, which in some cases can lead to disability or death. Therefore, this study was conducted to systematically examine the factors affecting the reduction of patient falls in the hospital. **Materials and Methods:** This systematic review was conducted to identify the factors affecting the reduction of patient's fall in the hospitals based on the Prisma protocol. On this basis, all English-language articles published in this field from 1990 to the end of September 2019 were extracted during a search in four international databases and publishers including Web of Science, PubMed, Scopus, Science Direct, and Google Scholar. Articles were searched and screened by three researchers independently and finally, the extracted articles were analyzed and classified through thematic content analysis. **Results:** According to the Prisma protocol, 6227 studies were extracted, of which 32 studies were finally included in the study process. Then, the thematic analysis of the studies showed that factors such as education, exercise, attention to physiological factors and treatment of the disease, environmental safety, use of fall detection device, and patient risk assessment were effective in reducing falls. **Conclusions:** The findings show that existing approaches to reduce falls have a favorable role. It is necessary to use several methods of fall prevention at the same time, in order to control most aspects and factors affecting the fall and reduce the rate of fall.

Keywords: Fall, patient, prevention, systematic review

INTRODUCTION

Patient falls in the hospital are common and one of the concerns of patients, family, and health-care system that can eventually lead to injury, disability, and in some cases death of patients.^[1,2] According to the World Health Organization, a fall is an event that causes an individual to descend or drop unintentionally to the ground or to a lower level. The National Database of Nursing Quality Indicators also defines a fall as follows: falling

to the ground with or without injury.^[3] The prevalence of falls in patients varies in different parts of the world, so that in review

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studies, this rate has been reported between 2.2% and 25%.^[1,2,4] It is also estimated at 3.3%–11.5% per 1000 patients each day in the USA.^[5] Falls occur frequently among hospitalized patients and are recurrent and can lead to adverse physical and psychological consequences in patients. These consequences include injury, disability, increased hospital stay, death; if the fallen patient left uninjured, factors such as fear of falling, stress, anxiety, depression, and decreased physical activity are considerable. They affect a person's life and if they need care by family members or health personnel, they are prone to emotional reactions that can affect the individual's independence and rehabilitation. Among patients who fall, 28% result in bruising and minor injuries, 11.4% result in severe soft-tissue injury, 5% can cause bone fractures, and 2% can cause concussions, which can lead to hematoma, disability, or death. Also, falling in the hospital leads to increasing the length of stay of the patient in the hospital and increasing the costs related to the fall of the patient, including the cost of hospitalization, the cost of hospital care, and rehabilitation costs.^[4,6-8] Various factors are effective in increasing the number of patient's falling in the hospital, which are divided into two categories: individual factors and environmental factors. Individual factors influencing the falls are: age (especially over 60 years), history of falls, inability to walk, incontinence or frequent urination, medication and medication changes, hypotension, mental illness, behavioral disorders, vision problems, muscle weakness, and imbalance. Moreover, environmental factors affecting the fall of patients include low light, uneven floor, presence of an object in the floor, and excessive height of the chair or bed.^[1,9-12] Examination of environmental factors affecting the fall has shown that about 50% to 70% of the fall cases occurred next to a hospital bed or chair and 20% in the hallway, bathroom, etc. Although some of these factors, such as age, are adjustable, controlling other factors can reduce falls and prevent adverse consequences.^[5,13,14] As mentioned, the fall is caused by the interaction of several factors. Throughout the world, various approaches have been used to prevent and reduce patient's fall in hospitals, each of which has reduced patients' fall rate by observing specific principles and rules. These include the implementation of educational and behavioral programs such as exercise in the hospital, securing the hospital environment such as bed height and wheelchair use, fall risk assessment in patients, and management of patient medication.^[3,15,16] In general, in line with the four phases of the disaster management cycle, the importance of the prevention phase as the first stage in the risk management process in hospitals is very important. Also, considering that the patient's fall in the hospital occurs frequently and is considered as an emergency, the need to prevent and intervene for reduction of the patients' falling repetition, in the hospital in recent decades has attracted more attention in the field of patient control and safety in the world. Therefore, the present study aimed to identify the factors affecting the reduction of falls among hospitalized patients in the form of a systematic review, in order to identify approaches to prevent falls in patients, and to reduce the vulnerability of

hospitalized patients, and finally to take an effective step in promoting the health of community.

MATERIALS AND METHODS

This systematic review was performed to identify the factors affecting the reduction of patient falls. The papers were selected based on Prisma guidelines for systematic review.^[17] Then, using a thematic content analysis method, the articles were divided based on the findings. All stages of the research, including search, selection of studies, quality assessment of articles, and data extraction, were performed by the research team using the search method. The protocol of this study has been registered in the protocol registration system (PROSPERO) with the code CRD42020161328.

Search strategy

Articles were researched by three researchers, independently. Accordingly, all English-language articles published from 1990 to the end of September 2019 in electronic databases (Web of Science, PubMed, Scopus, and Science Direct) and Google Scholar web, key journals, gray resources, and other sources were investigated. To search for synonymous words from the point of view of experts, the websites of medical topics, the dictionary of synonyms, and keywords in articles related to the research topic were applied. The AND and OR operators were used to write the syntax. The syntax was written for each database separately. For example in PubMed database was (((((((((((((((fall* [Title/Abstract]) OR slip* [Title/Abstract]) OR "fall Injury" [Title/Abstract]) OR (injury [Title/Abstract] AND fall[Title/Abstract])) OR "Falling down") OR "falling factor") OR (factor* [Title/Abstract] AND falling* [Title/Abstract])) OR "falling index") OR (index * AND falling)) OR "accidental fall") OR (accidental * AND fall))) AND (((((hospital* [Title/Abstract]) OR "Health care Service" [Title/Abstract]) OR "Health service" [Title/Abstract]) OR "Health Facility" [Title/Abstract]) OR "Health center" [Title/Abstract])) AND (((((((patient * [Title/Abstract]) OR client[Title/Abstract]) OR inpatient[Title/Abstract]) OR sick[Title/Abstract]) OR "Hospitalized patient" [Title/Abstract]) OR "in-patient" [Title/Abstract]) OR hospitalization[Title/Abstract])) AND (((((((prevention* [Title/Abstract]) OR decrease[Title/Abstract]) OR reduce[Title/Abstract]) OR reduction[Title/Abstract]) OR decline[Title/Abstract]) OR restraint[Title/Abstract]) OR abatement[Title/Abstract])) AND ("1990/01/01" [Date-Publication]: "2019/09/30" [Date-Publication]). In order to avoid reporting bias, we have tried to pay attention to unpublished materials and reports. Extensive searches have been conducted to avoid citation bias and to prevent multiple publication bias, we have used resource management software such as End Note. All published English-language articles that mentioned the effective factors in reducing the fall of hospitalized patients and the consequences of fall prevention intervention were included in the study, and studies that were not about the strategies for patient fall reduction, and studies that examined fall outside the hospital as well as articles published in non-English languages

were excluded. The quality of the articles was assessed, using the STROBE checklist) for observational studies) and CASP checklist (for qualitative and interventional studies). Data extraction was performed by completing a preprepared data sheet (including author, year of publication, place of study, type of study, falls prevention method, and summary of findings). Data analysis was conducted using the five-step thematic analysis method, which included familiarity with the data, creating basic code, searching for themes, reviewing themes, and defining themes.

RESULTS

Study selection

In this study, 6227 studies were extracted from databases. Initially, study records were analyzed by the resource management software (EndNote X7™, Thomson Reuters, Thomson Reuters released EndNote® X7.5 Windows) and 2122 articles were removed from the study due to be repetitive. Then, by reviewing the titles and abstracts of articles, 3810 articles were excluded from the study due to irrelevance, and after reviewing the full text of articles, 263 more articles were deleted, due to lack of review of fall prevention approaches in patients. Also, 32 articles had inclusion criteria that were entered into the review process and subjected to thematic content analysis. Results of studies conducted between 1994 and 2019 on the prevention of patient falls in the hospital were investigated [Table 1].

Thematic analysis

Thematic content analysis of the studies revealed that various approaches to fall prevention have been evaluated around the world, each covering specific aspects of falls and reducing the specific rate of falls. Patient fall is a multidimensional event and various factors involve in its occurrence, and therefore interdisciplinary falls prevention is essential in hospitals. In general, the findings were divided into two main groups and six subgroups, which include human factors (education, exercise, and physiological factors) and organizational management factors (environmental safety, fall detection device, and fall risk assessment) [Table 2]. It is necessary and effective to use a set of measures in the hospital to prevent the patient from falling. In the following, we will discuss each of the thematic groups in detail.

DISCUSSION

Systematic review of articles has shown that various methods in the field of fall prevention have been evaluated in the world, each of which covers specific aspects of falls and reduces the specific rate of falls. They include education, exercise, control of physiological factors and treatment of disease, environmental safety, fall prevention diagnostic device, and fall risk assessment.

The findings of our study show that the use of education approach has a positive role in preventing patient falls in the

hospitals, and that it is necessary for nursing staff, patients, and their companions to be aware of the fall risk factors and the ways to prevent them. Studies have revealed that having educational programs and educational intervention by occupational therapists, especially nurses and the trained students in the field of falls to patients, and teaching methods of fall prevention and self-protection lead to a reduction of events. Also, in the study of the fall process for patients, especially patients with a history of falls, it has been proved that controlling environmental factors, performing physiotherapy programs, helping and educating patients in the field of using assistive devices, daily eating, taking medication, tidying up beds, etc., have been effective in reducing patients' falls.^[18-22] Also, the results of studies have shown that the implementation of training programs electronically and through the media for nurses and educating patients on the principles of fall prevention through posters, handbooks, CDs, and brochures lead to an increase in their activities without the need for help and reduction of falls among patients.^[23-25,31,47] In general, it is necessary to implement training programs in the field of fall prevention in the following five sections: fall risk screening, fall prevention strategies, postfall assessment and management methods, and clinical documents related to falls in hospitals.

Another important finding of the present study is the role of exercise in preventing falls among the hospitalized patients. Because, one of the factors affecting the fall of the patients is unfavorable physical conditions, so that patients, especially those who are hospitalized for a long time, suffer from weakened muscle and skeletal strength, thus exercise interventions in hospital are essential. Studies have proved that implementation of exercise program for hospital patients in a few sessions per week by a physiotherapist reduces the number of falls. Exercise increases flexibility and strength of muscles as well as cardiovascular fitness, stability in walking, and stability in physiological and metabolic conditions of the body. It also maintains the body balance and prevents from falling.^[18,49] Studies have confirmed the role of exercise in reducing falls, and it has been recommended that exercise and correctional activities in the hospital to be performed by physiotherapists and the trained personnel.^[3,5,15,50-52] Therefore, it seems that hospitals need to provide conditions for patients to perform and increase physical activities during hospitalization. Findings of studies show that for patients who are not able to increase physical activity due to the disease conditions, timely and correct alternative methods and rehabilitation medicine should be used.^[53-55] So, focusing on rehabilitation medicine in addition to reducing the patient's muscle wasting can be effective in reducing patients' fall, as a latter consequence.

Our study showed that attention and control of the patient's physiological factors, proper treatment of the patient, adjustment, and correct use of medication can prevent the complications of the disease, and consequently reduce the patient's fall. Studies have confirmed that careful evaluation and clinical and physiological measures are necessary because physiological changes in patients can increase their

Table 1: General characteristics of the studied articles for identifying effective factors in reducing the fall of hospitalized patients in the systematic review

Author	Year of publication	Place of study	Falls prevention method	Summary of findings
Haines <i>et al.</i> ^[18]	2004	Australia	Falls risk alert card with information brochure, exercise program, education program and hip protectors	In the intervention group, there was a trend for a reduction in the proportion of participants who experienced falls and 28% fewer falls resulted in injury
Hägqvist <i>et al.</i> ^[19]	2012	Sweden	Education	The results indicated differences in components that facilitate workplace learning and knowledge transfer
Alexander <i>et al.</i> ^[20]	2013	England	Safe environment	Improved identification of fall risk patients and consistent application of innovative prevention strategies show a trend toward reduction of falls and fall-related injuries
Hill <i>et al.</i> ^[21]	2015	Australia	Education	Fall prevention education led to mutual understanding between staff and patients, which assisted patients to engage in falls' prevention behaviors
Williams <i>et al.</i> ^[22]	2016	Australia	Education training program	Groups of students learn the communication skills and falls prevention knowledge necessary for delivery of the program
Harper <i>et al.</i> ^[23]	2017	Australia	Brief scripted education	Continuing education even after discharge has been effective in reducing patients' falls
Twibell <i>et al.</i> ^[24]	2015	Indiana	Behaviors to prevent falls	Nurses' assessments indicated a risk for falls. A small number of patients did not understand the fall and many even asked for help to get out of bed
Yates and Creech Tart ^[25]	2012	USA	Fall prevention interventions	The fall rate and fall injury rate doubled in Phase II compared to these rates in Phase I for general medicine inpatients
Yu X <i>et al.</i> ^[26]	2008	Singapore	Fall detection device	The importance of the role of wearable device, peripheral device and camera-based in preventing the patient from falling
Doukas and Maglogiannis ^[27]	2008	Greece	Movement and sound data	The importance of the role of sensors equipped with accelerometers and microphones in preventing the patient from falling
Shorr <i>et al.</i> ^[28]	2012	Tennessee	Bed alarm	There was no difference in fall rates
Glab <i>et al.</i> ^[29]	2014	Illinois	Medication	The importance multidisciplinary intervention, importance of educating patients, monitoring symptoms, adjusting doses, or discontinuing drugs implicated in reducing falls
Koh SS ^[30]	2007	Singapore	Multidisciplinary intervention	Implementation of Environmental modifications and (ensuring that the call bell was within reach, adjusting the bed height to the lowest position with wheels locked, side rails in the upright position when the patient was in bed, and ensuring a dry and unobstructed floor surface) the most common multidisciplinary intervention implemented
Krauss <i>et al.</i> ^[31]	2008	Washington	Education	Increased nurses' knowledge in preventing falls
Dykes <i>et al.</i> ^[32]	2009	England	Fall prevention toolkit	Fall TIPS toolkit as means to integrate effective fall prevention practices into the workflow of interdisciplinary caregivers, patients and family members
Carroll <i>et al.</i> ^[33]	2012	USA	Prevention toolkit	Documentation of fall risk status and planned interventions tailored to patient-specific areas of risk was significantly better on the intervention units
Stevens ^[34]	2013	Georgia	STEADI tool kit	The STEADI tool kit is a broad, evidence-based resource that is intended to help health-care providers incorporate fall risk assessment and individualized fall interventions into their clinical practice. In addition, it can be used to link clinical fall risk assessment with community exercise or fall prevention programs
Vassallo <i>et al.</i> ^[35]	2004	UK	Wristbands; risk factors were corrected and environmental changes	Falls be reduced in a multidisciplinary fall-prevention program, but the results are not definitive because of the borderline significance achieved and the variable length of stay
Hurley <i>et al.</i> ^[36]	2009	USA	Fall risk status and tailored interventions	Multidisciplinary interventions are very necessary and useful; the fall rate decreased importance of fall prevention toolkit to provide actionable alerts to nurses, nursing assistants, and other interdisciplinary health care team members and educational materials for patients and families in acute hospital settings
Zuyev <i>et al.</i> ^[37]	2011	UK	Fall TIPS toolkit	The importance of multidisciplinary intervention. Three output tools from the toolkit are bed poster, plan of care, and patient education handout

Contd...

Table 1: Contd...

Author	Year of publication	Place of study	Falls prevention method	Summary of findings
Oliver <i>et al.</i> ^[2]	2010	England	Multidisciplinary intervention	Previous fall prevention programs in the hospital setting have usually only been successful in reducing falls when multiple interventions were included; implementation of one part does not seem enough to improve outcomes
Wong <i>et al.</i> ^[38]	2010	Hong Kong	Multidisciplinary intervention	The importance multidisciplinary intervention, perception of fall, a safe environment; absence of chronic illness, and ability to walk without aids. Support from family/carers may be an important element in participation
Sweeting ^[39]	1994	UK	Multidisciplinary intervention	Following a 6-month survey of factors contributing to falls in the elderly unit within the trust, prevention program is still in its infancy but the initial results are encouraging
Von Renteln-Kruse and Krause ^[40]	2007	Germany	Multidisciplinary intervention	A structured multifactorial intervention reduced the incidence of falls
Barker <i>et al.</i> ^[41]	2016	Australia	Multidisciplinary intervention	Positive changes in falls prevention practice occurred following the introduction of the 6-PACK program
O'Connell and Myers ^[42]	2001	Australia	Management practices and sport	Most staff reported satisfaction with the program and indicated that it increased their awareness of falls and was helpful in highlighting high-risk patients
Szekely <i>et al.</i> ^[43]	2019	New York	Multidisciplinary intervention	The importance of multidisciplinary intervention. The fall rate decreased
Delahoz and Labrador ^[44]	2014	USA	Wearable and external sensors	The importance of using patient fall detection devices in preventing patient fall
Schwendimann <i>et al.</i> ^[45]	2006	Switzerland	Interdisciplinary falls prevention program	Need to incorporate strategies to maximize and evaluate ongoing adherence to interventions in hospital falls' prevention programs
Knight <i>et al.</i> ^[46]	2008	Canada	Chair alarm	Processed using gesture recognition algorithms to determine when a patient is attempting to stand and to alarm the care providers. This system uses a range of voice and light feedback
Johnson <i>et al.</i> ^[47]	2015	Minnesota	Education	Education in combination with the regular use of audit and observation of patients and nurses can support improvements in falls prevention strategies
Haines <i>et al.</i> ^[48]	2006	Australia	Education	Patient education is essential to prevent falls in the hospital

TIPS: Tailoring interventions for patient safety, STEADI: Stopping elderly accidents deaths and injuries

falling possibility. It has been also stated that the approach of substitutability and regulation of drugs, paying attention to the time of drug use when the patient needs less mobility, educating patients about drug use, monitoring physiological symptoms and diseases, and special attention to drugs that reduce consciousness and increase the patient's fall can play an effective role in reducing the problem.^[29,35,50,56-58]

The findings show that one of the factors that play a crucial role in reducing patient falls in the hospital is the existence of a safe environment because if the hospital environment is not safe, by controlling other factors, patients' falls cannot be reduced to a desirable level. Studies have shown that environmental factors including suitable hospital floor, bedrail next to the bed, easy access to the bathroom, adequate light next to the bed at night, level floor and no stairs, proper height of the bed, availability of wheelchairs and canes, dry floor (not being wet), and using hip protectors can reduce the damage and fractures caused by falls and play an important role in reducing patients' falls in the hospital.^[18,38,43] Therefore, a safe environment is one of the basic needs of the hospital for patients and it is necessary to pay much attention. Studies reveal that special attention should be paid to the elderly in hospitals because they are not familiar with the environment, when entering the hospital

environment; if there are obstacles and the environment is unsafe, they will fall. As a result, maintaining the standards of the hospital environment is essential to prevent the patient from falling.^[3-5,50] In general, it is necessary for hospital officials to pay special attention to control environmental factors that can greatly reduce the fall of patients.

According to the findings of this study, the control of environmental factors by using a device to detect and prevent falls has been considered by many researchers. Fall detection and prevention devices contain audio, video, pressure, and vibration sensors that receive information about the patient's physical conditions. The data are analyzed and transmitted to the central system through a wireless system. If the patient is in inappropriate condition, the alarm system is activated and some of them even warn the patient about the physical conditions when he/she is moving with a cane and wheelchair, and prevent the collision with obstacles and environmental factors affecting the fall. Studies confirm that using fall detection devices in the patient's room and with the patient is useful to send a warning to the nurse or patient companions and prevent injury to the patient.^[26,27,46,59] One of the disadvantages of devices that require the installation of cameras is that they may affect the patient's privacy and reduce the patient's activities. In general,

Table 2: Factors related to human and organizational management in identifying effective factors in reducing the fall of hospitalized patients based on a systematic review

Category	Subcategory	Example of codes
Human factors	Education	Patient education
		Student education
		Staff training
		Learning methods
	Sport	Strengthen muscles
		Sport activities
		Physiotherapy program
		Collaborate in movements
	Physiologic	Patient underlying disease
		Type of drug used
		Medication adjustment
		Symptoms
		Modification of drugs
Organizational management related factors	Environmental safety	Hospital flooring
		Bedside fence
		The light
		Bed height
		Slippers and clothes
		Access to services
		Smooth floor
		Protectors
		Removing obstacles
		Camera installation
	Fall detection device	Send message
		Install the sensor (audio, video, pressure, and vibration)
		Alarm
	Fall risk assessment	Tool kit
		Evaluation and management
		Clinical documents
		Electronic form

the use of these approaches can reduce patient falls, but it has not been confirmed in all studies. In a study conducted in 2012, the use of bedside alarms in the hospital in the area from the hip to the patient's shoulder line was examined, so that whenever the patient was at risk of falling, more pressure was applied to this area and an alarm was sounded in the nursing office. This method was not efficient in reducing patients' falls.^[28] In the hospital bedside alarm method, warning about the falling patient to the staff or companions can prevent the fall when the staff or companion of the patient immediately come to the aid of the patient, but in case of delay, the patient will fall and injure.

Based on the results of the present study, another method of reducing patient falls in the hospital is fall risk assessment. As mentioned earlier, falls have different aspects and are affected by various factors, and the use of specialized tools by nurses, physicians, and specialists is necessary to assess the risk of the patient falling and to control it. Accordingly, only by evaluating and controlling one aspect, fall cannot be

greatly reduced and the emphasis on using interdisciplinary fall prevention approach is the most desirable way to prevent patients from falling in hospitals. In other studies, the use of interdisciplinary fall prevention and multidisciplinary team approaches has reduced the number of patient falls in the hospital and it is recommended to use them to reduce patients' falls.^[2,3,5,15,16,36-43,56,60,61] Studies have also confirmed that the assessment of the risk of falls in patients and the implementation of effective interventions, led to a reduction of injuries caused by falls in patients.^[13,18,30,32-34,40] In general, as studies revealed, initial assessment of the patient and review of patient fall indicators by caregivers and intervention measures are necessary at each shift, and interventions should be recorded to determine the next intervention measures to prevent the patient from falling. Limitations of our study included studies for which full text was not available and articles were published in non-English languages.

CONCLUSIONS

In general, fall is affected by various individual and environmental factors, some of which are adjustable and some are not. As a result, fall prevention is not possible perfectly, but the existing interdisciplinary approaches in the field of fall prevention have played an effective role in fall reduction. It is recommended to use several fall prevention methods at the same time because in this approach, most aspects and factors affecting the fall are examined and controlled, and as a result, the fall rate can be reduced in a more favorable way and higher rates.

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Conflicts of interest

There are no conflicts of interest.

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