ORIGINAL ARTICLE

Identification of the patient at risk for a fall related injury in an acute care setting: A retrospective study

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ABSTRACT

Objective: The aim of this study was to identify the patient at risk for a fall-related injury while receiving care in an acute healthcare setting. The prevention of patient falls in hospital settings has been identified as an international patient safety goal. Despite a myriad of validated assessment tools, falls do occur.

Methods: Using a retrospective study design, the medical records of patients who encountered a fall-related injury were reviewed, with demographic and situational variables included in the study data set.

Results: Frequency and descriptive analyses were performed on the study population that fell, then sub-grouped by level of fall-related injury. These results were correlated to the results of the routinely used fall assessment tool and to the research literature.

Conclusions: The study concluded that an assessment tool has value in identifying the patient at risk for a fall but is limited in the ability to identify the patient at risk for a fall related injury. Advanced age does increase the risk for a fall-related injury, especially if the patient is taking antidepressive medications or has been diagnosed with Parkinson's Disease. Women appear to have a slight propensity toward fall-related injuries. The overall length of hospital stay is prolonged as a result of the fall, and the ability to return to a private home is at risk. The design of this study consisted of data from patients and investigated due to caregivers' desire to decrease these scenarios. Fall-related major injuries, while rare, demonstrate vague identifiable variables, not predictable using present-day assessment tools.

Key Words: Patient falls, Fall assessments, Retrospective study, Fall-related injuries, Acute care

1. INTRODUCTION

Patient falls, as defined by the World Health Organization (WHO)[1] are unexpected events "in which a patient unintentionally comes to rest on the floor or against some lower level with or without injury" (para1). In 2014 the National Database of Nursing Quality Indicators (NDNQI)[2] and in 2015 the Joint Commission (JC)[3] identified patient falls as a sentinel event. These documents resulted in the JC publishing patient safety goals in 2017, making patient falls a reportable event. Data from their most recent annual report[4] describe patient falls as the leading sentinel event since 2019. The Agency for Healthcare Research and Quality (AHRQ)[5] reports that fall rates in United States (US) hospitals declined by 5% between 2014 and 2017, a result of these initial efforts. Using mandatory patient adverse events reporting data, Morris and colleagues[6] calculated that the national fall rate is 3%-5% in US hospitals. Burns and associates[7] report that the rates of falls in US hospitals range from 3.3 to 11.5 per 100 patient days with 26% of these falls resulting in an injury, and between 4% and 11% requiring medical care. The

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negative health consequences of falls are so well documented that in 2022 the Centers of Medicare and Medicaid Services (CMS)[8] mandated fall data, specifically among hospitals patients, to be collected and reported. The purpose of this retrospective chart review study was to describe the patient who suffered a major injury as a result of their fall. Comparing the non-modifiable and modifiable variables of these individuals to those of patients who suffered an injury as a result of their fall provided the ability to identify gaps in our knowledge and/or assessment tools. This study contributes to the literature by describing the patient at risk for a major injury related to their inpatient fall. These data can be useful when evaluating the limitations of an assessment tool in preventing fall-related injuries and identifying site-specific areas of vulnerability.

1.1 Background

1.1.1 *Assessment tools*

There are a variety of fall risk assessment tools, with no universal method identified. Despite Aranda-Gallardo and associates[9] identifying the STRATIFY scale as having the highest sensitivity for identification of the patient at risk for falling, these authors note that "the behaviour of these instruments varies considerably depending on the population and the environment, and so their operation should be tested prior to implementation." (p. 13/15). Since this publication, Kim and associates[10] directly compared the Morse Fall Scale (MFS) and the Johns Hopkins Fall Risk Assessment Tool (JHFRAT). Analysis of data from patients who scored a high risk for falling determined that the sensitivity of the MFS was higher than that of the JHFRAT, yet the JHFRAT was higher in specificity during reassessments. These authors acknowledged that these results, and the need for reassessment, could result in an increase in nursing workload, with no guarantee that this would prevent falls. Using a realistic investigative approach, Randell and associates[11] completed synthesis testing of two theories related to inpatient falls. These results identified four factors that contribute to falls. These include (1) leadership, (2) shared responsibility, (3) facilitation, and (4) patient participation. The WHO[1] identified four risk factors (biological, socioeconomic, environmental, and behavioral) which contribute to a fall outcome. The outcome is then categorized by the type of fall and level of injury. While the variables in this model are not methods of assessment, they are inter-related and do impact falls within acute care settings.

Recent research literature has explored the incidence of falls among elderly patients,[12] taking specific medications,[13,14] based on a previous history of falls,[15] and /or length of stay.[16] There is an abundance of variables that contribute to a fall, resulting in an inability to prevent these instances from occurring.[17] While assessment tools and interventions aimed at decreasing falls have value, they should not be considered never-events. Certainly, assessments and interventions aimed at preventing falls should be included in any standard of care, preventing major injuries as a result of an inpatient fall, and avoid unintended consequences for both the patient and the healthcare facility.

2. METHODS

2.1 Aim

Using retrospective medical record data, the aim of this study was to describe the patient who suffered a fall-related major injury using non-modifiable and modifiable variables. These data allowed study population subsets to be compared.

2.2 Design

Using a retrospective study design, data were obtained from medical records.

2.3 Sample and setting

The study population consisted of medical record data of 82 adult patients (> 18 years of age) who suffered a fall while receiving inpatient care between October 2022 and May 2023. There were 10 instances of missing completely at random data within the 14 mandatory variables ($81 \times 14 = 1{,}134$). This calculates to 0.11% of missing data. Since analyses were limited to descriptive data, imputation techniques were not appropriate and may have resulted in skewing analyses. Thus, the data set contains missing data. The study site is a 451licensed bed Magnet designated healthcare facility located in a Midwestern US metropolitan area.

2.4 Measurements

Fall injuries were classified as required by NDNQI.[2] All data were retrieved from the electronic medical record and consisted of demographic (non-modifiable) and health-specific (modifiable) variables. Study data included specific demographic information (age, gender, race and ethnicity, calculated body mass index (BMI), residence prior to admission and residence upon discharge, activity status prior to admission, and disclosure of any falls within six months prior to admission) and situational variables (the reason for admission the first three co-morbidities as disclosed on the admission record, and the results of the admission JHFRAT assessment.[8] Fall-specific data included the length of stay (LOS), time, and type of injury from the fall, the fall day from day of admission, and the type (assisted or unassisted then witnessed or not) and the classification of the fall injury (none, minor, moderate, or major). The administration of (1)

opioids, (2) diuretics, (3) antihypertensives, (4) antiparkinsonian drugs, (5) antidepressants, and (6) anticoagulants were included in the data set, based on the presumption that they increased the risk of a fall.

2.5 Ethical considerations

This study was approved by the Sterling Institutional Review Board (IRB), an independent IRB of utilized by the study site (approval 092823RICEX) on 09-28-23 and was conducted per the ethical principles of the Declaration of Helsinki. Confidentiality of these data was described as a part of the approval process and maintained by not including any personal identifying information in the study data set, which is kept within password protected computers.

2.6 Data analysis

Descriptive and frequency statistics were used to describe the entire study population. Then, guided by the fall consequence, (none, minor, moderate, major) as defined by the NDNQI[2] study subgroups were developed. After initially reviewing these results, the study data was reviewed using diabetes, of any category, being either the reason for admission or one of the top three co-morbidities, or the presence of tachycardia, defined as a heart rate > 90 beats per minute (bpm) as modifying variables. All analyses were performed using SPSS Statistics for Windows.[19]

3. RESULTS

There were 259 falls during the 242-study-day timeframe. The calculated to 1.07 falls per day, which is within the acceptable range as described by the NDNQI[20] and the JC.[4] Of these, 81, or 31.2% were reported as falls with injury. Demographically, females encompassed 51% of the falls and were slightly more likely to suffer an injury (53%) from their fall when compared to males. Other than this, the study population was demographically similar to the population who receive care at the study site. The results of this study will consist of analyses of the data only from patients who suffered an injury from their fall, which aligns with the stated purpose.

Demographically, these individuals ranged in age from 26-93 years, with a mean age of 61.8 years (*SD* = 15.96). The population consisted of 36 females and 36 males, with 58 (79.4%) reporting their race/ethnicity as white. Calculated BMI ranged from 17.34-66.57 with a mean of 32.27 (*SD* = 10.76) which reflects an obese population. The activity status of the majority of the population was fully or partially independent prior to admission (n = 57). Fifty-five of these patients were admitted from their private home, while 44 were dismissed back to their private residence. A history of previous falls within six months of the present admission was reported by 33 of these individuals, with 36 reporting no history. Table 1 provides comparison data based on the level of injury from the fall. There was one moderate injury as a result of the fall. These data were included in the mild category to prevent the identification of any one specific patient. Table 2 displays the differences between the type of injury and the modifiable variables included in the study data set.

Table 1. Accessible study related demographic variables classified by type of injury

Variable	Categories	Fall Injury Population (n = 82)	Fall with Mild/Moderate Injury (n = 73)	Fall with Major Injury (n = 9)
Age (year)		Range = 20-95 *X* = 63.09 *SD* = 17.48	Range = 26-93 *X* = 61.84 *SD* = 15.96	Range = 35-89 *X* = 69.88 *SD* = 17.70
Gender (n)	Female	43	36	7
	Male	38	36	2
BMI (kg/m^2)		Range = 17.34-66.57 *X* = 30.23 *SD* = 8.89	Range = 17.34-66.57 *X* = 32.27 *SD* = 10.76	Range = 20.46-46.49 *X* = 29.17 *SD* = 9.16
Activity Status (n)	Fully Independent	42	38	4
	Partially Independent	21	19	2
	Fully Dependent	17	14	3
Pre-hospital residence (n)	Private home	60	55	5
Hospital discharge (n)	Private home	46	44	2
Previous fall history (n) (6 months prior to admission)	Yes	38	33	5
	No	40	36	4

Table 2. Accessible study related assessment variables classified by type of injury

Variable	Category	Fall Injury Population (*n* = 82)	Fall With Mild/Moderate Injury (*n* = 73)	Fall With Major Injury (*n* = 9)
Risk fall assessment prior to fall (JHFRAT)		Range = 0-30 *X* = 15.00 *SD* = 7.81	Range = 5-26 *X* = 17.62 *SD* = 8.27	Range = 5-26 *X* = 17.62 *SD* = 8.27
Calculated fall date from admission (day)		Range = 0-50 *X* = 5.59 *SD* = 8.64	Range = 0-31 *X* = 4.97 *SD* = 5.99	Range = 0-50 *X* = 9.66 *SD* = 15.88
Time of fall		Range = 00:20 a.m.-23:30 p.m. *X* = 12:02:29 h:min:s *SD* = 7:04:33 h:min:s	Range = 00:05 a.m.-22:23 p.m. *X* = 13:34:11 h:min:s *SD* = 6:08:03 h:min:s	Range = 00:20 a.m.-23:03 p.m. *X* = 13:50:00 h:min:s *SD* = 8:21:04 h:min:s
Total length of stay (day)		Range = 0-60 *X* = 9.77 *SD* = 10.15	Range = 0-32 *X* = 9.71 *SD* = 8.19	Range = 2-52 *X* = 14.11 *SD* = 14.89
Location of fall (*n*)	Bathroom – general	20	18	2
	From or by bed/chair	37	32	5
	While ambulating	24	22	2
Type of fall (*n*)	Assisted	16	14	2
	Unassisted	64	57	7
Observed (*n*)	Witnessed	31	29	4
	Unwitnessed	49	44	5
Sedative medication (*n*)	Yes	57	51	6
	No	23	20	3
Opioid medication (*n*)	Yes	35	30	5
	No	45	41	4
Diuretic medication(*n*)	Yes	13	12	1
	No	67	59	8
Antihypertensive medication (*n*)	Yes	50	44	6
	No	30	27	3
Antiparkinsonian medication (*n*)	Yes	5	4	1
	No	75	67	8
Antidepressive medication (*n*)	Yes	35	30	5
	No	46	42	4
Anticoagulation medication (*n*)	Yes	35	31	4
	No	45	40	5

4. DISCUSSION

Despite the availability of fall risk assessment tools, the ability to identify the patient at risk for a fall related injury remains allusive. Concentrating only on incidences where the fall resulted in a major injury limits the ability to make a direct comparison to previously published data. Despite that, analyses identified several notable trends. Trinh and associates[21] estimate that, while falls are "common accidental adverse events in acute care hospitals" 25%-50% of the falls result in an injury" (p. 2). Burns and associates,[7] among the falls, between 4% and 11% result in a major injury. Historical data from the study site determined that 30% of any fall resulted in any level of injury, with mild/moderate or major injuries occurring in 3%-5% of all falls. Thus, the incidences of falls, and injuries from falls at the study site remain under the 50th percentile as recommended by NDNQI.[20]

Data from the 2023 Annual Sentinal Report from the JC[4] 35% of falls occurred while ambulating, 25% were falling from the bed, and 19% while toileting. Of these events, 4% resulted in death, 8% caused permanent harm, and 80% resulted in severe harm.

Of the 82 incidences of falls in the present study, 9%, or 10.9% sustained a major injury, requiring medical intervention. In this study, the minor or moderate consequences of an inpatient fall include abrasions and skin tears ($n = 20$) to every extremity, upper extremity pain (shoulder, elbow, and hand) ($n = 25$), and lower extremity pain ($n = 27$). Beyond assessing, cleansing, applying dressings and notification of the specific healthcare team, none of these events required additional intervention(s). Medical consequences, as a result of a major fall-related injury, varied but did not include mortality. Five if of the falls required a neurosurgical consultation, radiological screening, and surgical intervention. The remaining four cases resulted in a lower extremity fracture. Treatment included radiological screening, followed by surgery. Incidences of falls with injury, in the present

study, occurred 29% of the time while ambulating, 45% were falls from the bed, and 24% while toileting. The variations in locations from the published norms,[4] specifically the increase in falls from the bed at the study site identify an area of opportunity for improvement.

There is some value in identifying trends when focused on falls that result in an injury. These incidents are few, thankfully, yet this limits statistical analysis. The literature identifies five areas of interest which will be used to guide this discussion. These areas are: (1) the usefulness of fall risk assessment tools, (2) falls among the elderly population, (3) the impact specific medications have on fall risk, (4) how a previous history of falls influences subsequent falls, and (5) how fall risk changes during one's LOS.

The inclusion of a fall risk assessment into the plan of care has been recommended by the JC since 2017.[3] At the study site, the JHFRAT is used to routinely assess each patient's fall risk. As displayed in Table 2, mean JHFRAT scores for those that fell were 15.0, which increased to 17.62 for those that suffered an injury from their fall. Thus, higher assessment results do indicate a risk for a fall related injury. This supports the use of routine assessment for a fall risk as recommended by Kim and associates.[10]

In their systematic review of fall risk assessment tools, Strini and colleagues[22] describe the fall risk among the elderly as a result of the decrease of functional reserves that are used to maintain the orthostatic position and vulnerabilities or pathologies as the result of factors that occur simultaneously, pathological processes, and adverse pharmacological incentives. The Centers for Disease Control and Prevention (CDC)[23] estimates that 1 in 4 adults over the age of 65 years falls each year, rendering this the leading cause of injury for this population. While age was not explicitly identified as a variable in this study, it is interesting to note that the mean age of those with major injury as a result of their fall was higher, at 69.88 years, than any other study subpopulation, supporting the premise.

Warren and colleagues[14] report that hospitalized patients over the age of 60 years had a higher incidence of falling if they were taking ACE inhibitors, antipsychotics, antipsychotics, benzodiazepines, serotonin modulators, selective serotonin-reuptake inhibitors, tricyclics, norepinephrine reuptake inhibitors, or miscellaneous anti-depressants. The risk of a mild/moderate injury from a fall while receiving any of these medications ranged from 85.7 to 93.5, while the risk of a major injury ranged from 2.5 (antiparkinsonian) to 16.6 (antidepressive). In their narrative review, Virnes and associates[24] conclude that opioid use increases the risk for falls, and this risk appears to be dose (amount and frequency) dependent. The risks and benefits for this treatment should be used to guide clinical decision making. Appropriate administration of a sedative, opioid, diuretic, antihypertensive, antidepressive, antiparkinsonian, or anticoagulation medication does not appear to increase the risk for an injury from the fall. The results of a Cochrane Review[25] determined that patients with Parkinson's Disease routinely experience falls, and these experiences may have resulted in their ability to protect themselves from major injuries. Lohman and associates[26] describe the association between antidepressive medications and falls, while noting that the mechanism for this is unclear. Our results, as described in Table 2, vary from previous research results. The multitude of variables that contribute to a fall identifies the impact health conditions and/or medications have on falls, but further research is warranted into this phenomenon.

Research results demonstrate that, overall, patients with a history of falls within the previous six months have a statistically significant decrease in stability and balance, which leads to a greater risk of falling.[26] This hypothesis is not supported by our data, where a previous history was almost evenly divided, even when gender was treated as a co-variant (see Table 2). This may reflect the use of a routinely performed fall-assessment used to identify the patient at risk for a fall.

Results of a retrospective chart review by Hasan and associates[16] concluded that any fall, with or without an injury, prolonged the average LOS by 4.9 days. Appeadu and Bordonib[27] determined that the association between inpatient falls and prolonged LOS was observed regardless of whether the fall resulted in injury. As reported in Table 2, the mean LOS among those with a major injury as a result from their fall was 14.11 days in this study, while the mean LOS associated with a mild/moderate fall was 9.71 days. Comparing this to the calculated fall date from day of admission reveals that the actual fall occurred during an elongated LOS. The fall, among those with a major injury, occurred toward the end of their 9th hospital day and an overall mean LOS of 14.11 days. Thus, a major injury resulted in an additional 4.5 days. The mean hospital fall day was 5 among those with a mild/moderate injury, with a mean LOS of almost 8 days. Thus, a mild/moderate injury added almost 5 extra days to the LOS. These results support the findings of Appeadu and Bordonib.[27]

In addition to these results, our data also demonstrates: (1) females have a slight propensity toward having a major injury as a result of their fall, (2) results from a calculated BMI has minimal effect on the type of fall related injury, (3) while the time range for all falls included the entire day (00:05

– 23:30), the mean time of fall, regardless of the level of injury, was between 12:00 and 13:50. Finally, experiencing a fall, with any injury, while receiving inpatient care, does impede the ability to return to their home. Of the 55 patients who experienced a mild/moderate fall related injury, only 44 (80%) of them were able to return home. For the 5 patients who were admitted from their home and suffered a major fall related injury, 2 (40%) of them were able to be discharged to their home. While these numbers are small, they do describe a depressing scenario. These are variables not reported in the published literature and may be unique to the study setting. Replication of this study, using both different settings and populations, is recommended.

Limitations

This study is the first identifiable effort toward examining clinical scenarios that result in a major fall-related injury among patients receiving care in an acute care setting. Data for this study was obtained from one clinical site, thus generalizability to both clinical facilities and geographical areas is limited. The clinical site is a private hospital, not associated with any academic institution, located adjacent to a Midwest metropolitan city, and serves the local population. Further research specific to geographical, cultural, financial, and academic variables should occur. These activities may conclude with an assessment tool capable of identifying the patient at risk for a major fall-related injury.

The limited number of major fall-related injuries limited the data analyses to descriptive and frequency tests. This hampers the ability of the results to be predictive or generalizable to other like environments. We would recommend replication of this study as that would allow comparisons to national norms and identify area(s) of weakness.

5. Conclusion

The objective of this study was to identify non-modifiable and modifiable variables that resulted in a fall-related major injury among hospitalized patients. Despite the myriads of assessment tools and preventative interventions aimed at preventing in-patient falls, the multitude of variables that result in a fall inhibit the ability to prevent these events. Falls, in themselves, are the result of complex factors, and a major injury from a fall appears to be unpredictable. The health outcomes of a major fall-related injury results in negative health outcomes and thus deserve further research efforts.

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Authors contributions

Ashley Peacock, Dawn Wheelhouse, Susan Brock, and Jennifer Sears designed the study. Peggy Ward-Smith and Ashley Peacock wrote the first draft of the manuscript. Statistical analysis plan was developed by Dawn Wheelhouse and Susan Brock, with Peggy Ward-Smith and Ashley Peacock performing the statistical analysis. Jennifer Sears revised the manuscript, and all authors reviewed and edited as necessary. All authors contributed to the identification of the variables included in the protocol and reviewed the data prior to and after analysis. All authors have provided final approval of the manuscript version accepted for publication.

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Conflicts of Interest Disclosure

The authors declare they have no conflicts of interest.

Informed consent

The requirement for written informed consent was waived because of the study's retrospective design.

Ethics approval

The Publication Ethics Committee of the Sciedu Press. The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Data sharing statement

No additional data are available.

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