

Risky Business: Factors That Increase Risk of Falls Among Older Adult In-Patients

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Abstract

In hospitals, older patients are at increased risk of falling multiple times. This study incorporated an epidemiologic cross-sectional design consisting of 4,348 older patients (≥ 65 -year-old). Eight hundred eighty five (20.4%) in-patients experienced multiple falls while remaining participants had one fall incident. A patient fall event was recorded with age, sex, incident date, type of fall, and location. Logistic regression assessed risk factors found in patients with multiple falls compared to those with one fall. Significant differences were observed in the proportion of multiple falls: in a bed with no rails, standing, walking, and using a wheel/Geri chair ($p < .05$). Overall, sex, type of fall, and location were significant in predicting multiple falls ($p < .05$). Male patients were at 16.1% greater risk of multiple falls, when compared to females ($p < .05$). A fall in complex care, mental health, or respirology were more likely to experience multiple falls ($OR = 2.659, 3.620, 1.593$ respectively), while season had no impact.

Keywords

single and multiple falls, hospital setting, reoccurring falls, type of fall

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What this paper adds

- Insight into hospital and patient circumstances in which multiple falls are most likely to occur.
- A comparison of individuals who have fallen only once and multiple times to assess similarities and differences among previously known fall risk factors.

Applications of study findings

- Hospital and care facility suggestions to minimize repeating types of falls through design, equipment use, and knowledge of multiple fall risk factors.
- Better understanding for health care teams who care for older adults in in-patient settings about multiple fall risk factors.

Introduction

Falls are a major public health concern as the second leading cause of unintentional injury deaths worldwide (World Health Organization [WHO], 2021). Falls among

the elderly population is a specific concern with approximately 20% to 30% of older people over the age of 65 in Canada experiencing a fall each year (Public Health Agency of Canada, 2014). Falls are among the most common incidents reported in hospitals (R. Morris & O’Riordan, 2017) resulting in decreased quality of life in hospitals (LeLaurin & Shorr, 2019) due to injuries such as lacerations, fractures, and internal bleeding (Hendrian & Tipton, 2020). Regardless of the severity of the fall or level of injury, falls in hospital are often associated with longer lengths of stay to manage complications (Hendrian & Tipton, 2020). As such, research studies have focused on identifying risk factors for in-hospital patient falls such as age, gender, solitary living, nutrition, fear of falling, and medical impairments (Appeadu & Bordoni, 2023; Najafpour et al., 2019).

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Furthermore, a recent systematic review focused on intervention studies aimed at preventing patient falls from occurring in a hospital or clinical setting (M. E. Morris et al., 2022). Despite the plethora of research surrounding single falls, less is known about the risk factors surrounding multiple falls, of which the likelihood increases after the first incident (Deandrea et al., 2013).

A fall is defined as an unplanned event resulting in a person coming to rest inadvertently on the ground or floor or other lower level (WHO, 2021), while multiple falls would be defined as two or more of these events per hospital visit. Although still serious; a single fall is not always indicative of a major problem and may be an isolated event (Fuller, 2000). However, a patient falling multiple times in a hospital setting is indicative of a more serious problem and understanding why this is happening is critical to prevention. Identification of risk factors associated with multiple falls (vs. single falls) would support the development of effective interventions to reduce falls in older adults in hospitals.

Knowing and understanding the risk factors of a single fall is crucial as this information will provide guidance on what factors should be investigated in patients who have had multiple falls. If multiple fall predictors can be determined based on the age, sex, type, location, or level of harm resulting from a patient's first fall, it could clarify which individuals are most at risk for a subsequent fall. Here, appropriate measures could then be taken to diminish the risk. It is also of interest to understand which of the risk factors that contribute to a singular fall, contribute to multiple falls as well. Risk factors identified in the literature include a history of falls (Todd & Skelton, 2004), stroke, arthritis, depression, or diabetes (Paliwal et al., 2017), as well as confusion or agitation, gait instability, urinary incontinence and frequency, and prescription of sedative and hypnotic drugs (Oliver, 2004). Additional factors include sex, mental health status, age, location, and day or night staff shift (Krauss et al., 2005).

Assessing multiple fall risk factors, specifically in a hospital setting is important due to the high population of health-compromised patients. A fall may result in further injuries, delayed recovery, or additional healthcare costs (Heng et al., 2020). Many resources are available to prevent patient falls such as hospital staff and specialized equipment to minimize risks, once identified. Identifying these patterns of recurrent fall locations early has the potential for major positive impacts on a patient's health status and overall hospital stay and recovery. So, precautions are warranted as the initial fall incident signifies hospital staff and patient of the potential for a subsequent fall (Todd & Skelton, 2004).

The literature exploring older patients who have experienced multiple falls is limited with examination of risk factors such as cognitive and physiological function (Martin et al., 2013) or gait and initiation time (Callisaya et al., 2016) to measure the association between a specific variable and multiple fall risk. However, a more

comprehensive investigation of risk factors of multiple falls in older persons in this setting is important to implement preventative interventions. The purpose of this study was to identify the risk factors associated with multiple falls relative to a single fall in older inpatients in a hospital setting.

Methods

Study Design and Participants

This study incorporated an epidemiologic cross-sectional design. The total sample consisted of 4,348 older patients (≥ 65 -year-old) from a comprehensive list of fall incidents across a hospital system over a 5-year period from April 2014 to December 2019. Participants were categorized as either one fall or multiple falls per hospital visit, where 885 (20.4%) individuals experienced multiple falls. The required sample size and power estimation to effectively make generalizable conclusions based on the logistic regression model has been met (Peduzzi et al., 1996).

Data Collection

Data was collected within Hamilton, Ontario with relevant hospital fall incident data uploaded to an encrypted and secure site. A patient fall event was recorded along with age, sex, incident date, type of fall, level of harm, and location in hospital. The dependent variable was categorized dichotomously as one fall or multiple falls. Age remained as a continuous variable, while all other independent variables were categorized. Incident date was grouped based on seasonality, consisting of spring, summer, autumn, and winter beginning on the 21st day of March, June, September, and December, respectively. Type of fall consisted of bed over foot or headboard, bed over rails or no rails, bedside chair, fall from standing, stretcher, toilet/commode, fall during transfer, unwitnessed fall, fall while using equipment, walking, fall from wheel/Geri chair, and other. Location of fall was categorized into cardiology, complex care, critical care, diagnostic imaging, emergency, medicine, mental health, nephrology, oncology, respirology, surgery, and other. Level of physical harm consisted of six levels, including close call/near miss (level 1), no harm (level 2), mild harm (level 3), moderate harm (level 4), severe harm (level 5), and death (level 6).

Analysis

T-tests and Chi-squared tests were used to assess difference in study risk factors between participants who recorded one fall or multiple falls. Logistic regression was optimal based on the binary nature of the outcome of interest, the categorical independent variables, and the lenience of the regression on normality and variance constraints. Analysis was conducted using SPSS version 28.0 (IBM Corp, 2020). Logistic regression model and

Table 1. Proportion Comparison of Patient Fall Characteristics.

	Falls count (% of falls)		
	Single fall	Multiple falls	Total (%)
Sex			
Female	1,688 (48.7)	405 (45.8)	2,093 (48.1)
Male	1,775 (51.3)	480 (54.2)	2,255 (51.9)
Location in hospital			
Cardiology	125 (3.6)	24 (2.7)	149 (3.4)
Complex care*	705 (20.4)	330 (37.5)	1,035 (23.8)
Critical care	116 (3.3)	20 (2.3)	136 (3.1)
Diagnostic imaging*	30 (0.9)	2 (0.2)	32 (0.7)
Emergency*	369 (10.7)	55 (6.2)	424 (9.8)
Medicine*	777 (22.4)	171 (19.3)	948 (21.8)
Mental health*	67 (1.9)	35 (4.0)	102 (2.3)
Nephrology	234 (6.8)	52 (5.9)	286 (6.6)
Oncology	263 (7.6)	51 (5.8)	314 (7.2)
Respirology	190 (5.5)	49 (5.5)	239 (5.5)
Surgery*	526 (15.2)	88 (9.9)	614 (14.1)
Other	61 (1.8)	8 (0.9)	69 (1.6)
Type of fall			
Bed—foot/headboard	68 (2.0)	16 (1.8)	84 (1.9)
Bed—over rails	444 (12.8)	123 (13.9)	567 (13.0)
Bed—no rails*	412 (11.9)	128 (14.5)	540 (12.4)
Bedside chair	214 (6.2)	58 (6.6)	272 (6.3)
Standing*	195 (5.6)	31 (3.5)	226 (5.2)
Stretcher	64 (1.8)	9 (1.0)	73 (1.7)
Toilet/commode	287 (8.3)	60 (6.8)	347 (8.0)
Transfer	71 (2.1)	17 (1.9)	88 (2.0)
Unwitnessed	508 (14.7)	140 (15.8)	648 (14.9)
Using equipment	15 (0.4)	3 (0.3)	18 (0.4)
Walking*	849 (24.5)	159 (18.0)	1,008 (23.2)
Wheel/Geri chair*	303 (8.7)	138 (15.6)	441 (10.1)
Other*	33 (1.0)	3 (0.3)	36 (0.8)
Season			
Autumn	910 (79.5)	235 (20.5)	1,145 (100)
Spring	879 (78.8)	236 (21.1)	1,115 (100)
Summer	849 (79.8)	215 (20.2)	1,064 (100)
Winter	825 (80.6)	199 (19.4)	1,024 (100)
Total	3,463 (100.0)	885 (100.0)	4,348 (100.0)

*Level of significance, $p \leq .05$.

comparisons of risk factors between groups were based on a level of significance of $\alpha \leq .05$.

Results

A total of 4,348 in-patients aged 65-years or older participated in this study. Of these, 885 (20.4%) reported multiple fall incidents during a hospital visit, while the remaining 3,463 (79.6%) older persons reported one fall incident. The average age of participants in the multiple fall group and single fall group was 81.27 ± 8.135 and 80.52 ± 8.319 , respectively. A standard *T*-test indicated no significant difference in age among the groups.

Descriptive statistics summarize the percentage of older persons who had multiple falls and single falls in

the sub-categories of the independent variables of interest, including sex, location in hospital, type of in-hospital fall, and calendar season (Table 1). Results demonstrate no significant differences in the proportion of males in the single fall and multiple fall groups or the females in the single fall and multiple fall groups.

Significant differences were reported in complex care, diagnostic imaging, emergency, medicine, mental health, and surgery. Specifically, a larger proportion of older persons who had multiple falls fell significantly more in complex care and in mental health units compared to those who had a single fall ($p < .05$). Conversely, there was a significantly lower proportion of older persons that had fallen multiple times in diagnostic imaging, emergency, medicine, and surgery ($p < .05$). No

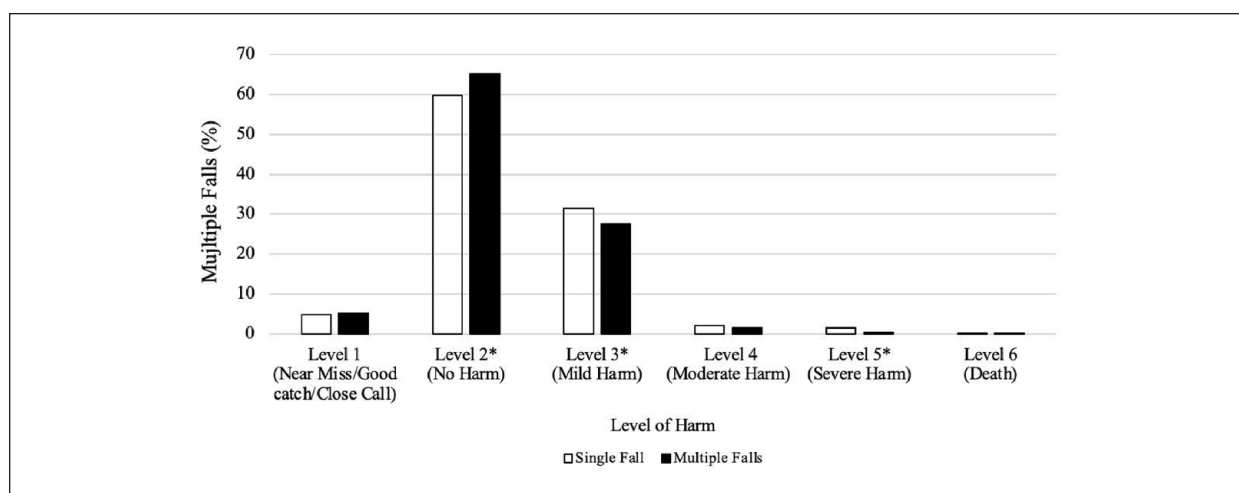


Figure 1. Proportion comparison of the level of harm brought on by a fall in patients who fell once versus multiple times per hospital visit.

*Level of significance, $p \leq .05$.

major differences among the groups were observed in any of the other locations or sections of a hospital. It is important to note that across individuals who had a single fall incidence and multiple fall incidences the majority of falls took place in complex care and medicine, emphasizing the enhanced fall risk of these locations.

Type of fall analysis demonstrated that falling off a bed with no rails, a bed with the rails down, or from a wheelchair/Geri-chair were significantly more prevalent among older persons who fell multiple times ($p < .05$). Conversely, falling from standing, walking, or other fall type (e.g., from exam/operating table, on stairs, in shower/tub, while being held by caregiver, while running/playing), were significantly more prevalent in older persons with a single fall ($p < .05$). Across both groups, a fall while walking represented the highest percentage of falls at 23.2% of the total study population. Additionally, no significantly different proportion of falls were reported in any season in both single and multiple fall groups.

Comparing the levels of harm, investigators found that older persons with multiple falls reported no harm significantly more ($p < .05$) often than those with one fall (Figure 1). Conversely, a mild level of harm and a severe level of harm was reported significantly more by older persons with one fall compared to multiple falls ($p < .05$).

The logistic regression model identified sex, type of fall, and location in hospital as significant predictors of falling multiple times while age and season were not significant (Table 2). Compared to females, male patients were 1.16 (95% CI [0.719, 0.979]) times more likely to suffer multiple falls. Within the location variable, complex care, mental health, and respiratory were significant in comparison to the reference category of surgery. The odds of experiencing multiple falls in complex care, mental health, and respiratory were 2.659 (95% CI [2.033, 3.478]), 3.620 (95% CI [2.247, 5.829]), and 1.593 (95%

CI [1.077, 2.355]) times higher respectively compared to surgery. Using a fall from a wheel or Geri chair as the reference, significant differences were observed in several fall types. Most notably, falling from standing ($p < .001$), walking ($p < .001$), from the toilet/commode ($p < .05$), or having a fall type identified as other ($p < .05$) had significantly lower odds of multiple falls than our reference category. Age, and season were not significant predictors of multiple falls in the regression model.

Discussion

The purpose of this study was to identify the risk factors associated with multiple falls relative to a single fall in older inpatients in a hospital setting. As discussed previously, any individual can experience an accidental fall at any time. Yet any variable more prevalent in patients that have fallen multiple times provides evidence of a concerning trend worthy of investigating.

Age

In this study, there was no significant difference in the age of patients who experienced multiple falls compared to single fall patients. Furthermore, our regression model did not identify age as a predictor of multiple falls. This contrasts with other research that has identified increased age as a recognized risk factor falls in older persons (Lord et al., 2021) and increases the risk of serious injury or death (Deandrea et al., 2010). It is possible that our non-significant finding is likely due to the exclusion of individuals younger than 65 years in our study.

Sex

In this study, there were no significant sex differences (proportionally) among those who fell multiple times

Table 2. Logistic Regression Variables as Predictors of Multiple Falls.

	B	Sig.	Exp (B)	95% CI for Exp (B)
Age	0.003	.513	1.003	[0.994, 1.013]
Sex* (Female)	-0.176	.026	0.839	[0.719, 0.979]
Season (Winter)		.925		
Autumn	0.005	.961	1.005	[0.810, 1.249]
Spring	0.062	.572	1.064	[0.857, 1.322]
Summer	0.001	.991	1.001	[0.803, 1.249]
Type of fall** (Wheel/Geri chair)		<.001		
Bed—foot/headboard	-0.069	.830	0.934	[0.499, 1.747]
Bed—over rails	-0.176	.246	0.838	[0.622, 1.129]
Bed—no rails	-0.198	.185	0.821	[0.613, 1.099]
Bedside chair	-0.354	.056	0.702	[0.489, 1.009]
Standing**	-0.789	<.001	0.454	[0.292, 0.708]
Stretcher	-0.417	.291	0.659	[0.304, 1.429]
Toilet/commode*	-0.527	.004	0.590	[0.414, 0.842]
Transfer	-0.390	.186	0.677	[0.380, 1.206]
Unwitnessed*	-0.307	.035	0.736	[0.553, 0.979]
Using equipment	0.834	.198	0.434	[0.122, 1.544]
Walking**	-0.639	<.001	0.528	[0.401, 0.695]
Other*	-1.315	.034	0.268	[0.080, 0.906]
Location** (Surgery)		<.001		
Cardiology	0.173	.494	1.189	[0.724, 1.951]
Complex care**	0.978	<.001	2.659	[2.033, 3.478]
Critical care	0.004	.987	1.004	[0.591, 1.706]
Diagnostic imaging	-0.718	.335	0.488	[0.113, 2.102]
Emergency	-0.145	.467	0.865	[0.586, 1.278]
Medicine	0.253	.079	1.288	[0.971, 1.708]
Mental health**	1.286	<.001	3.620	[2.247, 5.829]
Nephrology	0.323	.095	1.382	[0.946, 2.019]
Oncology	0.198	.306	1.219	[0.834, 1.780]
Respirology*	0.465	.020	1.593	[1.077, 2.355]
Other	-0.068	.865	0.935	[0.429, 2.037]
Constant	-1.618	<.001	0.198	

Note. Parentheses denotes reference category used for each independent variable in the model. Level of significance * $p \leq .05$; ** $p \leq .01$.

and those who fell a single time, yet sex was a significant predictor of multiple falls as males were 16.1% more likely to fall multiple times, compared to females. Interestingly, there was a higher number of females in locations such as complex care, mental health, and respirology, that were shown to be higher-risk areas for multiple falls. Literature reports women have a higher risk of falls than men, especially in an older adult population (Gale et al., 2018). However, Pereira et al. (2013) found that men demonstrated a higher probability of falling after adjusting for comorbidities and physical fitness. Stevens et al. (2012) identified that regardless of prevalence, women were significantly more likely to report falls, seek care, and discuss their falls and fall prevention with their healthcare provider. Although females may be at higher risk for an initial fall, this brings awareness to the importance of addressing a first fall, fall prevention education, and taking necessary proactive steps

in order to avoid a subsequent fall. In response to the findings of Stevens et al., as well as the current study, medical providers should discuss previous falls and implement prevention education, especially in older male patients.

Location

The current study observed a significantly higher proportion of multiple falls occurring in mental health units, at a nearly 4-time greater odds compared to the surgery unit. This finding is consistent with the surplus of literature concluding that fall risk is exacerbated by mental health conditions (depression, mania, anxiety) and psychotropic medications (Bunn et al., 2014; Healey et al., 2014). Additional considerations apply to this population based on notable unpredictable behaviors due to differing mental statuses based on the time of day or

changes in medication (Carpels et al., 2022). Mental health units of hospitals often observe confused or frustrated older adults move in and out of bedrooms or wander in open spaces (Heslop et al., 2012). There are also specific diseases that affect the older adult population disproportionately, such as Parkinson's and Alzheimers, which may directly impact a patient's balance and gait, or their mental status and development of delirium, confusion, and agitation (Heslop et al., 2012).

This study also demonstrated a significantly higher proportion of multiple falls occurring in complex care, along with a significantly greater likelihood that a patient would fall multiple times in complex care than other in-patient hospital locations. Complex care is for patients with chronic or multiple non-urgent medical needs who are in the hospital for specialized services and resources including rehabilitation and recovery (Kuluski et al., 2017). Additionally, it is reported that in clinical trials, multifactorial interventions that are specific to the individual are typically the most successful in reducing falls (Panel on Prevention of Falls in Older Persons, American Geriatrics Society and British Geriatrics Society, 2011). As complex care units are already tailoring treatment to the individual, they should incorporate personalized fall risk assessments and prevention.

Investigators also found an increased risk of multiple falls in respirology units. Similarly, Roig et al. (2011), found that COPD patients and those presenting with dyspnea had a high susceptibility to falls. Further research would enhance the understanding of the relationship between respiratory challenges and multiple fall risk.

Other fall locations such as diagnostic imaging, emergency medicine, and surgery showed a significantly higher proportion of single falls. While important to note, these falls appear to be one-time incidences more often than not. Appropriate safety adjustments within the hospital and fall prevention strategies occurring after an initial fall in these locations may help to avoid further incidents.

Type of Fall

The current study found that falling from a bed with no railings or with the rails down was significantly more prevalent in patients that fell multiple times. Bed rail use for fall prevention is controversial, as some research supports the use of rails as a preventative measure (Huynh et al., 2020; Meyer et al., 2009), while others feel they are dangerous and result in greater risk of falling as some patients attempt to climb out of bed over the railings (Enns et al., 2014; Köpke et al., 2012). The studies that did not support the use of bed rails suggested alternatives such as bed alarms, lower beds, or restraints.

Patients using wheelchairs or Geri-chairs were also more likely to fall multiple times based on the current

studies results. Special consideration must be taken regarding transfer into and out of the chair, chair maintenance, and confusion of the patient that could all increase the risk of falling (Sutton & McCormack, 2019). Due to lack of training or practice using equipment in a hospital setting, a more rigorous multifactorial fall prevention approach is recommended consisting of supervised exercise, ability and transfer assessments, and conditional requirements of the equipment (Sutton & McCormack, 2019). However, these recent recommendations will require time for hospitals to implement and in the meantime, those aiding wheelchair and Geri-chair users should remain diligent.

A fall while walking was the most common fall type across individuals who fell a single time and multiple times. Ambulation is the ability to walk independently (Halpern, 2017) and is frequently discussed in relation to risk of falling. A patient in a hospital setting may have compromised ambulation due to illness, where physiological stress or weakness can negatively impact mobility (Fisher et al., 2013). Researchers assessed patient ambulation trajectory 2 weeks post-discharge and reported little or no change in the previously established weakened mobility (King et al., 2019). As a result, walking should be aided both in the hospital (Fisher et al., 2013) and the 2 weeks following (King et al., 2019).

Subsequent fall types, including from an exam or operating table, on stairs, in a shower or bathtub, while being held by a caregiver and while running or playing, were only prevalent in patients who fell a single time. As these are not common types of falls and they did not occur repeatedly, it can be assumed that these fall types are less likely to be associated with multiple falls.

Season

No significant differences between the single and multiple fall groups in any season were identified. It was hypothesized that there might be a higher proportion of individuals falling multiple times in the winter based on the premise that visitors may be wearing wet footwear inside the hospital or the entrances and exits may be slippery. Magota et al. (2017), examined seasonal and diurnal variations in fall types and found the most falls occurred around dawn, October through February. López-Soto et al. (2016) also analyzed fall records of hospitalized patients aged 65 years or older and found that falls were more frequent in the winter and spring as well as at specific times of day and days of the week. Few studies reported a higher fall-risk in the summer and spring months. Researchers suggested that warm weather tends to provoke a desire to go outside and walk (Vongsachang et al., 2021) and that older people are at a greater risk to adverse outcomes in high temperatures (Leyk et al., 2019). While a heat-related factors could be contributing in a minor role in the current study, further research is needed to determine the relationship with

single and multiple falls in terms of season and time of day.

Level of Harm

In this study, patients were most likely to have a subsequent fall if they indicated no harm, compared to mild or severe harm. In general, individuals who have experienced a first fall are more likely to acknowledge their fall risk for a subsequent event and more likely to take precautions (Horne et al., 2008). However, Mihaljcic et al. (2015) found that up to 63% of patients underestimate risk for a first fall. As a result, patients do not appropriately consider their fall risk until a first incident causes memorable harm, so earlier education and risk assessment are warranted.

Limitations and Recommendations

This study used secondary data analysis of a Southern Ontario fall incident-specific database. It was limited by unknown individual risk factors such as pre-existing conditions, medication, and cognition frequently discussed in the literature, as well as variables of interest including reason for hospital visit, time of fall incident, and whether the patient was accompanied by staff. There was also risk of non-reporting bias if minor falls went unreported in the hospital setting. Furthermore, as this study was cross-sectional in nature, causality cannot be established.

Although the increased fall risk is understandable in many of the situations discussed, the current study draws attention to the frequency that patients are repeatedly falling. Given this data, further research should be conducted, and resources allocated to determine how to make the hospital a safer place in terms of fall risk. Proposed recommendations include a higher number of staff in high-risk units, technology such as virtual side rails to notify staff of movement, nursing interventions such as bowel and bladder programs to limit urgency to get up, leaving lights turned on where possible, and using equipment that can lock in place during transfers (Malik & Patterson, 2012).

Conclusions

Compared to single falls, a higher proportion of multiple fall incidences were associated with patients in complex care or mental health units, falling from beds with no rails or from a wheel or Geri-chair, and falls that caused no harm. Expanding on this, sex, type of hospital fall, and hospital location were predictive risk factors of multiple falls of older in-patients. In the context of a rapidly aging population, hospital use among older adults has become a priority. Ensuring hospital stays are healthful experiences, recovery requires optimum attention to preventing adverse events that cause injury and harm due to in-patient falls. This study makes an important

contribution to our understanding of risk factors for multiple falls—an area of limited research to date. As well as highlighting the need for further research in this area, findings from this study provide insight into some of the key risk factors for multiple falls in hospitals—sex, types of falls, location, and level of harm. This knowledge is important for falls prevention with respect to clinical practices, hospital design, and enhancing quality of life among older patients.

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Ethical Board Approval

This study was granted human ethics approval from the Hamilton Integrated Research Ethics Board and Brock University Research Ethics Board.

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