JAMDA 20 (2019) 171–176

JAMDA

journal homepage: www.jamda.com

Original Study

An Analysis of Falls and Those who Fall in a Chronic Care Facility

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Keywords:
Falls
geriatric
chronic care
hospital
falls
prevention
injury rates

A B S T R A C T

Objectives: Falls in hospitals lead to adverse patient outcomes and prevention of falls is of upmost importance. Little is known about fall and injury rates in chronic care facilities, which are similar to skilled nursing facilities in the United States. Current fall risk tools in this setting are not well studied. Enhancing the understanding of how patient characteristics relate to fall circumstances is also needed.
Design: Retrospective analysis of falls over 3 years on consecutive admissions and discharges.
Setting and Participants: A 104-bed geriatric chronic care facility.
Measures: Fall and injury data, descriptive data for patients measuring mobility, balance, cognition, function, and frailty in relation to risk of falls and fall circumstances were analyzed.
Results: There were 1141 falls, with an overall fall rate of 8.48 falls per 1000 occupied bed days. The overall injury rate was 37.2 injuries per 100 falls. Being male and frail, having a mobility aid, poor mobility, balance, or cognition were associated with falling. Patients with good balance but poor cognition was more likely to fall outside their room, while those with poor mobility/balance fell more often in their room. The Clinical Frailty Scale performed modestly well at predicting falls with an odds ratio of 2.5 (95% confidence interval 1.9-3.2).
Conclusions and Implications: Fall rates in chronic care facilities differ from what is reported in other settings. Patient characteristics such as male, use or misuse of a mobility aid, and poor cognition are more common in fallers. Fall circumstances differ in those with poor cognition compared with those with poor mobility and balance. More research focusing on frailty, cognition, and mobility/balance is needed to develop accurate tools that can predict those at a high risk of falls in these facilities.

Falls in older adults are a significant problem in hospitals, chronic care facilities, and long-term care facilities. The effectiveness of fall prevention strategies in hospital are mixed.[1–8] Literature pertaining to falls in hospitals has focused on acute care units,[8] rehabilitation units,[9,10] and some psychogeriatric units.[11] Chronic care facilities are defined by the Canadian Institute of Healthcare Information[12] as beds in a hospital or a free standing facility where patients with complex care needs continue to receive professional care. However, these patients are no longer in need of acute hospital care. Chronic care facilities are similar to skilled nursing facilities in the United States. Falls in this type of care environment are poorly understood.

Fall risk assessment tools have been studied and no tool has been shown to be effective in accurately determining risk in different care settings.[13–15] Fall rates in acute care hospitals range from 3.56 falls/1000 occupied bed days (obd) in the United States[16] to 4.4 falls/1000 obd in Canada.[17] Injury rates as a result of a fall are as high as 26.1% (0.93/1000 obd)[16] in acute care hospitals with 42% of first falls resulting in injury.[18] It is estimated that more than 25% of patients in chronic care facilities are at a high risk of falling.[6]

Falls are often multifactorial, influenced by intrinsic patient characteristics such as sex, age, balance, mobility, use of mobility aids, cognition, medications, and diagnosis.[2] Falls are also ecologically related to the circumstances and surroundings. These extrinsic characteristics are often captured in incident reports completed by

The authors declare no conflicts of interest.

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https://doi.org/10.1016/j.jamda.2018.06.022
1525-8610/

nursing staff after a fall. The intrinsic and extrinsic characteristics are often not considered together as a possible way to predict or prevent falls for individual patients. A better understanding of these interactions could be valuable in the development of better risk prediction tools and prevention strategies.

This retrospective analysis examined falls experienced by frail older adults in a chronic care facility. Overall fall and injury rates, the relationship of intrinsic and extrinsic characteristics to falls, and evaluation of fall risk prediction tools are reported.

Methods

Setting

This study took place in a 104-bed chronic care facility in New Brunswick, Canada. Consecutive patients admitted and discharged between December 1, 2012 and July 31, 2016 were included. The facility has a Cognitive Assessment and Management Unit (20 beds), Geriatric Evaluation and Management Unit (21 beds), Restorative Care Unit (21 beds), and 2 Transitional Care Units (42 beds).

Patient Characteristics

Patient demographic data and results of tools administered on admission were obtained from the Health and Aging Database. These variables were considered to be intrinsic patient characteristics. Categorical variables included sex, age group, mobility status on admission, and from where a patient was admitted. Scale variables included measures of comorbidity (Charlson Comorbidity Index),[19] mobility (Timed-Up and Go test),[20] balance [Berg Balance Scale (BBS) test],[21] functional independence (Functional Independence Measure),[22] cognition [Mini-Mental State Examination (MMSE)],[23] frailty [Canadian Study of Health and Aging (CSHA) Clinical Frailty Scale (CFS)],[24] and falls risk [Morse Falls Scale (MFS)].[25]

Fall Characteristics

Fall data was recorded by nurses and entered into the Post Fall Database (PFD) using a tool that was designed for this facility. Fall data included time of day, location of fall, patient and staff activity at time of fall, environmental factors, medication factors, sensory factors, footwear, and use of a mobility aid. These were considered to be the extrinsic fall characteristics.

The level of harm from the fall was reported as no injury; slight/mild injury (bruises, minor lacerations); or moderate/severe injury (fractures, major lacerations).

Data Analysis

Fall and injury rates

The fall rate was calculated as the number of falls per 1000 obd [1000 × no. of falls/(no. beds × occupancy rate × no. of days)][26] for all falls reported, which included first falls and repeat falls. Injury rates were then computed by number of injuries per 100 falls (100 × no. of injuries/no. of falls).[26]

Patient characteristics and falls

This analysis linked data using a unique identifier from the Health and Aging Database and PFD. This allowed for intrinsic patient characteristics captured on admission to be determine if any of these would be predictors for falls. For patients with more than 1 admission during the study period, only the first admission was analyzed. Patients were grouped into faller (fell at least once during admission) and nonfaller cohorts. Student *t*-tests and χ^2 cross-tabulations were used to compare intrinsic patient characteristics between the 2 cohorts. Logistic regression and receiver operator characteristic analysis were used to evaluate if select patient characteristics were able to classify patients into faller and nonfaller groups based on their admission characteristics.

Patient and fall event characteristics

This analysis was to determine if the patient (intrinsic) characteristics were related to the extrinsic fall characteristics. This analysis utilized first fall events aligned to the specific extrinsic fall characteristics for the first fall. The extrinsic characteristics were collapsed to dichotomous variables. Then the relationships between the intrinsic and extrinsic characteristics were determined by conducting χ^2 tests for categorical intrinsic variables and analysis of variance tests for scale variables across categories of the dichotomized extrinsic variables. If a patient fell multiple times, only the data for the first fall was included for analysis.

Statistical significance for all tests was set at $\alpha = 0.05$. The study protocol was approved by Research Ethics Boards of the health authority and university.

Results

Fall and Injury Rates

There were 1141 falls reported for 366 admissions over 1308 days. The average monthly bed occupancy was 98.9% for the 104 beds. The overall fall rate was 8.48 falls/1000 obd with month to month variation (<3–16 falls/1000 obd) (Figure 1). The first-fall rate was 2.72 falls/1000 obd, meaning that repeat falls accounted for 5.76 falls/1000 obd.

The overall injury rate was 37.2 injuries/100 falls, with a moderate to severe injury rate of 4.2 injuries/100 falls. Injury rate for first-falls was higher at 42.2 injuries/100 first-falls, with a moderate to severe injury rate of 4.7 injuries/100 first-falls. Injury rate for repeat falls was lower at 35 injuries/100 repeat-falls, with 4 injuries/100 repeat-falls being moderate to severe.

Patient Characteristics and Falls

There were 945 admissions and discharges. Fifty patients had more than 1 admission, accounting for 55 repeat admissions. Of the 890 unique patients, sex and age were not recorded for 2 patients. Therefore, the sample consisted of 888 patients. Of this sample, 277 had at least 1 fall, with 51.2% falling more than once. The majority (611 patients) had no falls. The mean age of the nonfallers was 81.5 ± 7.5 years compared with 82.4 ± 7.6 years in the fallers.

Male patients were 1.6 times more likely to fall compared to female patients ($P < .001$). Those that were not independent ambulators (with or without a mobility aid) at the time of admission were 1.7 times more likely to fall compared with those who were independent ambulators at admission ($P < .001$). Fallers were significantly more frail (CFS, $P < .001$), had more impaired balance (BBS, $P < .001$), more impaired cognition (MMSE, $P < .001$), and a higher falls risk score (MFS, $P < .001$) compared with nonfallers (Table 1).

Individual scale variables were not good predictors of a first fall. The best performing measure was the CFS, having an odds ratio of 2.5 [95% confidence interval (CI) 1.9–3.2], true positive rate of 44.5%, and false positive rate of 16.4%. All other scale variables, including the MFS, were highly specific in identifying nonfallers, having small (or zero) false positive rates, but had poor sensitivity with small (or zero) true positives rates.

The length of stay for fallers (155 days, 95% CI 139–170 days) was significantly ($P < .001$) longer compared with those that did not fall (78.3 days, 95% CI 72.0–84.6 days). In addition, 12.6% admissions that fell died in hospital compared with 4.4% of those who did not fall

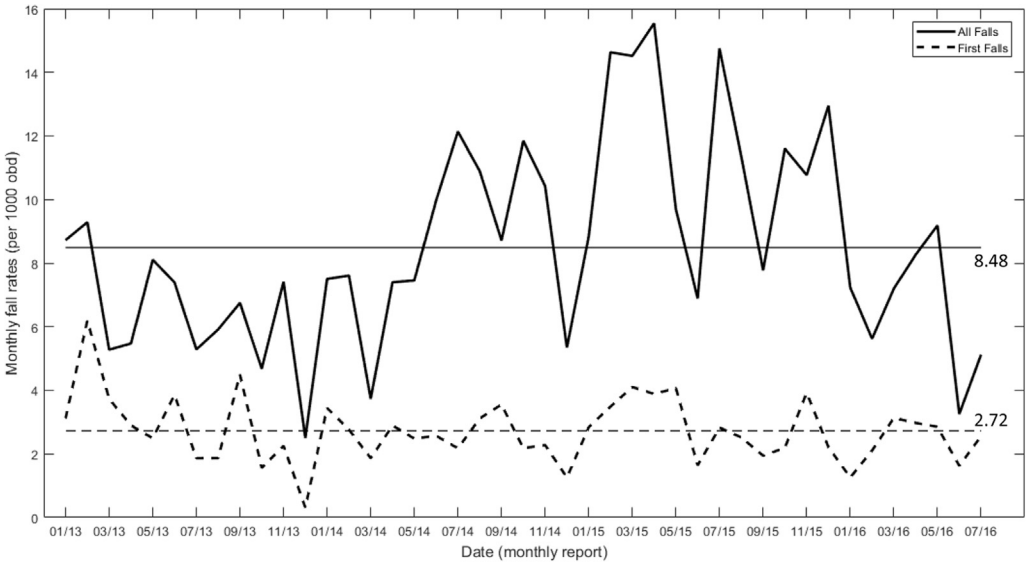

Fig. 1. Fall and injury rates by month (n = 1141 falls); Fall rate considering all falls (*heavy solid line*) and first-fall only (*heavy dashed line*). The horizontal solid line is mean overall fall rate (8.48), and the horizontal dashed line is mean first-fall rate (2.72).

($P < .001$); the odds of dying in hospital was 2.8 (95% CI 1.6–4.8) times higher for fallers compared with nonfallers.

Patient and Fall Event Characteristics

In the PFD, there were 366 fall events reported, however, 1 record was incomplete and was removed, leaving a sample of 365 fall events that are summarized in Table 2.

Most (57.1%) of falls occurred between 8:00 AM and 8:00 PM with a slight peak between 2:00 PM and 4:00 PM. The majority (83.0%) of falls occurred in the patients' rooms. A similar number of falls occurred both during ambulatory (50.4%) and nonambulatory (49.6%) activity.

Staff were engaged in other tasks when 87.2% of patient falls occurred. Environmental factors were reported to be related to the fall in the minority (13.6%) of falls. Medication- related factors were also reported in a minority (16.4%). Appropriate footwear was not worn in 29.3% of falls, and these falls were more likely to occur between 2:00 AM and 8:00 AM ($P < .001$) during nonambulatory (transferring) activities ($P = .004$). Sensory deficits were present in 85% of those admissions that fell.

Most fallers (63.5%) were prescribed a mobility aid, but 27.5% were not using it at the time of the fall (Table 2). Patients with mobility aids were more likely to fall in their room/bathroom ($P < .001$) and during nonambulatory activity ($P < .001$). Injury rates were higher in those with a mobility aid ($P = .020$), but whether the aid was being used

Table 1
Intrinsic Patient Characteristics of Fallers and Nonfallers (n = 888)

Intrinsic Patient Characteristics		Total	Fall Status				Fallers vs Nonfallers		Fall Prediction		
			Did Not Fall (n = 611)		Had at Least 1 Fall (n = 277)		Test Statistic	95% Sig.	OR	TP, FP	ROC
Categorical variables	Category	Count	Count	SR	Count	SR	χ^2	*P* value	OR (95%CI)	TP, FP	
Sex	Male	304	188	−1.4	116	2.1	10.130	.002*	1.6 (1.2–2.2)	0, 0	
	Female	581	420	1.0	161	−1.5					
Age group	Under 80 y	357	254	.5	103	−.8	1.526	.217	.83 (.62–1.1)	0, 0	
	Over 80 y	531	357	−.4	174	.6					
Mobility status at admission	Not independent	480	335	−1.0	155	1.6	9.783	.002*	1.7 (1.2–2.4)	0, 0	
	Independent	293	229	1.3	64	−2.1					
Admitted from	Home	277	184	−.5	93	.7	1.063	.310	1.2 (.87–1.6)	0, 0	
	Hospital	611	427	.3	184	−.5					

Scale variables	Mean	SD	Mean	SD	Mean	SD	t	*P* value	OR (95% CI)	TP, FP	AUC
CCI at admission	3.89	2.45	3.81	2.45	4.05	2.44	−1.093	.198	1.0 (.97–1.1)	0, 0	.534
CFS at admission	5.96	.81	5.79	.78	6.31	.76	−7.673	<.001*	2.5 (1.9–3.2)	44.5, 16.4	.680
FIM at admission	84.78	14.56	85.42	14.89	82.97	13.51	1.270	.205	.99 (.97–1.01)	0, 0	.432
TUG test at admission	20.28	9.66	19.74	9.45	21.93	10.34	−1.805	.072	1.0 (.99–1.1)	0, 0	.563
BBS test at admission	29.99	16.52	31.91	16.42	24.96	15.79	3.956	<.001*	.97 (.96–.99)	0, 0	.387
MMSE at admission	22.12	6.31	23.01	5.68	19.99	7.20	6.414	<.001*	.93 (.91–.95)	9.1, 3.3	.373
MFS at admission	58.76	25.49	56.60	26.65	63.75	21.81	−3.496	<.001*	1.0 (1.0–1.02)	0, 0	.570

AUC, area under curve; *CCI*, Charlson Comorbidity Index; *FIM*, Functional Independence Measure; *FP*, false positive rate; *OR*, odds ratio; *ROC*, receiver operator characteristic; *SR*, standardized residual; *SD*, standard deviation; *t*, Student *t*–statistic; *TP*, true positive; *TUG*, Timed up and Go.
*Significant at $P < .05$.

Table 2
Extrinsic Characteristics of Falls (N = 365 Fallers)

Variables	Category	Count	%	Recode	Count	%
Time of day	8:00 AM–10:00 AM	29	7.9	Active hours	212	57.9
	10:00 AM– 12:00 PM	37	10.1			
	12:00 PM–2:00 PM	38	10.4			
	2:00 PM–4:00 PM	42	11.5			
	4:00 PM–6:00 PM	28	7.7			
	6:00 PM–8:00 PM	38	10.4			
	8:00 PM –10:00 PM	30	8.2	Inactive hours	153	41.8
	10:00 PM–12:00 AM	31	8.5			
	12:00 AM–02:00 AM	11	3.0			
	02:00 AM–04:00 AM	23	6.3			
	04:00 AM–06:00 AM	28	7.7			
	06:00 AM–08:00 AM	30	8.2			
	Total	365		Total	365	
Location of fall	Bathroom	50	13.7	Within Room	303	83.0
	Room	253	69.3			
	Hallway	19	5.2	Outside Room	62	17.0
	Other	43	11.8			
	Total	365		Total	365	
Activity during fall	Altercation	11	3.0	Ambulatory	184	50.4
	Slip/trip	85	23.2			
	Walking	88	24.0			
	Bathroom	33	9.0	Nonambulatory	181	49.6
	In bed	33	9.0			
	Transferring	88	24.0			
	Other	71	6.6			
	Total	365		Total	365	
Staff activity at time of fall	Breaks	22	6.0	n/a	–	–
	Reporting	24	6.6			
	Other Tasks	319	87.2			
	Total	365				
Environ-mental factors	Bed height	1	0.3	n/a	–	–
	O2 tubing	0	0.0			
	Wet floor	17	4.6			
	Clutter	15	4.1			
	Equipment	17	4.6			
	N/A	315	86.1			
	Total	365				
Medication factors	No	305	83.6	n/a	–	–
	Yes	60	16.4			
	Total	365				
Appropriate footwear on	No	107	29.3	n/a	–	–
	Yes	258	70.7			
	Total	365				
Sensory impairment	No	55	15.1	n/a	–	–
	Yes	310	84.9			
	Total	365				
Does the patient use a mobility aid?	No	133	36.5	No aid	133	36.3
	Yes	131	36.0	Aid Rx	231	63.5
	Yes not used	100	27.5			
	Total	365		Total	365	
				Proper use	264	72.5
				Improper use	100	27.3
				Total	365	

properly at the time was not related to whether they sustained an injury or not ($P = .905$).

The location of the fall and whether or not a patient had a mobility aid were the only extrinsic factors found to be related to intrinsic patient characteristics. Notably, patients who fell outside of their room had less impaired balance ($P = .009$) but more impaired cognition ($P < .001$).

Discussion

The overall fall rate of 8.48 per 1000 obd is almost twice the rate for acute care hospitals[16,17] and in the upper range reported by community hospitals in the United Kingdom.[27] It is lower than the rate for geriatric units in Switzerland (11.7/1000 obd)[28] and higher than 1.8/1000 obd on a psychogeriatric unit.[11] However, when the first fall rate was calculated, the fall rate dropped to 2.72/1000 obd, which is a similar fall rate reported for acute care hospitals.[16] This suggests that the longer the length of stay in a facility, the higher the overall fall rate might be, since 5.2/1000 obd was accounted for by the falls from repeat fallers. The variability in the number of falls from month to month may be due to the specific types of patients in the units and/or staffing, as suggested by others.[29,30] When only the first fall rate was calculated by month, there is less variability, again suggesting that the variability seen month to month may be due to the type of patient. The overall injury rate of 37.2 injuries/100 falls is similar to rates reported in acute care hospitals in the United Kingdom,[27] but less than rates reported in the United States.[16]

Our findings that being male and not an independent ambulator prior to admission are consistent with the findings of others.[27,31] Despite the fact that the fallers had more impairment in balance and cognition, the individual tools (BBS, Timed-Up and Go test, MMSE) performed poorly as predictors of a first fall in the hospital.

Research by others shows some conflicting results.[32–34] The CFS was the only tool that predicted those at a high risk of falling, but with only moderate accuracy. Frailty has been shown to be related to other adverse outcomes for geriatric patients.[35–37] This is the first time the CFS has been evaluated as a tool to predict risk of falling. The MFS did not accurately predict a high risk of falling, which is similar to the results of others.[38,39] Our finding that function and comorbidity were not related to falls differs from rehabilitation settings; this may be because our setting was more diverse.[40,41]

Those with a mobility aid (and/or did not use them properly) fell more often in the room/bathroom during non-ambulatory activity. This suggests that heightened vigilance by staff for these patients during this type of activity may be important. The peak time of day for falls in our study was different than in reports of others, suggesting that many factors likely contribute to peak fall times on specific units.[2,27] Staff reported that they were engaged in other activities when the falls occurred, suggesting that high-risk patients may benefit from increased supervision when direct patient care is not being performed. Others have demonstrated that environmental and medication-related causes often contribute to falls, but this was not seen in this study.[2,31] This may be because a fall prevention strategy in this facility may have heightened the awareness of usual environmental hazards. In addition, the low rate of medication-related causes may be due to the regular medication reviews that are part of usual patient care. Conversely, it may be because the nurses did not associate the patient's medications with the fall. Our finding that those with cognition impairment fall more often outside their room is an important patient characteristic that should be targeted by staff trying to deliver patient-specific fall prevention interventions.

This study took place in 1 facility which limits the generalizability of these results. Data collected on admission was part of the usual care and not all patients had complete data. The post-fall data was completed by the nursing staff, who relied on their clinical judgement.

Conclusions

The overall fall and injury rates in this chronic care facility were higher than in acute care hospitals. The CFS performed moderately well in predicting patients at high risk of falling. Tools that can accurately stratify patients into high and low risk of falls in chronic care settings need further research. Cognitive impairment, use of a mobility aid, balance impairment, and frailty are important variables that should be considered for tools developed to predict the risk of falling.

Patients with impaired cognition and/or mobility and balance have different patterns of falls. Those with cognitive impairment fall more often outside their room, while those with mobility and balance impairment fall more often in their room. Therefore, these patient characteristics may be helpful in the development of individualized fall prevention plans. There continues to be a need to focus research on finding effective fall risk assessment tools in various settings as well as the development of a person-focused approach to fall prevention.

Acknowledgments

The authors of this study would like to thank Connie Boyer for her administrative assistance; and also the staff on all of the geriatric units in this study.

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