Risk of Home Falls Among Older Adults After Acute Care Hospitalization: A Cohort Study

NCPD 2.0 ANCC Contact Hours

Christy M. Adams, PhD, MPH, RN ■ Daniel J. Tancredi, PhD ■ Janice F. Bell, PhD, MN, MPH ■ Sheryl L. Catz, PhD ■ Patrick S. Romano, MD, MPH

BACKGROUND: Acute care hospitalization has been associated with older adult home falls after discharge, but less is known about the effects of hospital- and patient-related factors on home fall risk.

OBJECTIVES: This study compares the effects of hospital length of stay, medical condition, history of falls, and home health care on period rates of home falls after discharge from acute care hospitalization.

METHODS: This was a retrospective cohort study comparing period rates of home injury falls among older adults (age ≥ 65) occurring after discharge from an acute care hospitalization. Data were collected from state health care utilization administrative records between January 1, 2016, and December 31, 2018. We used log-linear Poisson regression to model post-discharge injury fall incidence rates as a function of days since discharge and patient-level covariates.

RESULTS: A total of 736,230 older adults were included in the study cohort. Absolute risk for post-discharge home falls was 7%. Fall rates were highest the first week after discharge at 0.05 per 100 person-days, with a period incidence rate 74.29 times higher than the >90-day discharge period. Fall risk increased with age, with the highest risk in the ≥85 age group. Fall risk increased for a 2-day hospital stay but decreased for 5- to 30-day stays, compared to a 1-day length of stay. Discharge to home health care and history of falls were associated with increased risk.

CONCLUSIONS: Older adults are at highest risk for a home fall the first 7 days after discharge from acute care hospitalization. These findings describe patient-related risk factors that acute care hospitals can use to develop geriatric-specific discharge guidelines intended to reduce home fall risk during the early care transition to home.

KEY WORDS: Acute care discharge, Home falls, Older adults

Cite as: Adams, CM., Tancredi, DJ., Bell, JF., Catz, SL., & Romano, PS. (2024). Risk of home falls among older adults after acute care hospitalization: a cohort study. *Journal of Trauma Nursing, 31*(6), 281-289. https://doi.org/10.1097/JTN.0000000000000816

BACKGROUND

Injury falls among older adults living independently at home often result in decreased functional ability, reduced mobility, diminished quality of life, or loss of independence (Adam et al., 2024; Kakara et al., 2023). Fall risk among community-dwelling older adults is a well-studied and complex issue (Deandrea et al., 2010; Lusardi et al., 2017) associated with physiological changes from normal and pathological aging, chronic disease and related treatment, environmental factors, and a history of prior falls (Ambrose et al., 2013). Episodes of acute care hospitalization due to illness or injury may also introduce physiological changes that transiently increase the risk of falling after discharge to home (Hill et al., 2013). Associations between hospitalization and older adult home falls after discharge have been established in prior research (Adams et al., 2020; Hoffman et al., 2019; Mahoney et al., 2000; Qian et al., 2023), but additional research is needed to further differentiate the effects of hospital- and patient-related factors on post-discharge fall risk. Such research could serve to better inform acute care hospital geriatric discharge policy and practices and to improve patient outcomes by reducing post-discharge at-home fall risk among community-dwelling older adults.

Dates: Received June 5, 2024; Revised July 30, 2024; Accepted July 31, 2024.

Author Affiliations: Trauma Prevention Program, UC Davis Medical Center, University of California Davis, Sacramento, California (Dr Adams); Department of Pediatrics, School of Medicine, University of California Davis, Sacramento, California (Dr Tancredi); Betty Irene Moore School of Nursing, University of California Davis, Sacramento, California (Drs Bell and Catz); and Division of General Internal Medicine, School of Medicine and Center for Healthcare Policy and Research, University of California Davis, Sacramento, California (Dr Romano).

The authors have no conflicts of interest or funding to declare.

Correspondence: Christy M. Adams, PhD, MPH, RN, Trauma Prevention Program, UC Davis Medical Center, University of California Davis, 4900 Broadway, Suite 2600, Sacramento, CA 95820 (cmadams@ucdavis.edu).

OBJECTIVE

This study's objective is to examine the effects of hospital length of stay, medical condition, burden of illness, history of prior falls, and discharge to home health care on the home fall risk of older adults discharged home from acute care hospitalization.

METHODS

Study Design

This was a retrospective cohort study using a health care administrative dataset to compare period rates of

KEY POINTS

- Acute care hospitalizations increase older adults' risk of injury falls at home after discharge.
- The highest risk of injury falls occurs during the first week after discharge home.
- Trauma center older adult fall prevention efforts focus on inpatient and community settings.
- National guidelines are needed for geriatric home discharge protocols that reduce fall risk.
- Trauma nurses can advocate for geriatric discharge protocols that reduce home fall risk.

home injury falls requiring hospital or emergency department (ED) care that occurred after discharge from an acute care hospitalization. Eligible patients entered the study cohort on the date of the first discharge to home from an acute care facility (index admission) and were followed until the first inpatient acute care or ED treatment for an injury fall (the event of interest), or until the first acute care or ED treatment record that resulted in death or readmission to any type of hospital. To implement this design, administrative datasets consisting of inpatient admissions and ED encounters were combined to form a person-period dataset in which the total "at-risk" period for each person was segmented into a collection of intervals of varying lengths to permit estimating fall rates (e.g., number of events per total time at risk) as a function of person-level and time-varying characteristics of interest. Specifically, each eligible patient contributed one or more at-risk observation periods as the units of analysis. To permit the regression model to allow the fall rate to vary according to time from discharge, each person-period was further segmented to fit within intervals of 0–15, 16–30, 31–60, 61–90, and >90 days from the date of discharge to home. Patients still "at-risk" for the event of interest were censored on December 31, 2018, the end of available data.

Population and Setting

Study data were obtained from the California Department of Health Care Access and Information Nonpublic Patient Discharge Data (PDD) and ED datasets for the years 2016–2018. The PDD and ED datasets contain patient demographic data, health care utilization data, and International Classification of Diseases 10th Revision Clinical Modification (ICD-10-CM) codes for the principal diagnosis and up to 24 other diagnoses, from all non-federal licensed hospitals in California. For both PDD and ED datasets, ICD-10-CM External Cause of Morbidity codes are recorded for the mechanism that resulted in the most severe injury/health condition along with up to four additional contributing External Cause codes. Corresponding variables indicate whether each of the diagnoses and External Cause codes was present on admission. Cases were defined as California residents with one or more admissions to an acute care facility between July 1, 2016, and December 31, 2018, aged 65 years or older on the date of admission, and discharged directly to home with or without referral to home health services. A 6-month washout period was established prior to the first acute care hospitalization and excluded patients with one or more acute care hospitalizations with an admission date from January 1, 2016, to June 30, 2016. Similarly, all patients whose initial qualifying acute care discharge occurred on or after July 1, 2018 were excluded, to ensure a minimum 6-month post-discharge surveillance period. Approval for this research was granted by the California Committee for the Protection of Human Subjects (17-02-2887) and the University of California, Davis Institutional Review Board (1094204).

Data Collection

All PDD and ED data files were combined, and patient records were linked using the record linkage number, a unique identifier generated by Health Care Access and Information using social security numbers. Records with no record linkage number; with no acute care hospital admission between July 1, 2016, and June / 30, 2018, with discharge directly home; or with any non-California zip code of residence in the initial qualifying acute care record were excluded. Simultaneous, contiguous, or overlapping PDD records, based on the exact dates of admission and discharge, were collapsed into a single observation indicating the initial admitting diagnosis and facility type, total number of hospital days for the episode, discharge disposition, and all ICD-10-CM Principal External Cause of Injury E-codes indicating an injury fall present on admission at the initial facility or occurring during hospitalization. Index cases were identified as the first acute care admissions with discharge to home or home health, occurring between July 1, 2018, and June 30, 2018. The final dataset comprised 2,571,967 PDD and ED records representing 736,230 patients.

Variables

The outcome of interest was the rate of injury falls occurring during the post-discharge period. Injury falls were counted on the date treatment was initiated and defined as one or more W00-W19 ICD-10-CM External Cause of Morbidity codes documented as "present on admission" in any of the five External Cause fields of an ED or PDD record. Only External Cause fall codes commonly associated with community falls were included (e.g., falls on same level from slipping, tripping, and stumbling). External Cause codes typically not associated with home falls among community-dwelling older adults (W04-05, W09, and W11-16) were excluded. Demographic

Table 1. Cohort Demographics and Index Admission Characteristics

Demographics	Total *N* = 736,230	No Fall *N* = 684,215	Post-discharge Fall *N* = 52,015
Age, years, M (SD)	76.5 (8.2)	76.4 (8.1)	80.7 (8.6)
Age group, years, *n* (%)			
65–69	179,294 (24.3)	171,722 (25.1)	7,572 (14.5)
70–74	168, 912 (22.9)	160,520 (23.5)	8,392 (16.1)
75–79	138,547 (18.9)	129,524 (19.1)	9,003 (17.3)
80–84	110,295 (15.0)	100,705 (14.8)	9,658 (18.6)
≥85	139,182 (18.9)	121,792 (18.0)	17,390 (33.4)
Sex, *n* (%)			
Female	388,620 (52.8)	356,478 (52.1)	32,142 (62.0)
Male	347,610 (47.2)	327,737 (47.9)	19,873 (38.2)
Race Group,[a] *n* (%)			
Asian/Pacific Islander	79,471 (10.8)	75,248 (11.0)	4,223 (8.1)
Black	41,068 (5.5)	38,775 (5.7)	2,293 (4.4)
Hispanic	133,553 (18.2)	124,840 (18.3)	8,713 (17.0)
Native American/ Eskimo/Aleut	1,829 (0.3)	1,673 (0.2)	156 (0.3)
White	450,783 (61.2)	415,838 (60.8)	34,945 (67.1)
Other	24,714 (3.3)	23,281 (3.4)	1,433 (2.7)
Unknown	4,812 (0.6)	4,560 (0.7)	252 (0.5)
Characteristics of index admissions, M (SD)			
Length of hospital stay, days, M (SD)	3.3 (3.4)	3.4 (3.2)	3.2 (3.0)
Length of hospital, day range, *n* (%)			
1	185,825 (25.2)	173,399 (25.4)	12,426 (23.1)
2	196,000 (26.6)	181,663 (26.6)	14,337 (27.6)
3–4	206,736 (28.1)	191,170 (27.9)	15,566 (29.9)
5–30	146,579 (19.9)	136,947 (20.0)	9,632 (18.5)
>30	1,090 (0.1)	1,036 (0.1)	54 (0.1)
Elixhauser summary score, M (SD)	3.0 (1.9)	3.0 (1.9)	3.4 (2.0)
Discharge to home health, *n* (%)	230,651 (31.5)	211,531 (30.9)	19,120 (36.9)
Injury fall code present admission, *n* (%)	36,846 (5.0)	30,819 (4.5)	6,027 (11.6)
Inpatient injury fall code, *n* (%)	573 (0.1)	498 (0.1)	75 (0.2)
ED[b] fall code prior to index admission, *n* (%)	39,862 (5.40)	33,466 (4.9)	6,396 (12.2)

Note. ED = emergency department

[a]Normalized Race Group as defined in Health Care Access and Information dataset. Hispanic is assigned for Hispanic ethnicity. Reported race is assigned to Race Group for all other values of ethnicity.

covariates included age range, gender, and the Normalized Race Group variable created by Health Care Access and Information as a combination of reported race and ethnicity. Changes in health status were controlled using the following covariates: (1) Major Diagnostic Category of the principal diagnosis for the index admission, based on the Centers for Medicare & Medicaid Services' grouper; (2) Elixhauser Comorbidity Index (CI) summary score (Moore et al., 2017) for the index hospitalization, calculated using code for Stata (STATA, College Station, TX) adapted from the Healthcare Cost and Utilization Project Index for Elixhauser Comorbidity Software (Stagg, 2015); (3) number of hospitalized days for the index acute care admission; and (4) referral to home health at discharge from the index hospitalization. Three additional indicator variables were included to flag recent injury falls as defined by a W00-W19 External Cause of Injury Code in ED or PDD records: (1) injury fall present on admission at the index hospitalization, (2) an ED visit for injury fall within 6 months prior to the index admission, or (3) a fall during the index hospital admission.

Statistical Analysis

The group demographics and characteristics of the associated index acute care admission were described using adjusted length of stay (1 day plus the difference between the discharge date and admission date) grouped by day ranges to adjust for nonlinear effects, Elixhauser Comorbidity Index, fall history, and discharge to home health and compare patients who did and did not experience post-discharge injury fall (Table 1).

Table 2. All ED and PDD ICD-10-CM External Cause Fall Codes (*N* = 80,698)

ICD-10-CM External Cause Code Description	*n* (%)
Fall on same level from slipping, tripping, and stumbling	42,187 (52.3)
Unspecified fall	23,533 (29.2)
Fall on and from stairs and steps	3,624 (4.5)
Fall from bed	3,444 (4.3)
Fall from chair	1,413 (1.8)
Fall on and from ladder[a]	1,196 (1.5)
Other fall from one level to another	1,048 (1.3)
Fall off or from toilet	993 (1.2)
Fall from non-moving wheelchair, nonmotorized scooter, and motorized mobility scooter[a]	870 (1.1)
Other slipping, tripping, and stumbling and falls	825 (1.0)
Fall in shower or bathtub	690 (0.9)
Fall from other furniture	326 (0.4)
Other fall on same level due to collision with another person	154 (0.1)
Fall from, out of, or through building or structure[a]	151 (0.1)
Fall due to ice and snow	116 (0.1)
Slipping, tripping, and stumbling without falling	69 (0.1)
Fall, jump, or diving into water[a]	22 (0.0)
Fall while being carried or supported by other persons[a]	18 (0.1)
Fall on and from scaffolding[a]	18 (0.0)
Fall on and from playground equipment[a]	1 (0.0)

Note. ED = emergency department; ICD-10-CM = International Classification of Diseases 10th Revision Clinical Modification; PDD = patient discharge data.

[a]Excluded from multiple Poisson regression analyses.

Person-period data were analyzed using log-linear Poisson regression to model incidence rates as a function of days since discharge and patient-level covariates. To account for variation in the duration of person-periods, the natural logarithm of the duration was included as an offset in the regression model. To account for explainable variation in post-discharge incident fall risk, person-period segments were partitioned into the non-overlapping periods: 0–7 days, 8–14 days, 15–30 days, 31–60 days, 61–90 days, and >90 days post-discharge. The time period of >90 days after discharge was used as the reference period. In addition to the post-discharge period, other patient-level covariates were included in the model to account for explainable variation due to diagnosis type, age, sex, and other factors of interest. A robust estimator of variance was used for hypothesis tests and 95% confidence intervals for adjusted incidence rate ratios. As a check of the proportional incident rate assumption, we assessed whether covariates modified the association of period effects with incident fall risk by fitting additional models including interaction terms between each model covariate and the post-discharge period effect. All analyses were conducted using Stata Statistical Software: Release 18 (StataCorp LLC, College Station, TX).

RESULTS

Patients and Cohort

A total of 736,230 older adults (age ≥ 65) were included in the study cohort. A majority of study patients (61%) were White, non-Hispanic with a relatively even gender distribution (53% female) and a mean age of 80.7 years (Table 1). By comparison, individuals receiving hospital or ED treatment for falls after hospital discharge (*n* = 52,015) were significantly older (mean age = 80.6 years) and a higher proportion were female (62%). Individuals in the post-discharge fall group were more likely to be White, non-Hispanic (66% vs. 61%), and more likely to have been discharged with home health care (37% vs. 31%), than patients who did not have a post-discharge fall.

Ground level (ICD-10-CM W01) and unspecified (ICD-10-CM W19) were the most common types of fall mechanisms (52% and 29%, respectively) across all ED and PDD records (Table 2). The post-discharge fall group had a significantly higher prevalence of prior falls than the patients who did not fall, both at the index admission (12% vs. 5%) and based on ED visits prior to the index admission (12% vs. 5%). The incidence of inpatient falls during the index admission was 0.8% among patients with a post-discharge fall record compared with 0.2% among patients with no post-discharge fall record. The frequency of the 23 Major Diagnostic Categories included in the regression model was substantively similar between groups with slightly higher frequency prevalence of diseases of the nervous (11% vs. 7%) and circulatory systems (23% vs. 21%) in the post-discharge fall group than in the non-fall group (Table 3).

Post-discharge Injury Falls

Overall, 52,015 (7%) of patients had at least one PDD or ED record with a present on admission External Cause fall code occurring after discharge from the index acute care admission. Fall rates per 100 person-days at risk were highest during the first 0–7 days post-discharge (Rate 0.05; 95% CI [0.05, 0.05]), decreasing over subsequent periods (Table 4.) Adjusting for covariates in the model, the incidence rate of injury falls was 74.29 (95% CI [73.86, 74.73]) times higher during the first 7 days after discharge home from acute care than in the >90-day post-discharge period (Table 5). Period effects decreased steadily in magnitude with temporal distance from the date of hospital discharge.

Injury fall risk increased consistently by 5-year age group, with the highest risk among those ≥85 years of age (IRR 2.97; 95% CI [2.88, 3.05], relative to those 65–69 years of age). Women had an overall 34% higher

Table 3. Major Diagnostic Categories for Primary Diagnosis of Index Admission

Major Diagnostic Categories	Total *N* = 736,230	No Fall *N* = 684,215	Post-discharge Fall *N* = 52,015
	n (%)	*n* (%)	*n* (%)
DD of the circulatory system	153,706 (20.9)	142,707 (20.9)	10,999 (21.1)
DD of the musculoskeletal system and connective tissue	129,271 (17.6)	121,803 (17.8)	7,468 (14.4)
DD of the digestive system	87,910 (11.9)	82,157 (12.0)	5,753 (11.1)
DD of the respiratory system	78,169 (10.6)	72,242 (10.6)	5,927 (11.4)
Infectious and parasitic DD	68,395 (9.3)	63,382 (9.3)	5,013 (9.6)
DD of the nervous system	56,475 (7.7)	51,009 (7.5)	5,466 (10.5)
DD of the kidney and urinary tract	42,282 (5.7)	38,977 (5.7)	3,305 (6.4)
DD of the hepatobiliary system and pancreas	27,943 (3.8)	26,500 (3.8)	1,443 (2.8)
DD of the endocrine, nutritional, and metabolic system	23,397 (3.2)	21,552 (3.1)	1,845 (3.5)
DD of the skin, subcutaneous tissue, and breast	16,501 (2.2)	15,097 (2.2)	1,404 (2.7)
DD of the male reproductive system	9,033 (1.2)	8,798 (1.3)	235 (0.5)
DD of the female reproductive system	8,005 (1.1)	7,659 (1.1)	346 (0.7)
DD of the blood and blood-forming organs and immunological disorders	7,856 (1.1)	7,311 (1.1)	545 (1.1)
DD of the ear, nose, mouth, and throat	7,799 (1.1)	7,224 (1.1)	575 (1.1)
Injuries, poison, and toxic effect of drugs	6,839 (0.9)	6,237 (0.9)	602 (1.2)
Myeloproliferative poorly differentiated neoplasms	5,058 (0.7)	4,867 (0.7)	191 (0.4)
Factors influencing health status and other contacts with health services	2,066 (0.3)	1,796 (0.3)	270 (0.5)
Mental diseases and disorders	1,780 (0.2)	1,538 (0.2)	242 (0.5)
Alcohol/drug use or induced mental disorders	1,419 (0.2)	1,231 (0.2)	188 (0.4)
DD of the eye	1,219 (0.2)	1,125 (0.2)	94 (0.2)
Multiple significant trauma	649 (0.1)	581 (0.1)	68 (0.1)
Burns	283 (0.0)	258 (0.0)	25 (0.1)
Human immunodeficiency virus infection	175 (0.0)	164 (0.0)	11 (0.0)

Note. DD = diseases and disorders

risk of post-discharge falls than men (Incidence rate ratio [IRR] 1.34; 95% CI [1.32, 1.37]). All non-White racial–ethnic groups had significantly lower risk of injury falls than White non-Hispanic older adults, with Asian older adults having the lowest risk relative to their White non-Hispanic counterparts (IRR 0.66; 95% CI [0.63, 0.68]).

A one-unit increase in the Elixhauser Comorbidity Index summary score was associated with a 7% higher risk of injury falls (IRR 1.07; 95% CI [1.06, 1.07]). The effects of hospital length of stay on fall risk varied by length of stay. A slight by significantly increased risk was associated with a 2-day stay (IRR 1.03; 95% CI [1.00, 1.05]), no significant difference for 3–4 days (IRR 1.01; 95% CI [0.99, 1.03]), then a significant decrease in risk for 5- to 30-day stays (IRR 0.89; 95% CI [0.87, 0.92]) when compared with a 1-day length of stay. Discharge to home health care was associated with an increase in post-discharge fall risk (IRR 1.06; 95% CI [1.04, 1.08]). Patients with an injury fall present on index admission had a higher risk of falling post-discharge than those with non-fall-related admissions (IRR 1.71; 95% CI [1.66, 1.76]). Similarly, a history of an ED fall-related visit prior to the index admission was associated with an increased risk of post-discharge fall (IRR 1.76; 95% CI [1.72, 1.8]1).

Major diagnostic categories with the highest significant fall risk, relative to diseases/disorders of the circulatory system were burns (IRR 1.64; 95% CI [1.12, 2.40]), alcohol and drug use or induced mental

Table 4. Post-discharge Fall Rates per 100 Person-Days at Risk

Post-Discharge Period	Fall Events (*N* = 52,015)	Rate	95% CI
1–7 days	2,539	0.05	0.05, 0.05
8–14 days	1,723	0.04	0.03, 0.04
15–30 days	3,010	0.03	0.03, 0.03
31–60 days	4,777	0.03	0.02, 0.03
61–90 days	3,997	0.02	0.02, 0.02
>90 days	3,5969	0.02	0.02, 0.02

Table 5. Adjusted Incidence Rate Ratios for Post-Discharge Falls

	IRR	95% CI
Period effects relative to >90 days post-discharge		
0–7 days	74.3	73.9, 74.7b
8–14 days	36.4	3.6, 36.7b
15–30 days	17.0	16.9, 17.1b
31–60 days	8.4	8.4, 8.4b
61–90 days	5.23	5.3, 5.3b
Demographic covariate effects		
Age group (years, relative to 65–69)		
70–74	1.3	1.2, 1.3b
75–79	1.7	1.6, 1.7b
80–84	2.1	2.1, 2.2b
≥85	2.9	2.9, 3.1b
Gender (Female)	1.3	1.3, 1.4b
Race Group (relative to White)		
Asian/Pacific Islander	0.7	0.6, 0.7b
Black	0.7	0.7, 0.8b
Hispanic	0.9	0.9, 0.9b
Native American/Eskimo/Aleut	1.5	1.3, 1.7b
Other	0.9	0.8, 0.9b
Unknown	1.1	0.8, 1.7
Characteristics of index acute care admission		
Fall code—present on admission	1.7	1.7, 1.8
Fall code—not present on admission (inpatient fall)	1.6	1.3, 1.9
Emergency department fall code prior to index admission	1.8	1.7, 1.8
Elixhauser Comorbidity Index Score	1.1	1.1, 1.1b
Adjusted length of stay (day range, relative to 1 day)		
2 days	1.0	1.0, 1.0
3–4 days	1.0	0.9, 1.0
5–30 days	0.8	0.8, 0.9
>30 days	0.7	0.5, 1.0
Home health referral (relative to no home health)	1.0	1.0, 1.1b
MDC Index admission principle diagnosis[a]		
Human Immunodeficiency Virus Infection	1.5	0.8, 2.6
Burns	1.6	1.1, 2.4b
Alcohol/drug use or induced mental disorders	2.1	1.8, 2.4b
Mental diseases and disorders	1.6	1.4, 1.8b
Factors influencing health status and other contacts with health services	1.5	1.4, 1.7b
Multiple significant trauma	1.2	0.9, 1.5
Injuries, poison and toxic effect of drugs	1.3	1.2, 1.4b
DD of the nervous system	1.2	1.1, 1.2b
DD of the endocrine, nutritional and metabolic system	1.1	1.0, 1.1b
DD of the ear, nose, mouth and throat	1.0	0.9, 1.1
DD of the eye	0.9	0.7, 1.1
DD of the skin, subcutaneous tissue, and breast	1.0	1.0, 1.1[b]
DD of the kidney and urinary tract	1.0	1.0, 1.1[b]
DD of the blood and blood-forming organs and immunological disorders	0.9	0.8, 1.0
DD of the respiratory system	1.0	0.9, 1.0
DD of the digestive system	1.0	0.9, 1.0
Infectious and parasitic (systemic or unspecified sites)	0.9	0.9, 1.0
DD of the hepatobiliary system and pancreas	0.9	0.8, 0.9
DD of the female reproductive system	0.8	0.7, 0.9
Myeloproliferative DD (poorly differentiated neoplasms)	0.7	0.6, 0.9
DD of the musculoskeletal system and connective tissue	0.8	0.8, 0.9
DD of the male reproductive system	0.6	0.5, 0.7

Note. DD = diseases and disorders; MDC = Major diagnostic categories.

[a]Relative to diseases and disorders of the circulatory system

[b]$p < .05$

disorders (IRR 2.06; 95% CI [1.78, 2.38]), mental diseases and disorders (IRR 1.60; 95% CI [1.41, 1.81]), factors influencing health status (IRR 1.56; 95% CI [1.38, 1.75]), injuries, poison and toxic effects of drugs (IRR 1.30; 95% CI [1.20, 1.41]), diseases and disorders of the nervous system (IRR 1.18; 95% CI [1.14, 1.22]), diseases and disorders of the endocrine, nutritional and metabolic system (IRR 1.09; 95% CI [1.04, 1.150]), diseases and disorders of the skin, subcutaneous tissue and breast (IRR 1.06; 95% CI [1.01, 1.12]), and diseases and disorders of the kidney and urinary tract (IRR 1.04; 95% CI [1.00, 1.08]).

DISCUSSION

This population-based study demonstrates that older adults have an increased risk of home falls after discharge from an acute care hospitalization with the highest risk of falls occurring during the first 7 days after discharge. Patients with a history of prior falls, referral to home health care, or hospitalization for conditions affecting the central nervous system are most likely to experience a post-discharge home injury fall. Our study confirms the prior findings of temporal proximity of post-hospital falls (Mahoney et al., 2000; Qian et al., 2023) and further describes fall risk as highest during

the first week post-discharge, then steadily decreasing over subsequent weeks. The higher relative risks associated with hospitalizations for central nervous system conditions are consistent with prior studies correlating increased fall risk with Parkinson's disease (Minta et al., 2023; Pickering et al., 2007), dementia, cognitive impairment, and delirium (Mahmoudzadeh Khalili et al., 2024; Simpkins et al., 2024), and mental illness and substance use disorders (Kvelde et al., 2015).

Comorbidities measured by an Elixhauser Comorbidity Index summary score were associated with an increased risk of post-discharge falls. The correlations between the number of chronic diseases and fall risk have been established in early fall risk research (Tinetti et al., 1986) with subsequent research establishing clear patterns of risk with increasing burden of illness (Deandrea et al., 2010). The inverse correlation between lengths of hospital stay 5–30 days during the index admission and post-discharge fall risk was an unexpected finding, given prior studies on the deconditioning effects of hospitalization on elderly patients (Ferrante et al., 2015; Gill et al., 2015); however, Hoffman et al. (2024) found a reduction in 31- and 90-day fall-related injury readmissions among Medicare beneficiaries hospitalized for congestive heart failure, pneumonia, and acute myocardial infarction after implementation of Medicare's Hospital Readmissions Reduction Program in 2012. The authors conclude that the reduction in fall-related injury readmissions may reflect changes in hospital and discharge care, including increased length of stay, after implementation of the Hospital Readmissions Reduction Program.

LIMITATIONS

This study was subject to several limitations. Analyses were restricted to data elements available in the Health Care Access and Information datasets, which did not include information on medication use, decreased functional status, history of non-injury falls, and impaired mobility. These factors are known to increase fall risk, and our inability to adjust for them may have overestimated period effects on fall risk. The PDD and ED datasets used in our analyses were not linked with the state death statistical master file and did not include deaths occurring at home or in non-acute care facilities; thus, we were not able to ascertain the date of any person-periods ending in death at home.

CONCLUSION

Older adults discharged directly home from acute care hospitalization have an increased risk of falls with a significantly higher risk of falling during the first weeks after discharge. The aging U.S. population and increased rates of 31-day readmissions for injury falls among older adults (Hoffman et al., 2019) add urgency to the need for hospitals to develop and implement evidence-based initiatives to reduce post-hospital home falls among geriatric patients discharged from their facilities. Acute care facilities have a critical role in identifying and mitigating home fall risk factors in this population prior to hospital discharge; however, fall prevention initiatives in U.S. hospitals currently remain focused on reducing inpatient falls (Hempel et al., 2013) in response to a 2011 Centers for Medicare and Medicaid Services regulation prohibiting Federal reimbursement for certain health care-acquired conditions, including inpatient falls (Centers for Medicare and Medicaid Services, HHS, 2011). While older adults with the highest fall risk are more likely to receive inpatient fall prevention education, there is evidence that this type of education does not reduce home falls after discharge (Hill et al., 2011). Related research suggests older adult patients have low levels of knowledge about post-discharge fall prevention strategies (Hill et al., 2011), and many experience barriers to engaging in risk-reduction strategies when they are available (Naseri et al., 2020). Hospitals would benefit from the development of evidence-based guidelines and resources focused specifically on older adult fall prevention during the care transition to the home setting, similar to the quality improvement toolkit to reduce inpatient falls developed by the Agency for Healthcare Research and Quality (2024). While the American College of Surgeons (American College of Surgeons, 2023) and the World Falls Guidelines Task Force (Montero-Odasso et al., 2022) provide trauma centers with evidence-based guidance on older adult fall prevention strategies, there are currently no consensus-based guidelines to inform trauma center discharge protocols for older adults that specifically address post-discharge home fall risk identification and prevention. Following the publication of the American College of Surgeons guidelines for geriatric trauma care (American College of Surgeons, 2023), injury prevention professionals from multiple national trauma organizations have convened a multidisciplinary workgroup under the auspices of the Trauma Prevention Coalition to develop specific consensus-based and best-practice geriatric discharge guidelines to reduce home fall risk after acute care hospitalization. The injury prevention-focused discharge guidelines, being developed as a collaborative effort between injury prevention professionals, geriatricians, and trauma care clinicians, are intended as a supplement to the American College of Surgeons geriatric trauma care guidelines. Trauma nurses can actively engage in reducing geriatric post-discharge home fall risk by increasing awareness of this issue and the forthcoming guidelines and advocating for the development to best-practice geriatric discharge guidelines by their trauma center.

Orcid iDs

Christy M. Adams https://orcid.org/0000-0001-9194-9972
Daniel J. Tancredi https://orcid.org/0000-0002-3884-7907
Janice F. Bell https://orcid.org/0000-0002-9337-4831
Sheryl L. Catz https://orcid.org/0000-0002-6325-9349
Patrick S. Romano https://orcid.org/0000-0001-6749-3979

REFERENCES

Adam, C. E., Fitzpatrick, A. L., Leary, C. S., Ilango, S. D., Phelan, E. A., & Semmens, E. O. (2024). The impact of falls on activities of daily living in older adults: A retrospective cohort analysis. *PLoS One*, *19*(1), e0294017. https://doi.org/10.1371/journal.pone.0294017

Adams, C. M., Tancredi, D. J., Bell, J. F., Catz, S. L., & Romano, P. S. (2020). Associations between home injury falls and prior hospitalizations in community dwelling older adults: A population case-crossover study. *Injury*, *51*(2), 260–266. https://doi.org/10.1016/j.injury.2019.11.035

Agency for Healthcare Research and Quality. (2024). Preventing falls in hospitals. https://www.ahrq.gov/patient-safety/settings/hospital/fall-prevention/toolkit/index.html

Ambrose, A. F., Paul, G., & Hausdorff, J. M. (2013). Risk factors for falls among older adults: A review of the literature. *Maturitas*, *75*(1), 51–61. https://doi.org/10.1016/j.maturitas.2013.02.009

American College of Surgeons. (2023). *Geriatric Trauma Management*. https://www.facs.org/media/ubyj2ubl/best-practices-guidelines-geriatric-trauma.pdf

Centers for Medicare and Medicaid Services, HHS. (2011). Medicaid program; payment adjustment for provider-preventable conditions including health care-acquired conditions. Final rule. *Fed. Regist.*, *76*(108), 32816–32838. https://www.govinfo.gov/content/pkg/FR-2011-06-06/pdf/2011-13819.pdf

Deandrea, S., Lucenteforte, E., Bravi, F., Foschi, R., La Vecchia, C., & Negri, E. (2010). Risk factors for falls in community-dwelling older people: A systematic review and meta-analysis. *Epidemiology*, *21*(5), 658–668. https://doi.org/10.1097/EDE.0b013e3181e89905

Ferrante, L. E., Pisani, M. A., Murphy, T. E., Gahbauer, E. A., Leo-Summers, L. S., & Gill, T. M. (2015). Functional trajectories among older persons before and after critical illness. *JAMA Intern. Med.*, *175*(4), 523–529. https://doi.org/10.1001/jamainternmed.2014.7889

Gill, T. M., Gahbauer, E. A., Han, L., & Allore, H. G. (2015). The role of intervening hospital admissions on trajectories of disability in the last year of life: Prospective cohort study of older people. *BMJ*, *350*, h2361. https://doi.org/10.1136/bmj.h2361

Hempel, S., Newberry, S., Wang, Z., Booth, M., Shanman, R., Johnsen, B., Shier, V., Saliba, D., Spector, W. D., & Ganz, D. A. (2013). Hospital fall prevention: A systematic review of implementation, components, adherence, and effectiveness. *J Am Geriatr Soc*, *61*(4), 483–494. https://doi.org/10.1111/jgs.12169

Hill, A. M., Hoffmann, T., Beer, C., McPhail, S., Hill, K. D., Oliver, D., Brauer, S. G., & Haines, T. P. (2011). Falls after discharge from hospital: Is there a gap between older peoples' knowledge about falls prevention strategies and the research evidence? *Gerontologist*, *51*(5), 653–662. https://doi.org/10.1093/geront/gnr052

Hill, A. M., Hoffmann, T., & Haines, T. P. (2013). Circumstances of falls and falls-related injuries in a cohort of older patients following hospital discharge. *Clin Interv. Aging*, *8*, 765–774. https://doi.org/10.2147/CIA.S45891

Hill, A. M., Hoffmann, T., McPhail, S., Beer, C., Hill, K. D., Oliver, D., Brauer, S. G., & Haines, T. P. (2011). Evaluation of the sustained effect of inpatient falls prevention education and predictors of falls after hospital discharge–follow-up to a randomized controlled trial. *J Gerontol A Biol Sci Med Sci*, *66*(9), 1001–1012. https://doi.org/10.1093/gerona/glr085

Hoffman, G. J., Alexander, N. B., Ha, J., Nguyen, T., & Min, L. C. (2024). Medicare's Hospital Readmission Reduction Program reduced fall-related health care use: An unexpected benefit? *Health Serv Res*, *59*(1), e14246. https://doi.org/10.1111/1475-6773.14246

Hoffman, G. J., Liu, H., Alexander, N. B., Tinetti, M., Braun, T. M., & Min, L. C. (2019). Posthospital fall injuries and 30-day readmissions in adults 65 years and older. *JAMA Network Open*, *2*(5), e194276. https://doi.org/10.1001/jamanetworkopen.2019.4276

Kakara, R., Bergen, G., Burns, E., & Stevens, M. (2023). Nonfatal and fatal falls among adults aged ≥65 years - United States, 2020-2021. *MMWR Morb. Mortal. Wkly. Rep.*, *72*(35), 938–943. https://doi.org/10.15585/mmwr.mm7235a1

Kvelde, T., Lord, S. R., Close, J. C., Reppermund, S., Kochan, N. A., Sachdev, P., Brodaty, H., & Delbaere, K. (2015). Depressive symptoms increase fall risk in older people, independent of antidepressant use, and reduced executive and physical functioning. *Arch Gerontol Geriatr*, *60*(1), 190–195. https://doi.org/10.1016/j.archger.2014.09.003

Lusardi, M. M., Fritz, S., Middleton, A., Allison, L., Wingood, M., Phillips, E., Criss, M., Verma, S., Osborne, J., & Chui, K. K. (2017). Determining risk of falls in community dwelling older adults: A systematic review and meta-analysis using posttest probability. *J Geriatr Phys Ther*, *40*(1),1–36. *(2001)*. https://doi.org/10.1519/JPT.0000000000000099

Mahmoudzadeh Khalili, S., Simpkins, C., & Yang, F. (2024). A meta-analysis of fall risk in older adults with Alzheimer's disease. *J Am Med Dir Assoc*, *25*(5), 781–788.e3. https://doi.org/10.1016/j.jamda.2024.01.005

Mahoney, J. E., Palta, M., Johnson, J., Jalaluddin, M., Gray, S., Park, S., & Sager, M. (2000). Temporal association between hospitalization and rate of falls after discharge. *Arch Intern Med*, *160*(18), 2788–2795. https://doi.org/10.1001/archinte.160.18.2788

Minta, K., Colombo, G., Taylor, W. R., & Schinazi, V. R. (2023) Differences in fall-related characteristics across cognitive disorders. *Front. Aging Neurosci. 15*: 1171306. https://doi.org/10.3389/fnagi.2023.1171306.

Montero-Odasso, M., van der Velde, N., Martin, F. C., Petrovic, M., Tan, M. P., Ryg, J., Aguilar-Navarro, S., Alexander, N. B., Becker, C., Blain, H., Bourke, R., Cameron, I. D., Camicioli, R., Clemson, L., Close, J., Delbaere, K., Duan, L., Duque, G., Dyer, S. M., … Masud, T. (2022). Task Force on Global Guidelines for Falls in Older Adults. World guidelines for falls prevention and management for older adults: A global initiative. *Age Ageing*, *51*(9), afac205. https://doi.org/10.1093/ageing/afac205

Moore, B. J., White, S., Washington, R., Coenen, N., & Elixhauser, A. (2017). Identifying increased risk of readmission and in-hospital mortality using hospital administrative data: The AHRQ Elixhauser Comorbidity Index. *Med Care*, *55*(7), 698–705. https://doi.org/10.1097/MLR.0000000000000735

Naseri, C., McPhail, S. M., Haines, T. P., Morris, M. E., Shorr, R., Etherton-Beer, C., Netto, J., Flicker, L., Bulsara, M., Lee, D. A., Francis-Coad, J., Waldron, N., Boudville, A., & Hill, A. M. (2020). Perspectives of older adults regarding barriers and enablers to engaging in fall prevention activities after hospital discharge. *Health Soc Care Community*, *28*(5), 1710–1722. https://doi.org/10.1111/hsc.12996

Pickering, R. M., Grimbergen, Y. A., Rigney, U., Ashburn, A., Mazibrada, G., Wood, B., Gray, P., Kerr, G., & Bloem, B. R. (2007). A meta-analysis of six prospective studies of falling in Parkinson's disease. *Mov Disord*, *22*(13), 1892–1900. https://doi.org/10.1002/mds.21598

Qian, X. X., Chau, P. H., Fong, D. Y. T., Ho, M., & Woo, J. (2023). Post-hospital falls among the older population: The temporal pattern in risk and healthcare burden. *J Am Med Dir Assoc*, *24*(10), 1478–1483.e2. https://doi.org/10.1016/j.jamda.2023.07.014

Simpkins, C., Khalili, S. M., & Yang, F. (2024). Meta-analysis-based comparison of annual fall risk between older adults with Alzheimer's disease and mild cognitive impairment. *Adv Geriatr Med Res*, *6*(1), e240002. https://doi.org/10.20900/agmr20240002

Stagg, V. (2015). *ELIXHAUSER: Stata module to calculate Elixhauser index of comorbidity*. Statistical Software Components.

Tinetti, M. E., Williams, T. F., & Mayewski, R. (1986). Fall risk index for elderly patients based on number of chronic disabilities. *Am J Med*, *80*(3), 429–434. https://doi.org/10.1016/0002-9343(86)90717-5

For more than 85 additional nursing continuing professional development activities related to trauma topics, go to NursingCenter.com/ce.

Lippincott® NursingCenter®

NCPD Nursing Continuing Professional Development

INSTRUCTIONS

Risk of Home Falls Among Older Adults After Acute Care Hospitalization: A Cohort Study

TEST INSTRUCTIONS

- Read the article. The test for this nursing continuing professional development (NCPD) activity is to be taken online at **www.NursingCenter.com/CE/JTN**. Tests can no longer be mailed or faxed.
- You'll need to create an account (it's free!) and log in to access My Planner before taking online tests. Your planner will keep track of all your Lippincott Professional Development online NCPD activities for you.
- There's only one correct answer for each question. A passing score for this test is 8 correct answers. If you pass, you can print your certificate of earned contact hours and access the answer key. If you fail, you have the option of taking the test again at no additional cost.
- For questions, contact Lippincott Professional Development: 1-800-787-8985.
- Registration deadline is December 4, 2026.

PROVIDER ACCREDITATION

Lippincott Professional Development will award 2.0 contact hours for this nursing continuing professional development activity.

Lippincott Professional Development is accredited as a provider of nursing continuing professional development by the American Nurses Credentialing Center's Commission on Accreditation.

This activity is also provider approved by the California Board of Registered Nursing, Provider Number CEP 11749 for 2.0 contact hours. Lippincott Professional Development is also an approved provider of continuing nursing education by the District of Columbia, Georgia, West Virginia, New Mexico, South Carolina, and Florida, CE Broker #50-1223. Your certificate is valid in all states.

Payment: The registration fee for this test is FREE for STN members and $21.95 for nonmembers.

STN members can take JTN CE for free using the discount code available in the members-only section of the STN website. Use the discount code when payment is requested during the check-out process.

DOI: 10.1097/JTN.0000000000000824