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Original Study

Predictors of Serious Consequences of Falls in Residential Aged Care: Analysis of More Than 70,000 Falls From Residents of Bavarian Nursing Homes

Gisela Büchele PhD, MPH [a,*], Clemens Becker MD [b], Ian D. Cameron MB BS, PhD [c], Hans-Helmut König MD, MPH [d], Stephen Robinovitch PhD [e], Kilian Rapp MD, MPH [a,b]

[a] *Institute of Epidemiology and Medical Biometry, Ulm University, Ulm, Germany*
[b] *Department of Clinical Gerontology, Robert-Bosch-Hospital, Stuttgart, Germany*
[c] *Rehabilitation Studies Unit, Sydney Medical School, University of Sydney, Ryde, NSW, Australia*
[d] *Department of Health Economics and Health Services Research, University Medical Center Hamburg-Eppendorf, Hamburg, Germany*
[e] *Department of Biomedical Physiology and Kinesiology and School of Engineering Science, Simon Fraser University, Burnaby, BC, Canada*

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A B S T R A C T

Background/Objective: Falls are common in nursing homes and cause a high burden of injuries. The objective of this study was to analyze factors associated with serious consequences of falls in nursing home residents.
Design: Prospective observational study.
Setting: Falls were recorded over 1 year, covering all residents from 528 nursing homes in Bavaria, Germany.
Participants: The database consisted of 70,196 falls.
Measurements: The standardized form included information about date, time, sex, age, functional status, location of fall, activity leading to the fall, footwear, and about potential consequences, such as transfer to hospital or a suspected fracture. Transfer to hospital was the main outcome and served as surrogate for a serious fall. The association of potential risk factors with hospital transfer after a fall was estimated in multiple logistic regression models.
Results: Serious falls were associated with increasing age, being female, and less restricted functional status. Walking compared with transferring, and particularly the morning hours were also associated with a serious fall. Compared with midday, for example, the time period between 6 AM and 8 AM was associated with a more than 60% increased chance of transfer to hospital. Inappropriate footwear and weekends were associated with serious falls only in women.
Conclusion: Some observed factors or indicators associated with transfer to hospital are modifiable and targeted interventions may reduce injuries or costs after a fall.

There is a large body of evidence about risk factors for falls.[1,2] Examples are low muscle strength, impaired vision, or urinary incontinence. Some of the studies also evaluated injurious (or serious) falls as an outcome. In these studies, persons with an injurious fall were usually compared with all other persons of the study cohort. Most residents of nursing homes have a combination of several risk factors, which explains the high rate of about 1.5 to 2.0 falls per person-year in residential care.[3,4] Therefore, falls are common in nursing homes and cause a high burden of injuries. In Germany, for example, more than 20% of all femoral fractures occur in residents of nursing homes even though their contribution of person-years under observation is considerably lower.[5] Therefore, it could be of interest to determine specific factors or indicators that are able to predict serious falls in residents of nursing homes who experience a fall. These could be factors at an individual, environmental, or organizational level. Measures considering such factors would not be able to prevent falls but may potentially reduce injuries and/or costs.

Few studies have chosen this approach so far. They identified the following risk factors as predictors for fractures after a fall: fall characteristics, such as falling sideways or straight down; individual factors, such as lower weight or longer leg length; environmental

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* Address correspondence to Gisela Büchele, PhD, MPH, Institute of Epidemiology and Medical Biometry, Ulm University, Helmholtzstr. 22, 89081 Ulm, Germany.
E-mail address: gisela.buechele@uni-ulm.de (G. Büchele).

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factors, such as a hard surface; and risk indicators, such as the lack of a history of falls in the previous year.[6–10]

We used a dataset of more than 70,000 falls of residents of nursing homes. Our aim was to analyze if factors such as age, activity, or footwear, which are usually assessed by routinely used standardized fall documentation forms, may be associated with serious consequences after a fall. Transfer to hospital served as surrogate for a serious fall.

Methods

Study Population

In Bavaria, a federal state in South Germany with 12.5 million inhabitants, more than 12% of the citizens aged 80 years or older are residents in 1 of approximately 1400 nursing homes. Starting in 2007, a statewide fall prevention program (The Bavarian Fall and Fracture Prevention Study) was consecutively implemented in Bavarian nursing homes by Germany's largest health insurance company (AOK). The study was approved by the ethical committee of Ulm University. In the participating nursing homes, the reporting of falls to the health insurance company was compulsory. For each fall, a standardized documentation form was completed by the nursing staff with information about date, time, sex, 4 age categories, 4 levels of care (see later in this article), location of fall (resident's room, bathroom, common area, outside), activity leading to the fall (walking, transfer, others), and worn footwear (open or closed slippers, street shoes, no shoes, others). In addition, consequences of the fall, such as a wound, contusion, suspected fracture, contact to physician, or hospital transfer, were documented. If a resident had more than one fall in a day, only the first fall, or the most serious fall, was recorded. The anonymous fall report forms were sent to the health insurance's data center. Our analyses are based on the falls reported by the 528 nursing homes that were included in the program in 2008. The dataset comprised all falls (n = 70,196) that occurred between January 1, 2008, and December 31, 2008. The descriptive analysis of the falls dataset was published previously.[3]

Outcomes

Falls that resulted in "hospital transfer" were the main outcome and were defined as serious falls. For those falls resulting in "hospital transfer," pain was recorded in 44.4%, a wound in 42.7%, a contusion in 13.5%, and a suspected fracture in 36.6%. Secondary outcomes were "suspected fracture" and "contact to a physician" after a fall.

Level of Care

Most residents who live in a German nursing home fulfill the requirements of the mandatory long-term care insurance. This insurance was introduced in 1995. The insurance is compulsory for all citizens. Depending on the amount of care required, recipients are categorized into 1 of 3 levels after an assessment by a physician (levels 1, 2, and 3 requiring basic care, such as washing, feeding, or dressing for at least 0.75, 2, and 4 hours per day, respectively). Those residents whose assessment showed that they needed basic care of less than 0.75 hours per day are categorized as level of care "0" and represent a less frail population. Cognition is not part of the assessment process. People living in a nursing home and categorized as level of care "0" are often cognitively impaired and need continuous supervision despite a low need in basic care.

Statistical Methods

Differences between women and men were tested for statistical significance using the χ^2 test. The association of potential risk factors with the occurrence of serious falls was estimated in multivariate logistic regression models. Mutually adjusted odds ratios with 95% confidence intervals were calculated. All analyses were stratified by sex. Significant associations are marked bold in the tables. All statistical calculations were carried out using SAS version 9.3 (SAS Institute, Inc, Cary, NC).

Results

The analyses are based on 49,864 falls in women and 20,332 falls in men. More than 50% were recorded in residents aged between 80 and 89 years. Transfers and walking were responsible for 41% and 36% of all falls and approximately 75% of the falls occurred in the residents' rooms or bathrooms (Table 1). Approximately 25% of all documented falls caused an injury and approximately 15% led to contact with a physician. Hospital transfer was more frequent in women than in men (8.5% vs 6.7%; odds ratio 1.25, 95% confidence interval 1.17–1.33), which was mainly driven by a higher suspected rate of fractures in women (Figure 1).

A clear strengthening association between increasing age categories and chance of hospital transfer was observed in women but not in men. Falls in women aged 90 years and older, for example,

Table 1
Frequency of Falls Stratified by Potential Risk Factors or Risk Indicators

	Women		Men	
	n	%	n	%
Number	49,864		20,332	
Age group, y				
<70	2044	4.1	2887	14.2
70–79	6673	13.4	4897	24.1
80–89	28,501	57.2	9505	46.7
≥90	12,646	25.4	3043	15.0
Level of care				
0	4549	9.1	2024	10.0
1	21,040	42.2	7841	38.6
2	20,042	40.2	8469	41.7
3	4233	8.5	1998	9.8
Days of the week				
Working days*	34,403	69.0	14,062	69.2
Weekends/Holidays	15,461	31.0	6270	30.8
Time of day				
0 midnight to 2 AM	2543	5.1	1091	5.4
2–4 AM	2667	5.3	1089	5.4
4–6 AM	3176	6.4	1223	6.0
6–8 AM	4103	8.2	1498	7.4
8–10 AM	3880	7.8	1578	7.8
10 AM to 12 noon	5224	10.5	2173	10.7
12 noon to 2 PM	4214	8.5	1746	8.6
2–4 PM	6000	12.0	2363	11.6
4–6 PM	5892	11.8	2419	11.9
6–8 PM	5664	11.4	2315	11.4
8–10 PM	2981	6.0	1360	6.7
10 PM to 12 midnight	3520	7.1	1477	7.3
Activity				
Walking	18,654	37.4	6826	33.6
Transfer	20,134	40.4	8735	43.0
Others	11,076	22.2	4771	23.5
Location				
Residents room	31,052	62.3	12,649	62.2
Bathroom	6536	13.1	2341	11.5
Common area	10,951	22.0	4525	22.3
Outside	1325	2.7	817	4.0
Footwear				
Slippers closed	18,074	36.2	6,621	32.6
Slippers open	9234	18.5	3507	17.2
Street shoes	6649	13.3	2891	14.2
No shoes	14079	28.2	6299	31.0
Others†	1828	3.7	1014	5.0

N, absolute number of falls.
*Monday to Friday (except holidays).
†Others includes trainers and socks with antislide coating.