



Risk of institutionalization following fragility fractures in older people

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Abstract

Summary Previously independent living older people suffering fractures of the hip have a high risk of new admission to a nursing home during the subsequent months. This study shows that older people admitted to hospital for fractures of the pelvis and spine have a similar risk of admission to a nursing home.

Introduction Fall-related fractures are a serious threat to the health and well-being of older persons. Long-term consequences of hip fractures such as institutionalization and mortality are well-known. The impact of other fragility fractures is less well-understood. The aim of this study was to estimate risks of institutionalization and death for different fragility fractures and compare them with the corresponding risks after hip fracture.

Methods Data was retrieved from a German health insurance company. Between 2005 and 2008 more than 56,000 community-dwelling people with a hospital admission or discharge diagnosis of a fracture of the femur, spine, pelvis, proximal humerus, distal radius, tibia, or fibula were included. Crude and age-adjusted 6-month incidence rates for institutionalization and death were calculated. To compare the risks of institutionalization or mortality of non-hip fractures with the risk after hip fracture, multivariate regression models were applied.

Results Crude institutionalization rates and mortality were highest in patients with hip fracture. However, after adjustment for age, functional status, and comorbidity, risks of institutionalization after fractures of pelvis (relative risk (RR), 0.94; 95% confidence interval (CI) 0.86; 1.02 in women and 0.89; 95% CI 0.70; 1.12 in men), and spine (RR, 0.95; 95% CI 0.87; 1.03 in women and 0.91; 95% CI 0.76; 1.08 in men) were not statistically different compared to the risk after hip fracture.

Conclusions The risk of institutionalization after fractures of the spine and pelvis was similar to the risk after hip fracture. These fracture sites seem to be associated with a significant decline in physical function.

Keywords Epidemiology · Falls · Femoral fractures · Hip fractures · Humeral fractures · Osteoporosis · Spinal fractures

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Introduction

Fragility fractures represent a serious threat to older persons. Their incidence is increasing with age, they are more prevalent in women than in men, and they are often associated with low-energy trauma like falls. Hip fractures are the most serious fragility fractures. Their long-term consequences have been the focus of many studies. Excess mortality following other fragility fractures is high as well [1–5]. However, unfavorable outcomes go beyond mortality. Older persons sustaining a hip fracture suffer long-lasting limitations in mobility, activities of daily living, self-care, participation, and quality of life. Therefore, transition to long-term care is common in hip fracture patients. Depending on qualified rehabilitation services and availability of nursing home care, about 12 to 27% of hip fracture patients are newly institutionalized during the following year [6]. Given the loss of autonomy, privacy, and the financial costs associated, transfer to nursing home care is regarded as a “catastrophic” consequence by many older people. Other than for hip fractures, the long-term consequences following other fragility fractures like fractures of the spine, pelvis, proximal humerus, distal radius, and distal tibia or fibula are less studied despite their common nature. For example, the number of pelvic fractures has been increasing substantially [7]. Yet, information on loss of independence following pelvic fractures largely stems from small studies with limited follow-up [8–10].

Prevention of institutionalization not only serves the interest of fracture patients. In view of the increasing numbers of frail older adults, the prevention of institutionalization is of interest for policy makers and health care providers [11]. Post-acute in- and outpatient rehabilitation offers the opportunity to restore functional capacities. Currently, rehabilitative efforts in geriatric fracture patients predominantly focus on hip fracture patients in most countries [12]. At the same time, post-acute care after fragility fractures other than hip fracture has not been studied as vigorously. To assess the need for rehabilitation services after fragility fractures other than hip fracture the functional outcome after such fractures has to be evaluated. Considering limitations in availability those fractures with most unfavorable outcome have to be identified in order to provide rehabilitation to those patients with the highest associated risk of loss of autonomy.

The aim of this study was to estimate the proportion of previously independent living older people who are newly institutionalized during the 6 months following different fragility fractures. Risk of institutionalization following the different non-hip fractures were compared to the risk of patients sustaining a hip fracture. Institutionalization is the result of survival in the presence of severe functional limitations. Therefore, the risk of death was calculated since high mortality rates might compete with the risk of institutionalization.

Methods

Data source

Health insurance and long-term care insurance are statutory in Germany and are provided by several non-profit and for-profit insurances. The Allgemeine Ortskrankenkasse Bayern (AOK Bavaria) is one of the largest insurances and covers nearly 50% of the population aged 65 years and older in Bavaria, a federal state in the southeast of Germany. The routine data collection system of AOK Bavaria was used to select data on gender, age, hospital admission, and nursing home admission. In Germany, hospitals are obliged to send the admission diagnosis to the health care company of each patient. This diagnosis is based on the diagnostic process during admission and might differ from the discharge diagnoses. On discharge, hospitals send all relevant diagnoses with one being the main diagnosis in order to receive reimbursement according to Disease-Related Groups (DRG). All diagnoses are stored at the health insurance together with date on admission and discharge. For research purposes, data from health insurance branch (age, gender, information about the hospital stay like date of admission/discharge or main admission/discharge diagnosis and date of death) and from long-term care insurance branch (level of care need, nursing home status) was merged by a unique identifier for each insurant. Information was provided after pseudonymization.

Study population

The basic dataset consisted of 844,554 insured people who were (1) aged 65 years or older on January 1, 2004, (2) still living in the community on January 1, 2005, (3) and were consecutively insured during the following years until June 30, 2009 or death (Fig. 1). Inclusion and exclusion criteria are presented in Fig. 1. The final dataset was restricted to patients with an incident “index fracture” (spine, distal radius, proximal humerus, hip, pelvis, “lower extremities fractures”—see below for details) between January 1, 2005 and December 31, 2008.

Care need and institutionalization

The long-term care insurance is a branch of every health insurance company and covers costs of care provided by nursing homes as well as community care and informal care. Insured people with an expected minimum of 6 months of need for nursing care (care need) are eligible to receive reimbursement by the long-term care insurance [13]. Long-term care benefits are granted for professional, family, and/or informal help. Reimbursement depends on level of care, type of help (professional/informal), and residence in any nursing home. Hence, AOK Bavaria holds information on level of care need and institutionalization, as well as date of changes in either of

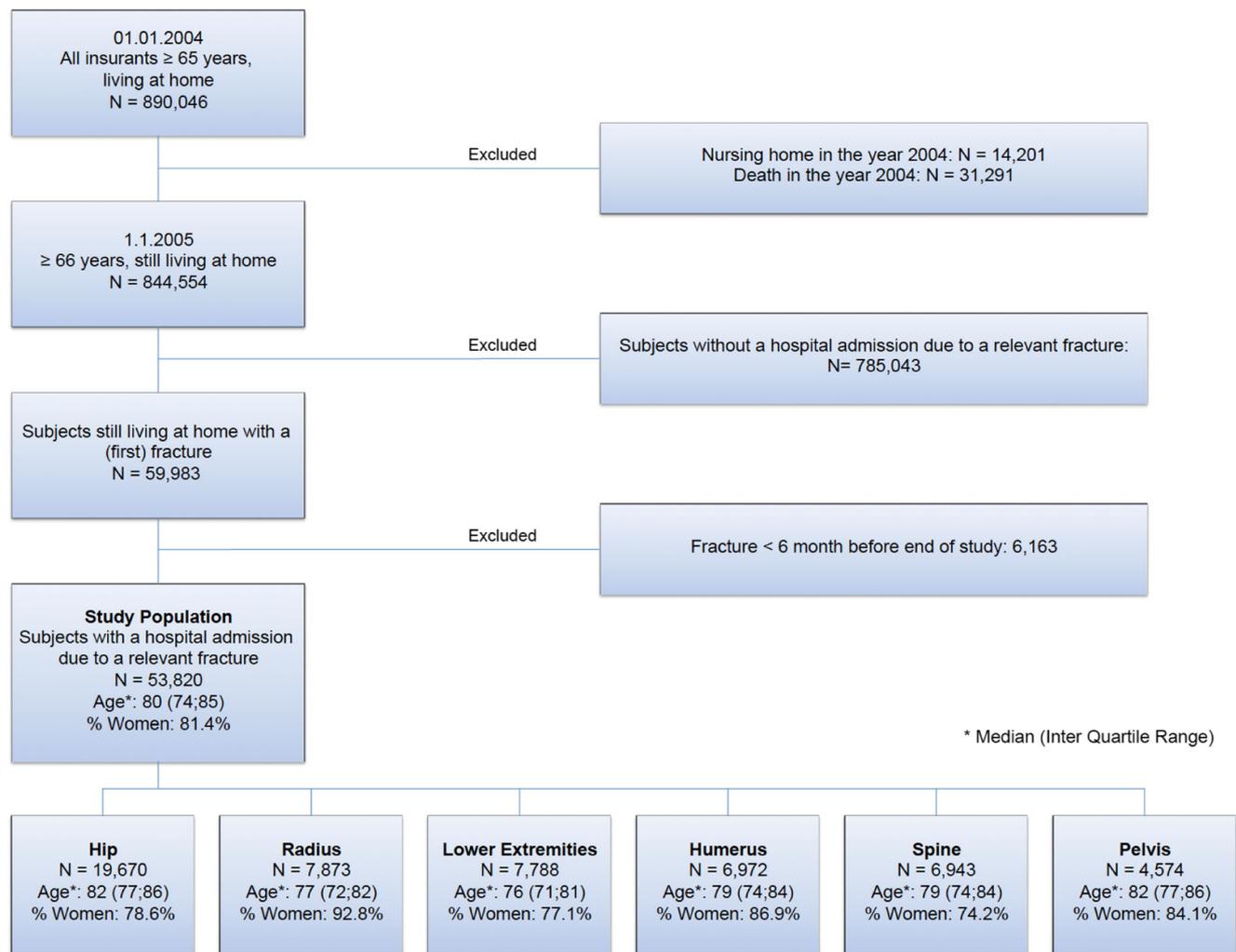


Fig. 1 Flow chart of study population and baseline characteristics stratified by fracture sites. Fractures < 6 months before end of study (June 30, 2009): N = 6163

this information. The exact date of a new onset of institutionalization is recorded in the dataset.

Index fracture

Hospital admission and discharge diagnoses were used to identify fragility fractures. All first hospital admissions due to any fragility fracture between January 1, 2005 and December 31, 2008 were included. Diagnoses were coded in the tenth revision of the International Classification of Diseases (ICD-10). Fractures were categorized as follows: fractures of the spine (S12.0, S12.1, S12.2, S12.7, S12.9, S22.0, S22.1, S32.0), of the distal radius (S52.5, S52.6), of the proximal humerus (S42.2), of the proximal femur (referred to as “hip fractures”) (S72.0, S72.1, S72.2), of the pelvic ring (S32.1, S32.3, S32.4, S32.5, S32.8). Fragility fractures of the distal femur and fractures of tibia and fibula were combined as “lower extremity fractures” (S72.3, S72.4, S82.0, S82.1, S82.2, S82.3, S82.5, S82.6, S82.81, S82.82).

Statistics

Institutionalization was the primary outcome of the study and defined as new admission to nursing home care within 6 months after index hospital admission. To estimate the risk of institutionalization, the observation period ended after 6 months, admission to nursing home, or death. The crude institutionalization incidence was calculated by dividing the number of institutionalizations by the total number of people under observation. Age-standardized incidence of institutionalization and mortality were calculated using the age distribution (in 5-year categories, i.e., seven age classes) of the basic dataset on January 1, 2014.

Mortality was defined as death within 6 months after index hospital admission. The inhospital mortality was analyzed as crude percentages by dividing the number of deaths by the number of patients independently of their length of hospital stay after index hospital admission. To estimate a 6-month mortality, the observation period ended after 6 months or at

death. A 6-month mortality included in-hospital death as well as death following discharge.

The cumulative number of days of all hospitalizations in 2004 was used as a surrogate marker for comorbidity. It was calculated for each person and classified into four categories (0 days, 1–7 days, 8–14 days, > 14 days). Functional status was defined as presence or absence of care need.

A log-binomial regression model was applied to compare the relative risks of institutionalization or of mortality after fractures of the proximal humerus, distal radius, spine, pelvis, or lower extremities with hip fractures. The regression estimates were mutually adjusted for the other fracture types. To account for possible differences in comorbidity, functional status, and for disproportional effects of progressive age, categories of hospitalization during 2004, and care need, were included in the regression model.

All statistical calculations were carried out using SAS version 9.4 (SAS Institute, Inc., Cary, NC).

Ethics

The study was approved by the ethical committee of Ulm University.

Results

During the observation period, 53,820 community-dwelling people were admitted to hospital with an admission or discharge diagnosis of one of the fractures of interest (“index fracture”). The median age of fracture patients on admission to hospital was 80.0 years, and 81.4% were women (Fig. 1). Hip fractures were the most frequent fractures with 19,670 patients (36.6% of the study population). The proportions of the different fracture sites were 14.6% distal radius, 13.0% proximal humerus, 12.9% spinal fractures, 14.5% fractures of the lower extremities (excluding proximal femoral fractures), and 8.5% pelvic fractures. Patients with pelvic fractures and with hip fractures had the highest median age (82.2 and 82.0 years) while patients suffering from fractures of the lower extremities (excluding proximal femoral fractures) were youngest (76.0 years). A total of 5394 patients (10.02%) died during the 6 months following any of the index fractures, and 5507 patients (10.23%) were newly admitted to a nursing home.

Six months after admission to the hospital, hip fractures were associated with the highest institutionalization rates in women and men (14.92 per 100 patients in women and 11.16 per 100 patients in men). Pelvic fractures were associated with rates of institutionalization in a similar range as observed in people suffering from hip fractures (13.6 per 100 patients in women and 9.22 per 100 patients in men). Fractures of the spine had high institutionalization rates as well (10.96 per 100

patients in women and 8.04 per 100 patients in men). The lowest rates of institutionalization were observed in people suffering from fractures of the distal radius (4.02 per 100 patients in women and 1.06 per 100 patients in men) (Fig. 2a and b). Six-month institutionalization rates increased with age for all fracture sites (Table A Supplement) and were generally higher in women than in men.

Six-month mortality was lower in women than in men for all fracture sites (Table A Supplement). Hip fracture was the fracture site with the highest age-standardized 6-month mortality (9.01 per 100 patients in women, 15.75 per 100 patients in men). Age-standardized 6-month mortality was lowest in patients admitted after fracture of the distal radius (2.44 per 100 patients in women and 4.23 per 100 patients in men). Hip fracture was the fracture site with the highest in-hospital mortality (5.53 per 100 patients in women and 10.31 per 100 patients in men) (Table 1).

After adjusting for covariates, the risks of institutionalization after pelvic and spinal fractures were not significantly different from the risk of institutionalization after hip fracture in women and men (Table 2). In contrast, the risks of institutionalization after fractures of the humerus, radius, or lower extremities were lower than after hip fracture. The risks of death within 6 months after any other fracture site were lower than the risk of death after hip fracture. The relative risk ranged from 0.31 (radius) to 0.71 (pelvis) in women and from 0.31 (radius) to 0.75 (pelvis) in men.

Discussion

This study of almost 54,000 older community-dwelling people suffering a fragility fracture demonstrates a high rate of new admission to nursing home care following a hip fracture. Moreover, it adds insight into outcomes after fractures other than hip fracture. Crude institutionalization rates 6 months after admission to hospital were lower in those admitted for non-hip fractures. Adjusting for differences in age-distribution, pre-fracture functionality, and co-morbidity, the risks of institutionalization 6 months after fractures of the spine and pelvis were similar to the risk after hip fracture, in both women and men. Patients suffering from fractures of the lower extremities, proximal humerus, and radius had significantly lower risks of institutionalization.

Previous studies on institutionalization after hip fractures demonstrated rates between 12% and 27% confirm our findings [1, 14, 15]. There are few studies reporting institutionalization rates after non-hip fractures. A Canadian study chose a similar approach using routine data but comparison of results with our results is not straightforward due to differences in fracture categories and age strata [16]. With respect to hip fractures, the institutionalization rate reported was in the same range as in our study. In contrast to

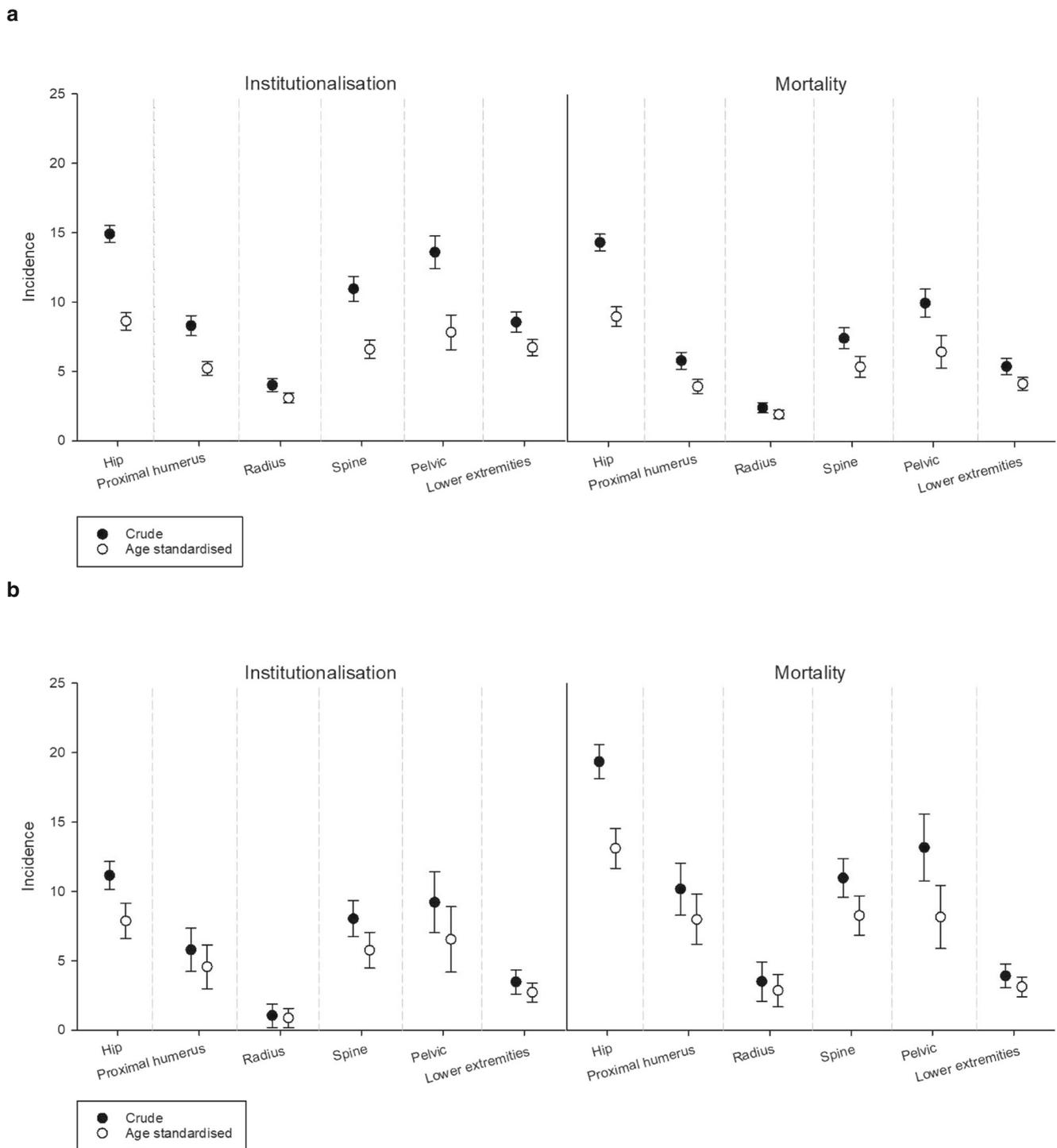


Fig. 2 Incidence of institutionalization and mortality (each per 100 persons) in women (a) and men (b) within 6 months after hospital admission due to different fragility fractures

some of our results, the rate of institutionalization was lower for non-hip fractures compared to our results. Most probably, this is due to grouping of a wide range of fractures with different risks, e.g., pelvic fractures were grouped with fractures of the scapula, clavícula, patella, tibia, fibula, and ankle. A number of other studies estimated the relative risk of institutionalization

after non-hip fractures compared to different reference groups such as the general older population or matched controls. However, falls as well as hospital admissions are risk factors for institutionalization per se [17–19]. Rather than comparing fracture patients to non-hospitalized non-fallers, the aim of this study was to compare outcomes between different fracture sites

Table 1 Crude in-hospital mortality after fracture of the hip, humerus, radius, spine, pelvis, and lower extremities

	Women ^a	Men ^a
Hip	5.53 (5.16; 5.90)	10.31 (9.34; 11.28)
Humerus	1.45 (1.15; 1.76)	4.15 (2.83; 5.47)
Radius	0.27 (0.15; 0.39)	0.35 (0; 0.84)
Spine	1.69 (1.33; 2.04)	3.80 (2.90; 4.70)
Pelvis	2.50 (2.00; 2.99)	5.50 (3.80; 7.21)
Lower extremities	1.72 (1.38; 2.05)	1.91 (1.27; 2.55)

^aRate per 100 persons with 95% confidence interval

in people admitted to hospital after fractures known to be associated with falls. Since hip fractures are regarded as the most catastrophic consequence of falls, we chose hip fracture patients as the reference group.

Risk of institutionalization after fractures of the hip, pelvis, and spinal fractures was not significantly different. Patients with fractures of the hip and pelvis experience immediate loss of mobility. Loss of mobility may last far beyond the immediate and post-acute period [8, 20–22]. Hence, the link between hip and pelvic fractures and subsequent institutionalization may be the result of mobility limitations. The causal path between fractures of the spine and institutionalization appears less evident. One potential explanation for subsequent institutionalization may be the disabling nature of associated pain. Fractures of the spine can be the beginning of a lasting deterioration of health and function [23, 24]. In this study, we report on incident fractures requiring hospitalization. Besides the impact of pain, the hospitalization process itself can be accompanied by deconditioning which may cause loss in function and independence leading to institutionalization in these patients.

The results of our study call for reevaluation of the burden associated with non-hip, non-vertebral fractures. While there are a number of studies estimating disability after fractures of the hip, spine, and distal radius, similar data is lacking for pelvic fractures and humerus fractures in older persons [25,

26]. For example, calculation of disability after pelvic fractures refers to utility values derived from expert opinion or pelvic fractures are considered as equal to other non-hip, non-vertebral fractures [27–29]. In the light of our results, such approaches underestimate the true burden.

Mortality rates after non-hip fractures were significantly lower compared to hip fractures. Death following fractures may be a direct result of the fracture and of perioperative complications. In hip fracture patients, 17 to 32% of all deaths are supposed to be directly related to the fracture [30]. Mortality may also be attributable to the patients' number and nature of comorbidities as well as poor physical functioning prior to the fracture. While hip fractures are almost exclusively treated by surgery, non-hip fractures display a heterogeneous treatment pattern with some being treated non-surgically. Considering the non-surgical treatment of most pelvic fractures in older patients, lower in-hospital mortality after pelvic fractures compared to hip fracture patients is not surprising. Yet, a 6-month mortality after pelvic fracture of about 10% in women and 15.8% in men is remarkable and in line with previous studies reporting 1-year mortality rates of up to 27% [20, 31].

Comparing our results with the results from other studies, one has to bear in mind several differences between studies. First, we included community-dwelling people only. Mortality would be higher when including nursing-home residents [32]. Second, follow-up after fracture in previous studies varied from time to discharge from hospital up to 21 years [3, 8, 10]. We limited the observation period to 6 months after admission to hospital in order to detect differences related to immediate health and functional consequences of the fractures. From an observational study of people recovering after hip fracture, we concluded that people who recover their pre-fracture mobility and ability to perform ADL activities do so within 6 months [21]. Finally, our data is restricted to patients admitted to hospital. While nearly all patients suffering from hip fracture are admitted to hospital, the proportion is considerably lower for other fracture sites. German data demonstrate that in older persons, only about 77% of distal fractures of the radius and 89% of proximal

Table 2 Risk of institutionalization or mortality within 6 months after admission to hospital after fracture of the humerus, radius, spine, pelvis, and lower extremities compared to hip fracture

	Women		Men	
	Institutionalization RR (95% CI) ^a	Mortality RR (95% CI) ^a	Institutionalization RR (95% CI) ^a	Mortality RR (95% CI) ^a
Hip	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)	1.00 (ref.)
Humerus	0.80 (0.73; 0.87)	0.59 (0.53; 0.66)	0.68 (0.51; 0.88)	0.70 (0.58; 0.82)
Radius	0.46 (0.41; 0.52)	0.31 (0.26; 0.36)	0.16 (0.06; 0.32)	0.31 (0.20; 0.45)
Spine	0.95 (0.87; 1.03)	0.66 (0.60; 0.73)	0.91 (0.76; 1.08)	0.71 (0.62; 0.80)
Pelvis	0.94 (0.86; 1.02)	0.71 (0.64; 0.78)	0.89 (0.70; 1.12)	0.75 (0.63; 0.88)
Lower extremities	0.91 (0.83; 0.99)	0.61 (0.54; 0.68)	0.53 (0.40; 0.68)	0.35 (0.28; 0.43)

^aModel was adjusted for age, functional status (presence/absence of care need), and hospital days in 2004 in four categories

fractures of the humerus were presented to hospital [33]. We can speculate that rather fit and healthy people with non-hip fracture are underrepresented in our sample of people admitted to hospital and unfavorable outcomes might be overestimated in non-hip fractures.

Institutionalization and mortality are both driven by an impaired health and low physical function. Therefore, institutionalization after fracture is probably influenced by the competing risk of mortality. High mortality following fracture may reduce the subsequent risk of institutionalization by a “healthy survivor” effect. In our study, mortality was clearly highest after hip fracture. This may be one reason why the institutionalization rate after hip fracture was not significantly higher than after fractures of the pelvis or spine.

What is consistent over nearly all our analyzed fracture types is a higher risk for mortality but a lower risk for institutionalization in men than in women. The literature about gender differences in institutionalization rates is inconsistent. Analyses of routine data from England found lower rates of discharge to nursing homes after hip fractures in men than in women [34], while a Canadian study found a higher risk of new institutionalization in older men compared to women 1 year after various fractures [16]. The reason for our findings of lower age-adjusted institutionalization rates in men is speculative. One reason may be the higher (competing) mortality rate in men, another reason is that men are more likely than women to have a spouse who can provide informal care at home since women have a longer life expectancy and tend to be married to an older partner.

It is a strength of our study to directly compare different fracture sites after adjustment for age, pre-fracture comorbidity, and functional limitations. The large size of our sample is another strength. We were able to identify more than 50,000 fragility fractures. So far, only one study was of similar size [16, 35]. Therefore, we could compare the mortality and institutionalization rates of different fracture sites and to calculate age-specific rates for seven age groups.

There are several limitations of our study. Available data ends in 2009, and the absolute number of fractures has changed since 2009 due to demographic change. Yet, nursing home policy has not changed in Germany. Admission to nursing home is usually associated with severe functional impairment. Hence, the age-adjusted comparison of institutionalization rates between fractures should not be influenced by demographic change. Changes in mortality after fracture cannot be ruled out. There is no data on temporal trends in fracture mortality in Germany. However, changes are not expected to be in a magnitude that would affect the basic findings of our analyses.

Furthermore, the routine data did not include clinical information like physical or cognitive function, comorbidities, body-mass-index, or social support at home. These parameters may have also influenced institutionalization rates. Therefore, risk of bias would have been lower if we would have been able to control for these parameters in our analyses.

Conclusions

After adjusting for possible confounders, the risks of institutionalization after fractures of the spine and pelvis were similar to the risk after hip fracture. Six-month mortality rates after all non-hip fractures were considerably lower than after hip fractures. Still, mortality after pelvic fractures was high considering the non-surgical treatment of such patients and their consequently lower inhospital mortality.

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Compliance with ethical standards The study was approved by the ethical committee of Ulm University.

Conflicts of interest None.

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