Temporal Trends in Fracture Rates and Postdischarge Outcomes among Hemodialysis Patients

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ABSTRACT

Patients with ESRD have a substantially increased risk of bone fractures, but the burden of fractures has not been sufficiently characterized in this population. Here, we analyzed fracture rates and postdischarge outcomes using Medicare data from hemodialysis patients in the United States between 2000 and 2009. We assessed adjusted quarterly fracture rates (inpatient and outpatient) and consequences of postfracture hospitalization for seven categories of fracture location. Pelvis/hip, vertebral, and lower leg fractures were the most prevalent fracture types. Pelvis/hip fractures declined slightly from 29.6 to 20.6 per 1000 patient-years between early 2000 and late 2009, but the incidence rates for all other fracture types remained relatively constant. Median lengths of stay for the primary fracture hospitalization ranged from 5 days (interquartile range [IQR], 3–9 days) for forearm/wrist fractures to 8 days (IQR, 5–12 days) for femur fractures. The proportion of patients discharged from the primary hospitalization to a skilled-nursing facility ranged from 28% (ribs/sternum) to 47% (pelvis/hip). A negative binomial regression model suggested that patients had an adjusted mean of 3.8–5.2 additional hospitalizations during the year after discharge from the index hospitalization, varying by fracture type, comprising a mean of 33–52 inpatient days. Case-mix–adjusted mortality rates after discharge ranged from 0.43 to 0.91 per patient-year and were highest for vertebral, pelvis/hip, and femur fractures. In conclusion, fractures in the dialysis population are common and are associated with a substantially increased risk for death and hospitalization.

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Fractures are an important public health concern associated with substantial morbidity, mortality, and costs among patients with ESRD.[1–4] Compared with the general population, dialysis patients are at an increased risk of any fracture and are 4.4–14 times more likely to experience a hip fracture.[1,5,6] The consequences of hip fracture, in particular, are substantial. In the general population, this type of fracture is associated with permanent disability, admission to long-term care facilities, and a mortality rate ranging from 15% to 40%.[7,8]

Several factors may contribute to the elevated fracture rate in dialysis patients relative to their age-, race-, and sex-matched peers not undergoing dialysis. These include a high prevalence of polypharmacy, large comorbidity burden, decreased muscle strength, and increased susceptibility to falls.[9–11] Additionally, secondary hyperparathyroidism and renal osteodystrophy, common among patients with ESRD, directly affect bone turnover and mineralization and are associated with pain and low-trauma fractures.[12,13]

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Currently available information on the incidence of fractures in dialysis patients is dated, has primarily focused on hip fracture, and is based on small, select groups of patients.[1,5,14–17] Furthermore, outcomes after discharge from a fracture hospitalization have not been analyzed in detail. We sought to characterize the clinical burden of fracture in the hemodialysis population, including both contemporary fracture rates and short- and long-term consequences after hospital discharge. Specifically, we estimated the adjusted quarterly incidence rates of select categories of high-burden inpatient and outpatient fracture types over time and among relevant patient subgroups. We hypothesized that pharmaceutical advances in the treatment of bone health and increases in the use of intravenous vitamin D use over the past decade[18] may have decreased fracture rates in this population.

Additionally, for fractures resulting in hospitalization, we estimated the hospital length of stay, discharge destination, and various postdischarge outcomes, including subsequent hospitalizations and 1-year mortality.

RESULTS

Table 1 describes the demographic and clinical characteristics of the dialysis population at risk for outpatient and inpatient fractures in the first quarter (Q1) of the first (2000), middle (2004), and last (2009) years of observation. The number of patients at risk increased over time. In each successive interval, patients at risk had a longer average number of years on dialysis. Otherwise, the selected demographic and clinical characteristics of the patients changed little over time.

Table 1. Demographic and clinical characteristics of population at risk for outpatient and inpatient fractures in 2000, 2004, and 2009

Characteristics	Year[a]		
	2000	2004	2009
Patients (*n*)	168,278	207,327	234,919
Age			
18–44 yr	13.5	12.1	11.7
45–64 yr	35.6	37.1	40.0
65–74 yr	28.3	26.5	25.0
>74 yr	22.6	24.3	23.4
Men	52.1	53.3	54.7
White	54.0	54.6	54.8
Duration of dialysis			
0–1 yr	44.2	41.8	37.5
2–5 yr	41.0	42.4	43.7
>5 yr	14.8	15.7	18.8
Cause of ESRD			
Hypertension	30.0	29.8	29.5
Diabetes	42.0	45.0	46.8
GN	12.3	10.9	9.7
Other	15.7	14.3	14.0

Unless otherwise noted, values are percentages.
[a]Quarter 1 of respective years

The adjusted quarterly incidence of fracture is presented in Figure 1, A and B, overall and limited to those occurring in the inpatient setting. All fracture types studied were more likely to result in an inpatient admission than to be identified through outpatient claims. Across all calendar years, pelvis/hip fracture was the most common fracture type, followed by vertebral and lower leg fractures, representing 42.2%, 18.7%, and 12.4% of all fractures respectively, in the fourth quarter (Q4) of 2009. Over time, pelvis/hip fractures declined slightly from 29.6/1000 patient-years in Q1 2000 to 20.6/1000 patient-years in Q4 2009, but the incidence of all other fracture rates remained relatively constant throughout the study period.

Figure 2 displays the adjusted incidence rates for the three most frequently observed fracture types (pelvis/hip, vertebral, and lower leg) within subgroups defined by age, sex, race, cause of ESRD, and years on dialysis in Q4 of 2009. Generally, fractures were more common among older patients and among women compared with men. A large imbalance among race groups was observed; the incidence of pelvis/hip fractures was 3.1 times greater among white than nonwhite patients. With regard to specific fracture types, across all strata, fractures of the pelvis/hip were most common. The increase in the rate of vertebral fractures with increasing age was greater than that observed for lower leg fractures and so represented a larger proportion of fractures among older patients than among younger patients.

Patients discharged from a fracture hospitalization were more likely to be female, white, and older; had a longer time on dialysis; and generally had a higher prevalence of comorbid conditions, particularly with regard to history of falls or walking disability and use of a wheelchair, walker, or cane, compared with patients with a nonfracture hospitalization (Table 2). The median LOS for patients hospitalized for fracture (all types) was longer than for the comparator patients (Table 3). Patients with femur, pelvis/hip, and vertebral fractures had the longest LOS at a median of 8, 7, and 7 days, respectively, versus 4 days for comparator patients. The in-hospital death rate was higher for patients who experienced a fracture event (with the exception of lower leg and forearm/wrist fractures) than for the nonfracture hospitalization comparator group. For those who survived the initial hospitalization, use of a skilled-nursing facility and other post–acute care services (*e.g.*, inpatient rehabilitation facility, long-term care hospital, swing bed) was considerably higher among patients experiencing a fracture hospitalization relative to the comparator group. The highest rate was seen for patients experiencing a pelvis/hip fracture; 66.8% of these patients were discharged to a skilled-nursing facility or other post–acute care facility. Only 14.2% were discharged to their home compared with 77.5% of comparator patients.

Given the differences in characteristics between patients with a fracture and those in the comparator group, 1-year postdischarge outcomes were adjusted by patient case-mix (Table 4). With and without adjustment, postdischarge mortality, hospitalizations, hospital days, admissions to a skilled-nursing facility, and skilled-nursing facility days were

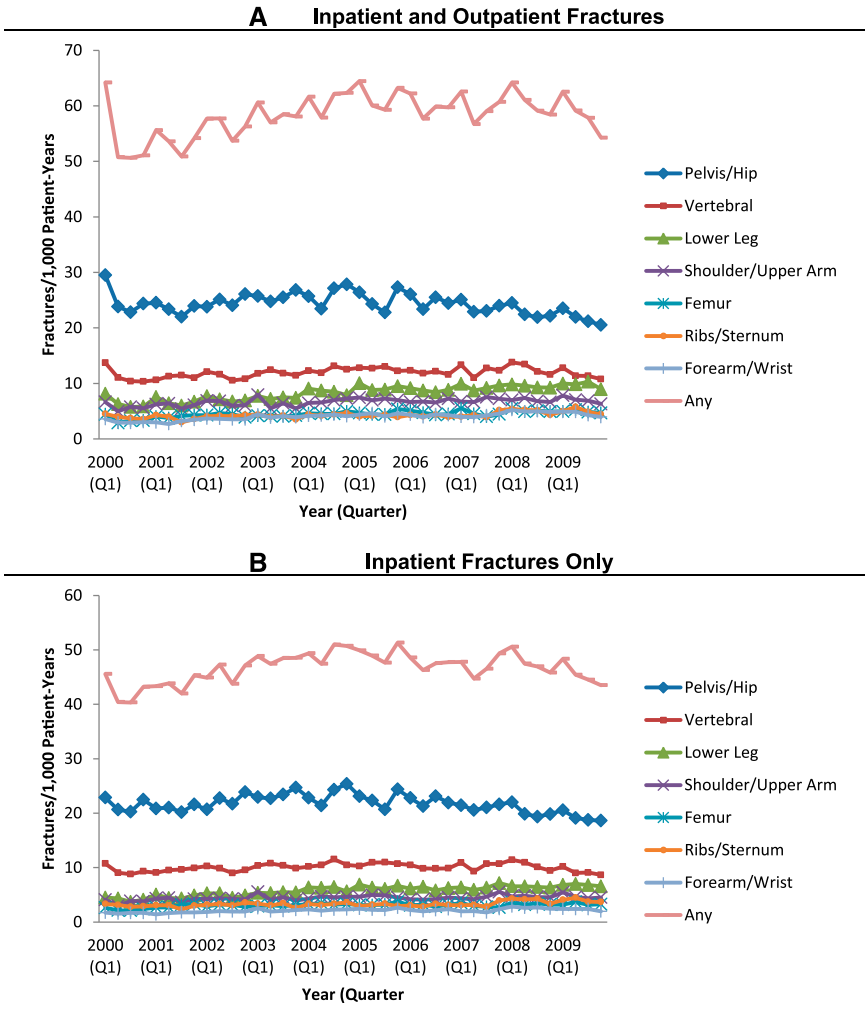

Figure 1. Adjusted fracture incidence rates remained constant in the years 2000–2009. Rates were highest for pelvis/hip, vertebral, and lower leg fracture categories. All trend lines were adjusted for age, race, sex, cause of ESRD, and years on dialysis. (A) Inpatient and outpatient fractures. (B) Inpatient fractures only.

substantively higher for all fracture categories relative to the comparator group. The 1-year adjusted mortality rate after a fracture hospitalization ranged from 0.43/patient-year (95% confidence interval, 0.38 to 0.49) for forearm/wrist fractures to 0.91/patient-year (95% confidence interval, 0.85 to 0.96) for vertebral fractures versus 0.38/patient-year (95% confidence interval, 0.38 to 0.39) for the comparator group. Similarly, adjusted hospitalization rates and hospital days during the year after a fracture hospitalization were highest among patients with vertebral fractures and lowest among those with forearm/wrist fractures and were all greater than the rates observed for the comparator group. Adjusted rates of skilled-nursing facility admissions were higher for all fracture types compared with the comparator group. Patients hospitalized for a pelvis/hip or femur fracture spent the most days in a skilled-nursing facility in the year after their discharge.

We further examined the postdischarge consequences in the pelvis/hip fracture group (the most common fracture type) within strata defined by age, sex, race, cause of ESRD, and years on dialysis (Figure 3). In all instances, the burden was considerably higher for patients experiencing a pelvis/hip fracture than for the comparator group. For both groups, mortality, hospitalization, and rates of admission to a skilled-nursing facility increased with age, were similar for men and women, and, in general, were modestly higher for whites than nonwhites.

DISCUSSION

We used contemporary data to examine the incidence of fractures, both in the inpatient and the outpatient setting, and to characterize postdischarge outcomes among the hemodialysis population in the United States. Overall, we observed a relatively constant rate of fractures over time, with evidence of a slight decline in the rate of pelvis/hip fractures in the most recent years. We investigated a range of postdischarge outcomes, including hospitalization, death, and use of post–acute care services, which have not been previously described. The postdischarge consequences of all types of fractures are substantial. Many patients are discharged to a skilled-nursing facility or other post–acute care setting and have a high rate of hospitalizations during the year after fracture. Postdischarge mortality rates in the first year after fracture were also more than twice as high as the mortality rate in the general dialysis population. Compared with a reference group of hemodialysis patients with a first hospitalization for any nonfracture reason, we observed higher rates of mortality and use of health care (*e.g.*, hospital, skilled-nursing facility, other post–acute care service) in the year after a fracture-related hospital discharge, highlighting the clinical consequences of major fracture events in the dialysis population.

The modest decline in the incidence of pelvis/hip fracture reported herein is consistent with findings on hip fracture incidence from the general Medicare population.[19–25] However, the rates we observed for hospitalized fractures are substantially higher than rates previously documented in the nondialysis population.[1] Some suggested explanations for the decline in hip fracture rates in the general population include increased physical activity and functional ability among the elderly, greater body mass, decline in smoking,[23,25] and

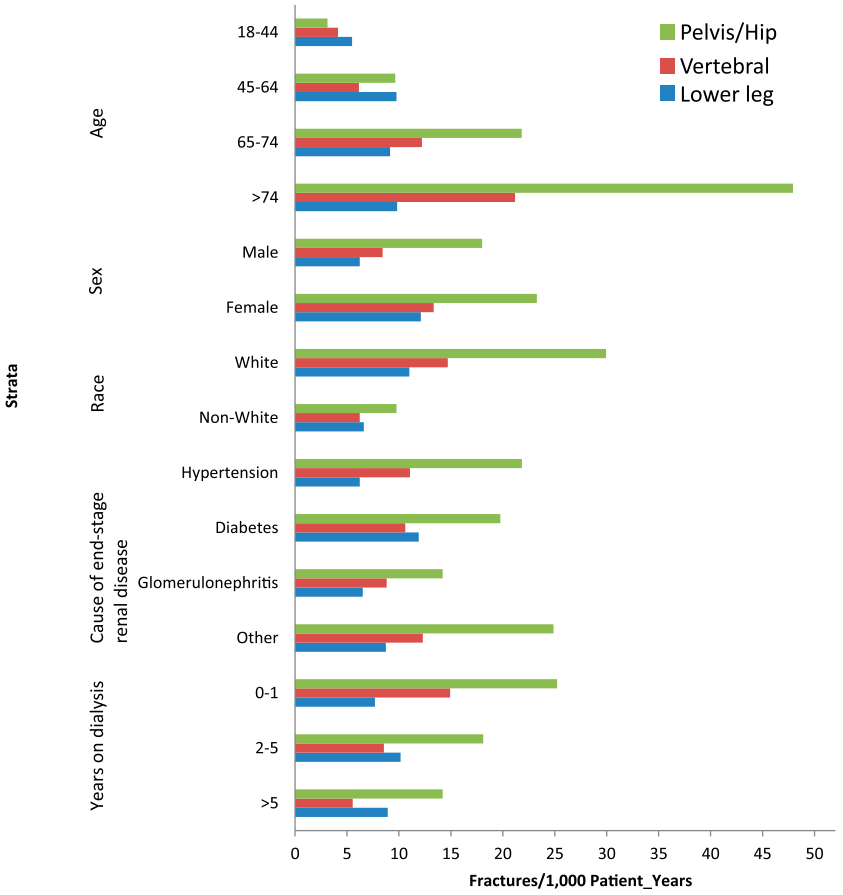

Figure 2. Adjusted fracture incidence rates by strata for the top three most prevalent fracture categories (pelvis/hip, vertebral, lower leg) in years 2000–2009. Rates were adjusted for age, race, sex, cause of ESRD and years on dialysis. The subgroup of interest was omitted from the adjustment for each respective subgroup category.

increased use of antiresorptive agents, such as bisphosphonates,[21] but the effect of these factors in the dialysis population has not been explicitly studied. Use of bisphosphonates is not likely to explain the slight decline in pelvis/hip fractures in dialysis patients because they are not generally prescribed these drugs as a result of concerns over drug toxicity related to impaired renal excretion.[26–28]

In the general population, many factors increase an individual's likelihood of fracture, independent of their bone mineral density.[29] Similarly, while bone disease is common in dialysis patients, due to secondary hyperparathyroidism and other forms of renal osteodystrophy, including osteomalacia and adynamic bone disease,[30] other factors, such as smoking status, may affect fracture risk independently of bone density.

In the dialysis population, various therapeutic interventions, including vitamin D sterols, calcium-based phosphate binders, and calcimimetics are used to decrease levels of parathyroid hormone, which directly affects bone resorption.[31,32] The use of these interventions has increased sizably over the past decade[33] in an effort to reduce parathyroid hormone, as well as calcium and phosphorus levels, which are associated with increased risk of adverse clinical outcomes, including fracture and mortality.[2,33–35] Despite increased use of these therapeutic advances in treating bone mineral metabolism disturbances and despite fracture risk factor awareness, we document only a small decline in fracture rates since 2000. Claims for calcium-based phosphate binders are in Medicare Part D records, a drug program in effect only since 2006 and, therefore, not included in this analysis.

We observed variations in fracture rates by age, sex, and race, consistent with previous studies.[1,4] In particular, the fracture rate among nonwhite patients was roughly half that of their white counterparts, and this difference persisted over time. Blacks have consistently been shown to have increased bone mass relative to whites. In the general nondialysis population, differences in the vitamin D–endocrine system among blacks results in greater circulating levels of $1,25(OH)_2D$ and higher levels of PTH, which in turn increases reabsorption of calcium in the renal tubule. This has been proposed as a potential causal factor for higher bone mass.[36] On dialysis, the higher parathyroid hormone among blacks relative to whites decreases the likelihood of low bone turnover, a fracture risk factor, and may therefore also help protect against fracture in these patients.[13] Because black patients are disproportionately represented in dialysis (approximately 33% versus 13% in the general population),[37] this may contribute to more pronounced racial differences in fracture rates within the dialysis population.[4]

The clinical consequences after hospitalization for fracture observed in this study were sizable and are consistent with previous work showing decreased functional ability even several months after fracture.[11] Following a fracture, patients may need care at a skilled-nursing facility or other post–acute care facility and assistance with activities of daily living.[11] We observed high rates of hospitalization and skilled-nursing facility admission after discharge, but possibly most striking was the time spent in these centers. Among patients with a pelvis/hip fracture, the mean time spent in a skilled-nursing facility, after adjustment for variation in patient characteristics, was approximately 2 months compared with 2 weeks for the incident hospitalization comparator group. These results are consistent with those of Braithwaite *et al.*, who estimated that 32%–80% of elderly patients experience permanent disability after an initial hospitalization for hip fracture, with up

Table 2. Demographic and clinical characteristics of patients' index hospitalization for any fracture versus comparator group in 2009

Characteristic	Any Fracture	Comparator Group[a]
Patients (*n*)	7283	45,125
Age		
18–44 yr	4.1	10.6
45–64 yr	26.3	37.9
65–74 yr	26.5	25.5
>74 yr	43.0	26.0
Men	43.0	54.8
White	72.6	60.3
Duration of dialysis		
0–1 yr	32.3	62.9
2–5 yr	49.7	33.1
>5 yr	18.0	4.1
Diabetes as cause of ESRD	50.2	49.9
Autoimmune disorder	5.4	4.9
Blood loss anemia	6.0	4.9
Cancer	17.9	13.8
Chronic obstructive pulmonary disease/asthma	33.6	26.9
Diabetes	69.4	67.9
Gastrointestinal bleeding	9.0	7.0
Infection	24.1	30.9
Heart diseases/heart procedure performed	88.4	82.5
Ischemic stroke	25.1	19.9
Hypertensive disease	98.3	97.5
Liver disease	5.6	5.4
Acute myocardial infarction	8.3	7.7
Other neurologic disorders	20.2	13.3
Peptic ulcer disease	4.6	3.6
Psychiatric disorder	9.7	6.6
Pulmonary circulation disease	10.5	7.5
Rheumatic heart disease	5.9	4.5
Substance use disorder	10.8	12.3
Blood transfusion	27.3	14.0
Walking disability/history of falls	55.6	16.7
Use of wheelchair	18.4	12.6
Use of walker/cane	7.2	3.9
Use of modified bathroom equipment	3.7	2.1

Unless otherwise noted, values are percentages.
[a]Patients hospitalized for the first time for any cause (except for fracture).

to 60% requiring treatment in a long-term skilled-nursing facility.[8]

We also observed high mortality rates after fracture, with the highest event rates for those with a vertebral, shoulder/upper arm, or pelvis/hip fracture. These results are consistent with previous estimates of elevated post–hip fracture mortality risk ranging from two- to three-fold higher relative to patients not experiencing a fracture.[3,4] With regards to race, nonwhites had lower mortality rates after fracture in our sample, which is contrary to findings in the general population.[38] These results suggest that the apparent survival advantage of nonwhites on dialysis[39,40] may persist even after fracture and is potentially related to increased access to health care due to universal Medicare coverage or unobserved clinical differences, whereby increases in lipids and other cardiovascular risk factors may actually be protective.[41]

This study has limitations. Fracture events were derived from Medicare claims data and are therefore subject to some misclassification. Certain fracture definitions may be specific, but not sensitive, likely leading to some underascertainment. It is also possible that patients do not receive medical care for certain categories of fractures. However, for serious fractures, such as those at the pelvis/hip, the outcome definitions will probably be both specific and sensitive because most of these fractures are likely to result in a hospitalization. To identify rule-out fracture diagnoses, patients in the outpatient setting were required to have at least two fracture diagnosis codes within a 28-day span (arbitrarily chosen) for a respective fracture category, possibly contributing to underascertainment of certain fractures. As with any analysis of administrative claims, we identified comorbid conditions according to International Classification of Diseases, Ninth Revision, diagnosis codes. Such an approach may not have completely captured the differences between the fracture and comparator groups, although we did notice substantial differences between the groups with regard to history of falls, walking disability, and use of assistive devices. We also did not control for place of residence (*e.g.*, long-term care facility) before fracture.

In summary, we document that fracture rates among patients with ESRD have remained high and that postfracture morbidity and mortality remain substantial. Future research is needed to increase our understanding of how to improve fracture prevention, improve postfracture outcomes across all race and sex groups, increase continuity of postfracture care, and optimize postfracture rehabilitation in order to ameliorate the clinical burden and economic impact of all fracture types in this population.

CONCISE METHODS

We used data from the U.S. Renal Data System[42] for the period January 1, 2000, to December 31, 2009, to identify all incident and prevalent in-center hemodialysis patients, 18 years and older, who had Medicare as their primary payer and both Part A and B coverage. Patients with a history of renal transplantation were excluded. Quarterly patient cohorts were used to estimate adjusted fracture rates.

Patients hospitalized for an inpatient fracture who survived their inpatient stay were followed for 1 year after discharge to assess postfracture outcomes. For all outcomes other than mortality, patients were censored if one of the following events occurred: (*1*) death, (*2*) kidney transplantation, (*3*) Medicare no longer the primary payer, or (*4*) switch to peritoneal dialysis. Patients were administratively censored on December 31, 2009.

Table 3. Median length of hospital stay and discharge destination by fracture category for index fracture hospitalizations[a] in 2000–2009

Patient/Fracture Group	Patients (*n*)	Median Length of Stay (Interquartile Range) (d)	Discharge Status (%)				
			Died	Skilled-Nursing Facility	Other Post–Acute Care Services[b]	Home	Other
Comparator group[c]	503,862	4.0 (2–7)	4.8	10.5	2.2	77.5	5.0
Pelvis/hip	35,956	7.0 (5–11)	9.3	47.3	19.5	14.2	9.7
Vertebral	15,946	7.0 (4–12)	7.8	30.7	9.2	43.9	8.4
Lower leg	10,514	6.0 (3–9)	3.6	43.2	12.7	33.5	7.0
Shoulder/upper arm	7662	6.0 (3–10)	6.9	40.8	9.2	34.6	8.5
Ribs/sternum	5623	6.0 (3–9)	7.4	27.8	7.5	49.9	7.5
Femur	5545	8.0 (5–12)	9.7	46.7	15.5	19.2	8.9
Forearm/wrist	3845	5.0 (3–9)	4.2	35.7	10.4	42.5	7.2

[a]Fractures in any diagnosis field.
[b]Inpatient rehabilitation facility, long-term care hospital, or swing bed.
[c]The first hospitalization between 2000 and 2009 for all dialysis patients (excluding those hospitalized for fractures).

Identification of Fractures and Calculation of Incidence Rates

We identified fractures according to International Classification of Diseases, Ninth Revision, diagnosis codes, which we grouped into seven categories: (*1*) vertebral; (*2*) pelvis/hip (femoral neck); (*3*) femur (excluding neck); (*4*) tibia, fibula, patella, and ankle (lower leg); (*5*) ribs and sternum; (*6*) humerus, scapula, and clavicle (shoulder and upper arm); and (*7*) forearm (radius and ulna) and wrist. This classification excluded fractures of the hands and feet (due to minimal consequences of these fractures), fractures of multiple areas, of the skull/trunk (likely indicating severe or blunt trauma), and ill-defined, unspecified fractures.

We examined both inpatient and outpatient claims for fracture diagnoses in any field. To mitigate the likelihood of mistakenly classifying a "rule-out" fracture diagnosis in the outpatient setting as an actual fracture occurrence, patients were required to have at least

Table 4. Postdischarge consequences (events per patient-year) by fracture category in 2000–2009

Category[a]	Deaths/ Patient-Year	Hospitalizations/ Patient-Year	Mean Hospital Days/ Patient-Year	SNF Admissions/ Patient-Year	Mean SNF Days/ Patient-Year
Comparator group[b]					
Crude	0.35	2.95	29.3	0.40	19.0
Adjusted (95% CI)	0.38 (0.38 to 0.39)	3.42 (3.41 to 3.43)	26.6 (26.4 to 26.7)	0.46 (0.46 to 0.47)	13.4 (13.2 to 13.6)
Pelvis/Hip					
Crude	0.63	3.56	54.4	1.26	78.5
Adjusted (95% CI)	0.82 (0.79 to 0.86)	4.42 (4.32 to 4.53)	50.1 (48.8 to 51.5)	1.47 (1.41 to 1.54)	55.9 (54.0 to 57.9)
Vertebral					
Crude	0.73	4.31	56.1	1.19	59.7
Adjusted (95% CI)	0.91 (0.85 to 0.96)	5.15 (5.00 to 5.30)	51.9 (50.1 to 53.7)	1.28 (1.20 to 1.35)	40.9 (38.5 to 43.3)
Lower leg					
Crude	0.41	3.58	45.7	1.05	63.7
Adjusted (95% CI)	0.46 (0.42 to 0.50)	3.90 (3.75 to 4.05)	38.8 (37.0 to 40.6)	1.23 (1.15 to 1.33)	48.0 (44.9 to 51.4)
Shoulder/upper arm					
Crude	0.60	3.76	47.1	1.15	70.6
Adjusted (95% CI)	0.71 (0.64 to 0.78)	4.23 (4.04 to 4.43)	40.0 (37.8 to 42.4)	1.11 (1.01 to 1.22)	43.4 (39.9 to 47.1)
Ribs/sternum					
Crude	0.57	4.12	44.5	0.98	49.1
Adjusted (95% CI)	0.54 (0.50 to 0.60)	4.33 (4.13 to 4.53)	38.2 (36.0 to 40.5)	0.91 (0.82 to 1.00)	29.1 (26.1 to 32.4)
Femur					
Crude	0.57	3.66	56.3	1.27	77.6
Adjusted (95% CI)	0.80 (0.71 to 0.91)	4.49 (4.22 to 4.79)	51.2 (47.6 to 55.0)	1.69 (1.50 to 1.89)	60.7 (54.9 to 67.0)
Forearm/wrist					
Crude	0.44	3.40	38.8	0.89	54.9
Adjusted (95% CI)	0.43 (0.38 to 0.49)	3.83 (3.60 to 4.07)	33.3 (30.8 to 36.0)	0.91 (0.80 to 1.04)	34.7 (30.5 to 39.5)

SNF, skilled-nursing facility; CI, confidence interval.
[a]Fractures for which follow-up was available.
[b]The first hospitalization between 2000 and 2009 for all dialysis patients (excluding those hospitalized for fractures).

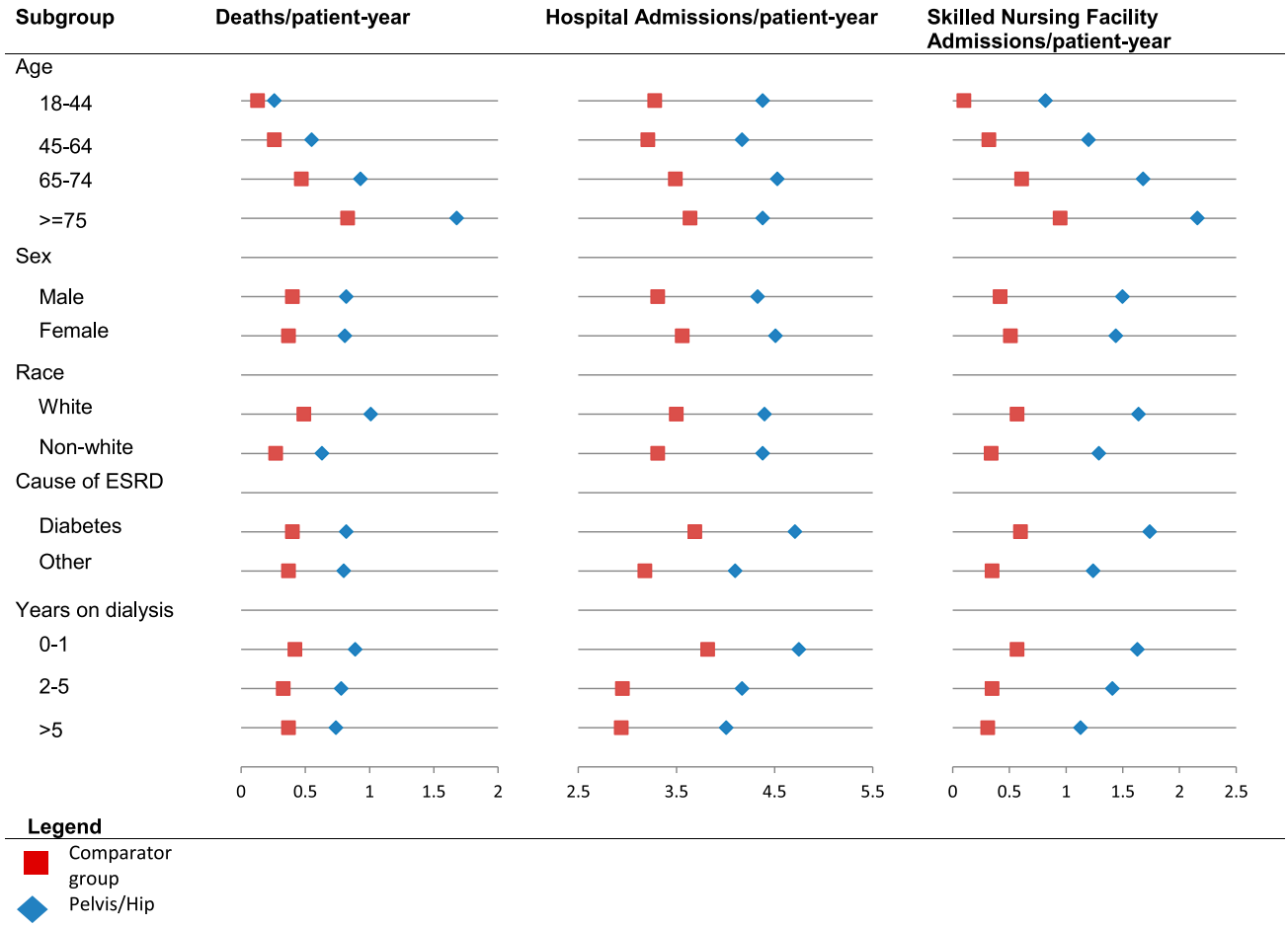

Figure 3. Following discharge from pelvis/hip fracture hospitalization, rates of mortality, readmission, and SNF admission increased with age, were similar for both sexes, and were slightly higher for whites than other races in years 2000–2009. Events per patient-year are presented for each respective event.

two outpatient fracture diagnosis codes within a 28-day span. Only the first occurrence (inpatient or outpatient) of a particular fracture type (*i.e.*, bone or joint area) contributed to the fracture incidence rate analyses. Patients were then no longer eligible to contribute data on that fracture type but could contribute to other types of fracture.

For each specific fracture type and overall, quarterly, crude fracture incidence rates were estimated by dividing the total number of fractures during the quarter by the total patient time at risk (Supplemental Figure S1). To derive fracture rates adjusted for secular trends, we computed a standardized mortality ratio–weighted model with a weight of 1 for patients hospitalized for a fracture in Q1 2000 (the comparator group) and a weight of $(p/[1-p])$ for patients hospitalized for a fracture in all other quarters (Q2 2000–Q4 2009). Here, p represented the probability that the patient was hospitalized for a fracture in Q1 of 2000 given a combination of covariates used for adjustment. All trend lines were adjusted for age, race, sex, cause of ESRD, and years on dialysis.

Rates were calculated overall and within strata of patient characteristics (age, sex, race, cause of ESRD, and years on dialysis). We also examined adjusted fracture rates over time by diabetes status (Supplemental Figure S2).

Assessment of Postfracture Outcomes

We examined postfracture outcomes for inpatient fractures only. Hemodialysis patients who were hospitalized during the study period (2000–2009) were required to have survived at least 270 days after the initiation of dialysis therapy (90 days after the initiation of dialysis to allow for stability in Medicare claims processing and 180 days to allow for a 6-month baseline period). Patients whose first hospitalization during the period was for a fracture event formed the fracture cohort, and patients whose first hospitalization for any reason other than fracture served as the comparator group. Demographic and clinical characteristics of both groups over time are described in Supplemental Table S1.

The 180-day period immediately preceding the index hospitalization was used to identify comorbid conditions. We calculated the median LOS for the index fracture admission and assessed whether the patient died in the hospital or was discharged to one of the following: home, skilled-nursing facility, other post–acute care facility, or other.

For those who survived and were discharged, we estimated both crude (Supplemental Table S2) and adjusted rates of mortality, hospitalization, and skilled-nursing facility admission during the 1 year after hospital discharge. Rates and days were adjusted to the distribution of the comparator group using negative binomial regression models adjusting for a range of characteristics. Postdischarge outcomes for pelvis/hip fractures were evaluated within patient strata.

Statistical analyses were performed using SAS software, version 9.2 (SAS Institute, Inc., Cary, NC).

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The data reported here have been supplied by the U.S. Renal Data System (USRDS). The interpretation and reporting of these data are the responsibility of the authors and in no way should be seen as an official policy or interpretation of the United States government.

DISCLOSURES

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