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Impact of Radiographic Vertebral Fractures on Inpatient Healthcare Utilization in Older Women

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Abstract

Background—Vertebral fractures (VFx) are the most common osteoporotic fracture and are associated with higher risk of impaired function, additional fractures and death. The purpose of this analysis was to test the hypotheses that VFx are also associated with greater inpatient healthcare utilization.

Methods—We studied 4709 Caucasian women enrolled in the Study of Osteoporotic Fractures (SOF) and merged SOF cohort data with Medicare claims or Kaiser encounter data. To be included in this analysis, women had to be enrolled in Medicare Fee for Service or Kaiser as of 1/1/1991 and have radiographic information on VFx status at SOF Visit 3 (1991–92). VFx status was assessed using quantitative morphometry on lateral thoracic and lumbar spine radiographs. Prevalent VFx were defined as any height ratio >3 standard deviations below normal. Women were considered to have a clinical VFx if they reported a new diagnosis of VFx and a clinical

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radiographic report that confirmed that a VFx was present. Any hospitalization and the number of annualized days of hospitalization were identified through inpatient claims or encounter data. Specific hospitalizations for 5 major common reasons for hospitalizations were also examined.

Results—Over 5-years, 2632 (55.9%) women were hospitalized. In multivariate adjusted models, women with a prevalent radiographic VFx were 21% (95% CI, 2–44%) more likely to be hospitalized for any reason. This association was independent of a number of risk factors including smoking. The annualized rate of inpatient day was, however, similar, 1.67 and 1.48 among women with and without a VFx, respectively, p=0.49. Women with an incident clinical VFx were more likely to be hospitalized including women without evidence of a radiographic VFx (odds ratio (OR)=5.33; 95% confidence interval (CI)=1.81–15.71) and women with a prevalent radiographic VFx (OR=2.13; 95% CI, 1.05–4.33). Women with a VFx were more likely to be hospitalized specifically for hip fracture or chronic obstructive pulmonary disease (COPD) but not stroke, myocardial infarction or congestive heart failure. The association with COPD was attenuated to non-significance after adjusting for smoking.

Conclusion—Our results extend the potential public health impact of radiographic and clinical VFx to include an increased risk of any hospitalization.

Keywords

Osteoporosis; epidemiology; health services research; health economics; vertebral fractures; healthcare utilization

Introduction

Vertebral fractures (VFx) are the hallmark of osteoporosis [1]. They are the most common osteoporotic fracture with prevalence estimates of 21% of men to 23.5% of women older than 50 years [2]. Only about one-third to one-fourth of VFx are clinically recognized in women [3, 4]. In men, the proportion of radiographic VFx that were also clinically diagnosed was much lower, about 14% [5]. This sex differences may reflect different methods for defining VFx but may also reflect a greater difficulty in distinguishing radiographic VFx from other non-osteoporotic vertebral deformities in men [6]. Women with VFx, even those not clinically recognized, experience decreased survival [7] and an increased risk of future fractures [8]. VFx also cause chronic back pain, limitations with common activities of daily living, and reduced quality of life [9, 10]. Data from The National (Nationwide) Inpatient Sample for years 2003–2007 showed a 17% increase in hospitalization for clinical lumbar spine fractures which was accompanied by a 27% increase in hospital charges. These numbers likely underestimate the costs since they included only clinically recognized VFx [11].

To examine the long-term inpatient healthcare utilization of radiographic and clinical VFx in a population based sample of women, we linked data from the Study of Osteoporotic Fractures (SOF) to Medicare Fee-For-Service (FFS) Claims data and Kaiser encounter data. We tested the hypothesis that women with either a radiographic or clinical VFx or both will experience greater inpatient healthcare utilization than women without a VFx.

Methods

SOF is a prospective cohort study designed to identify risk factors for fractures [12]. We recruited 9704 Caucasian women age 65 years and older at 4 US clinical sites from 1986–88. Women were excluded from SOF if they were unable to walk unassisted or had bilateral hip replacement. Follow-up visits occurred approximately every 2 years. The study was approved by the appropriate committees on human research, and all the women gave written informed consent.

The analytic sample for this report includes 4709 women who had at least 5-years of FFS/Kaiser data (either full 5-years or deceased within 5-years) and information on VFx status at SOF Visit 3 (1991–92).

Clinic measures

Bone mineral density (BMD) was measured at the femoral neck using DXA (Hologic QDR 1000 scanners). Women walked at their usual pace over a 6 meter course; the average speed of two trials in meters/second was calculated. Participants self-reported functional limitations (any difficulty with activities of daily living or instrumental activities of daily living (IADL): walking 2–3 blocks, climbing 10 steps, preparing meals, heavy housework, shopping); smoking status (current vs. past/never); physician diagnosis of medical conditions (diabetes, chronic obstructive pulmonary disease (COPD), hypertension, congestive heart failure (CHF), heart attack and stroke) and self-reported health status. Height was measured with stadiometers and weight, balance beam scales. Information on covariates was collected at Visit 3 (1991–92) or Visit 4 (1992–94) as noted.

Vertebral Morphometry

Lateral radiographs of the thoracic and lumbar spine were taken in accordance with current guidelines. Quantitative vertebral morphometry was performed as previously described [12] to calculate the anterior (H_a), middle (H_m), and posterior (H_p) height for each vertebral body from T4 to L4. Radiographs were first screened for probable fractures to reduce the number of morphometric measurements [12]. Briefly, highly trained technicians separated sets of radiographs into 3 groups termed *normal*, *uncertain*, and *probably fractured*, using a binary semiquantitative grading scheme that classified women by the most abnormal vertebral level on her films. The performance of the technician triage was evaluated in a random sample of 503 women, all of whose radiographs were triaged and underwent morphometry. The sensitivity of triage for prevalent and incident fractures was 97% and 100%, respectively [13, 14]. Morphometry was performed for all women classified as probably fractured. A vertebra was classified as having a prevalent fracture if any of the following ratios were more than 3 SDs below the trimmed normal mean for that vertebral level: (H_a/H_p), (H_m/H_p), or a combination of ($H_{pi}/H_{pi\pm1}$) [13].

Ascertainment of incident clinical vertebral fractures

Participants were contacted by mail or phone every 4 months after baseline (>99% of follow-up contacts were completed) and queried about fractures. Women were considered to have a clinical VFx if they reported a new diagnosis of VFx and a clinical radiographic

report confirmed that a VFx was present. The follow-up period for incident clinical VFx was 5 years after visit 3.

Medicare Linkage

Linkage of the SOF cohort to Medicare claims data has previously been described [15]. Medicare data was purchased from 1/1/1991 (earliest available) until 12/31/2010 and successfully linked to 9228 SOF participants. Linkage was performed by matching social security numbers/HIC numbers and verifying agreements on date of birth, date of death, gender, race and state of residence. A large proportion (90%) of Portland OR participants were enrolled in a Kaiser Medicare Advantage plan. We successfully linked these women to Kaiser encounters to obtain inpatient healthcare utilization.

Days of hospitalization were derived for participants enrolled in Medicare FFS using their MEDPAR inpatient claims. For women in Kaiser, we used Kaiser Encounter data to determine any hospitalization and cumulative inpatient days. The follow-up time was limited to 5-years after the Visit 3 x-ray. We identified hospitalization for any cause. We also identified hospitalizations with a primary diagnosis codes for major disease events including myocardial infarction (MI) (ICD-9 4.10), stroke (ICD-9 430, 431, 434, 436), hip fracture (ICD-9 820), CHF (ICD-9 428) and COPD (ICD-9 466, 490–496).

Statistical analyses

We used two-part models (“hurdle” models) to estimate the likelihood of any hospitalization, the rate ratio of inpatient hospital days amongst those hospitalized, and the mean number of inpatient days among all participants according to VFx status [16]. We examined prevalent radiographic VFx alone and their combination with incident clinical VFx over the 5 years of follow-up. The two-part hurdle model estimates the odds of being hospitalized (yes/no) using a logit function, and then among those who are hospitalized, the counts of inpatient data using log-link regression. Bootstrapping was used to derive confidence intervals (CIs). Cox proportional hazards models were used to examine the association between VFx and major disease cause specific hospitalization. Women were censored at time of death, outcome or end of follow-up period.

Results

Women with a prevalent VFx were older, had a lower body weight and were less likely to report good to excellent health status, Table 1. They were also more likely to report smoking and IADL impairment. Their BMD was lower and walking speed, slower than women without a VFx.

Radiographic vertebral fractures

Over 5-years of follow-up, 2632 (55.9%) women were hospitalized at least once. In age and clinic adjusted models, women with one or more VFx were 29% (95% CI, 12–49%) more likely to be hospitalized than women without a VFx. Further adjustment for weight, walking speed, IADL difficulty, comorbidities, health status and BMD, the odds of any hospitalization was 21% (95% CI, 2–44%) higher among those with a prevalent VFx, Table

2. Additional adjustment for smoking had no effect on these results. There was, however, no difference in the annualized rate of inpatient days. Examination of hospitalization for 5 specific major events showed that women with a prevalent VFx were more likely to be specifically admitted for hip fracture and COPD, but not for stroke, MI or CHF, Table 3. Because smoking is a risk factor for COPD and osteoporotic fractures, we further adjusted our models for smoking. The association between radiographic VFx and COPD hospitalization was no longer significant, HR=1.72 (95% CI; 0.90–3.27).

Clinical vertebral fracture with or without a radiographic vertebral fracture

Among women with no prevalent radiographic VFx, 37(1%) had an incident clinical VFx. Among women with a prevalent radiographic VFx, 53(4.8%) had an incident clinical VFx. The percent of women who were hospitalized over the 5 years of follow-up was highest in women with no prevalent radiographic VFx but an incident clinical VFx (86.5%), Figure 1.

In age and clinic adjusted models, women with either a prevalent radiographic VFx or an incident clinical VFx were more likely to be hospitalized in comparison to women without a radiographic or clinical VFx, Table 3. The greatest risk of hospitalization was observed among women with no prevalent radiographic VFx but an incident clinical VFx: these women were almost six times more likely to be hospitalized. Women with a prevalent radiographic VFx and an incident clinical VFx were 2.7 times more likely to be hospitalized. Results were similar in the fully adjusted model except the odds of hospitalization among women with a prevalent radiographic VFx were attenuated slightly. The annualized rate of inpatient days was greatest in women with a clinical VFx including those with no prevalent VFx (2.63 days) and those with a prevalent VFx (2.30 days).

Discussion

Women with osteoporosis have considerable comorbidity burden, highlighting the need for clinicians to be cognizant of their multimorbidity [17]. Previous reports have shown that the total healthcare bill associated with clinical lumbar spine fractures in 2008 exceeded 1 billion [11]. Our results extend these findings showing a 20% increased risk of any hospitalization in women with a radiographic VFx. In addition, women with an incident clinical VFx were 2 to 5 times more likely to be hospitalized, with longer hospital stays than women without a prevalent radiographic VFx or incident clinical VFx.

Most previous studies have focused on healthcare utilization or costs associated with *clinical* fractures, including clinical VFx. Using Medicare data, Kilgore et al showed the greatest costs were associated with hip fracture ($39,971) but costs associated with clinical VFx were substantial ($18,844) [18]. In the Age, Gene/Environment Susceptibility (AGES) Reykjavik study, clinical VFx were associated with an 40% increased risk of hospitalization and 50% longer hospitalizations. The larger impact observed in AGES compared with SOF may reflect their focus on *clinical* VFx which may be more severe than radiographic fractures because they came to clinical attention. Indeed, in our study we found a greater risk of hospitalization among women with an incident clinical VFx.

To our knowledge, there is only one other study that reported inpatient healthcare utilization associated with radiographic VFx [7]. Women with a prevalent radiographic VFx enrolled in an osteoporosis clinical trial and followed for 4 years were more likely to be hospitalized (relative risk=1.14; 95% CI, 1.02–1.27) than women without a VFx. Our results extend these results from a population at high risk of fracture to a more generalized population of older white women.

Women who experienced an incident clinical VFx and had no prevalent VFx, had the greatest risk of hospitalization. Nevertheless, the annualized rate of inpatient days was similar in women with an incident clinical VFx with or without a prevalent VFx. In addition, the number of women with a clinical VFx was small and confidence intervals around these estimates overlapped. Thus, the primary message is that the rate of hospitalization was greatest in women with an incident clinical VFx.

In addition to all cause hospitalization, our data showed that prevalent radiographic VFx predict subsequent hospitalization for hip fracture and COPD. This association with incident hip fractures is not surprising given VFx are a major risk factor for hip fracture [8]. However, we also showed that women with a VFx were more likely to be hospitalized for COPD; COPD occurs in approximately 15% of older persons and it the third most common cause of death [19]. Our results support the observation that older persons with COPD have a number of unique complications including VFx. The association with COPD was, however, not significant after we adjusted for smoking suggesting that smoking may mediate the association between VFx and hospitalization for COPD. Epidemiologic and biologic evidence supports a link between cardiovascular disease and osteoporosis [20, 21] but we found no association between prevalent VFx and hospitalization for MI or stroke.

Strengths to our study include the careful radiographic documentation of all VFx, including those not clinically recognized, control for many important confounding variables and high linkage with Medicare/Kaiser. Our study is limited to older white women, the highest risk group with respect to osteoporosis, but our findings cannot be generalized to non-white women or to men. A small number of women experienced an incident VFx and further stratification by prevalent VFx created small groups, limiting our power. We did not include non-VFx/non-hip fractures as major disease events because most individuals with these fractures are not hospitalized overnight.

In conclusion, women with a prevalent radiographic VFx were about 20% more likely to be hospitalized over an average follow-up of 4.8 years. The risk of hospitalization was substantially greater among women with a clinical VFx. These results extend the potential public health impact of radiographic and clinical VFx to include a higher risk of hospitalizations.

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References

1. Kendler DL, Bauer DC, Davison KS, Dian L, Hanley DA, Harris ST, McClung MR, Miller PD, Schousboe JT, Yuen CK, Lewiecki EM. Vertebral Fractures: Clinical Importance and Management. Am J Med. 2016; 129(2):221 e1–221 e10. [PubMed: 26524708]
2. Jackson SA, Tenenhouse A, Robertson L. Vertebral fracture definition from population-based data: preliminary results from the Canadian Multicenter Osteoporosis Study (CaMos). Osteoporos Int. 2000; 11(8):680–687. [PubMed: 11095171]
3. Fink HA, Milavetz DL, Palermo L, Nevitt MC, Cauley JA, Genant HK, Black DM, Ensrud KE. Fracture Intervention Trial Research G. What proportion of incident radiographic vertebral deformities is clinically diagnosed and vice versa? J Bone Miner Res. 2005; 20(7):1216–1222. [PubMed: 15940375]
4. Cooper C, Atkinson EJ, O'Fallon WM, Melton LJ 3rd. Incidence of clinically diagnosed vertebral fractures: a population-based study in Rochester, Minnesota, 1985–1989. J Bone Miner Res. 1992; 7(2):221–227. [PubMed: 1570766]
5. Ensrud KE, Blackwell TL, Fink HA, Zhang J, Cauley JA, Cawthon PM, Black DM, Bauer DC, Curtis JR, Orwoll ES, Barrett-Connor E, Kado DM, Marshall LM, Shikany JM, Schousboe JT. Osteoporotic Fractures in Men Research G. What Proportion of Incident Radiographic Vertebral Fractures in Older Men Is Clinically Diagnosed and Vice Versa: A Prospective Study. J Bone Miner Res. 2016
6. Ensrud KE, Schousboe JT. Clinical practice. Vertebral fractures. N Engl J Med. 2011; 364(17): 1634–1642. [PubMed: 21524214]
7. Ensrud KE, Thompson DE, Cauley JA, Nevitt MC, Kado DM, Hochberg MC, Santora AC 2nd, Black DM. Prevalent vertebral deformities predict mortality and hospitalization in older women with low bone mass. Fracture Intervention Trial Research Group. J Am Geriatr Soc. 2000; 48(3): 241–249. [PubMed: 10733048]
8. Klotzbuecher CM, Ross PD, Landsman PB, Abbott TA 3rd, Berger M. Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. J Bone Miner Res. 2000; 15(4):721–739. [PubMed: 10780864]
9. Nevitt MC, Ettinger B, Black DM, Stone K, Jamal SA, Ensrud K, Segal M, Genant HK, Cummings SR. The association of radiographically detected vertebral fractures with back pain and function: a prospective study. Ann Intern Med. 1998; 128(10):793–800. [PubMed: 9599190]
10. Siggeirsdottir K, Aspelund T, Jonsson BY, Mogensen B, Launer LJ, Harris TB, Sigurdsson G, Gudnason V. Effect of vertebral fractures on function, quality of life and hospitalisation the AGES-Reykjavik study. Age Ageing. 2012; 41(3):351–357. [PubMed: 22367357]
11. Baaj AA, Downes K, Vaccaro AR, Uribe JS, Vale FL. Trends in the treatment of lumbar spine fractures in the United States: a socioeconomics perspective: clinical article. J Neurosurg Spine. 2011; 15(4):367–370. [PubMed: 21740124]
12. Nevitt MC, Cummings SR, Stone KL, Palermo L, Black DM, Bauer DC, Genant HK, Hochberg MC, Ensrud KE, Hillier TA, Cauley JA. Risk factors for a first-incident radiographic vertebral fracture in women > or = 65 years of age: the study of osteoporotic fractures. J Bone Miner Res. 2005; 20(1):131–140. [PubMed: 15619679]
13. Black DM, Palermo L, Nevitt MC, Genant HK, Christensen L, Cummings SR. Defining incident vertebral deformity: a prospective comparison of several approaches. The Study of Osteoporotic Fractures Research Group. J Bone Miner Res. 1999; 14(1):90–101. [PubMed: 9893070]
14. Black DM, Palermo L, Nevitt MC, Genant HK, Epstein R, San Valentin R, Cummings SR. Comparison of methods for defining prevalent vertebral deformities: the Study of Osteoporotic Fractures. J Bone Miner Res. 1995; 10(6):890–902. [PubMed: 7572313]
15. Schousboe JT, Gourlay M, Fink HA, Taylor BC, Orwoll ES, Barrett-Connor E, Melton LJ 3rd, Cummings SR, Ensrud KE. Osteoporotic Fractures in M, Study of Osteoporotic Fractures Research G. Cost-effectiveness of bone densitometry among Caucasian women and men without a prior fracture according to age and body weight. Osteoporos Int. 2013; 24(1):163–177. [PubMed: 22349916]

16. Mullahy J. Specification and testing of some modified count data models. Journal of Econometrics. 1986; 3:341–365.
17. O'Malley CD, Tran N, Zapalowski C, Daizadeh N, Olenginski TP, Cauley JA. Multimorbidity in women with and without osteoporosis: results from a large US retrospective cohort study 2004–2009. Osteoporos Int. 2014; 25(8):2117–2130. [PubMed: 24859882]
18. Kilgore ML, Curtis JR, Delzell E, Becker DJ, Arora T, Saag KG, Morrisey MA. A close examination of healthcare expenditures related to fractures. J Bone Miner Res. 2013; 28(4):816–820. [PubMed: 23074090]
19. Morley JE. Chronic obstructive pulmonary disease: a disease of older persons. J Am Med Dir Assoc. 2014; 15(3):151–153. [PubMed: 24513223]
20. Sennerby U, Melhus H, Gedeborg R, Byberg L, Garmo H, Ahlbom A, Pedersen NL, Michaelsson K. Cardiovascular diseases and risk of hip fracture. JAMA. 2009; 302(15):1666–1673. [PubMed: 19843901]
21. Thompson B, Towler DA. Arterial calcification and bone physiology: role of the bone-vascular axis. Nat Rev Endocrinol. 2012; 8(9):529–543. [PubMed: 22473330]

Highlights

- Vertebral fractures (VFx) are the most common osteoporotic fracture.
- Women with a prevalent radiographic VFx were 21% more likely to be hospitalized for any reason.
- Women with an incident clinical VFx were more likely to be hospitalized irrespective of their prevalent radiographic VFx status.
- A specific association with COPD hospitalization was attenuated by smoking suggesting smoking may be a link between VFx and COPD.

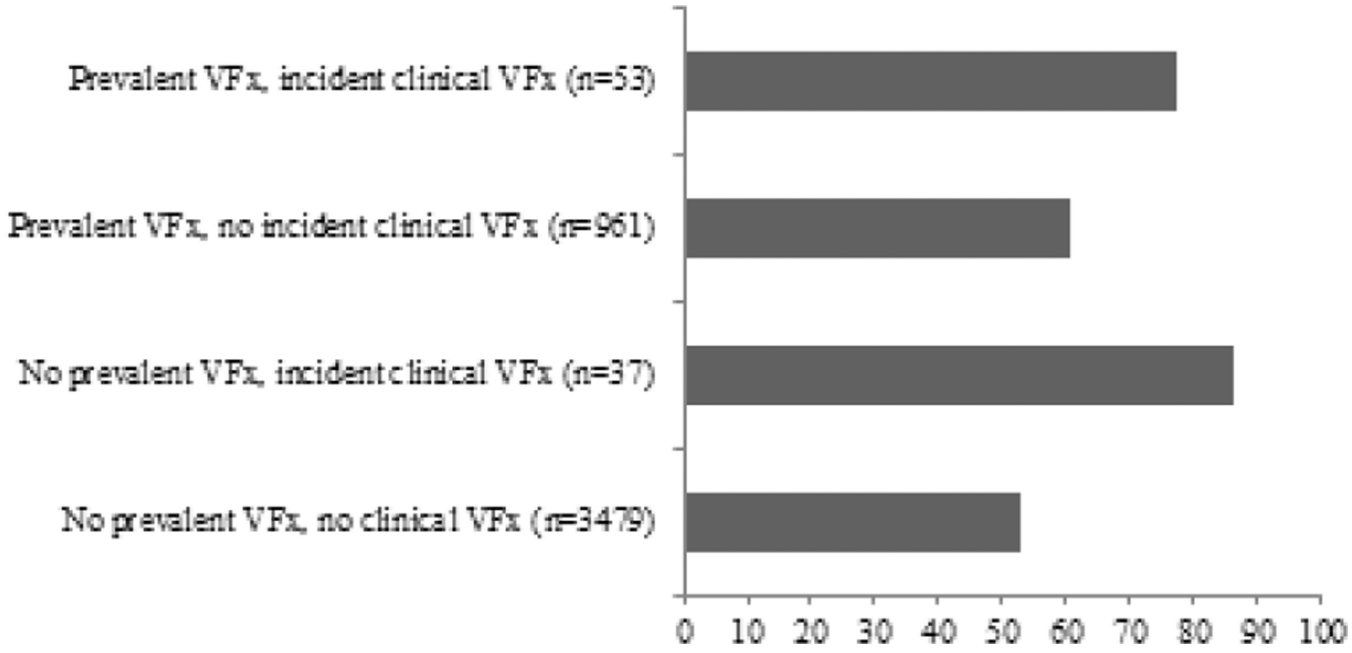

Figure 1.

The percent of women hospitalized over 5 years of follow-up by the combination of prevalent radiographic vertebral fracture and incident clinical vertebral fracture (VFx)

Table 1

Characteristics by Prevalent Vertebral Fracture Status (N=4709)

	Prevalent Vertebral Fractures Status		
	No (n = 3612)	**Yes (n = 1097)**	**p-value**
Age (yr)	74.4 ± 4.7	76.3 ± 5.4	<0.0001
Weight (kg)	67.2 ± 12.6	64.8 ± 12.8	<0.0001
Height (cm)	159.0 ± 5.9	157.1 ± 6.1	<0.0001
Self-reported health status (Excellent/Good)	86.0%	81.7%	0.0009
Myocardial infarction [a]	8.2%	7.2%	0.28
Chronic obstructive pulmonary disease [a]	10.7%	11.6%	0.39
Comorbidity (number) [b]	0.8 ± 0.9	0.8 ± 0.9	0.53
Current smoker [a]	5.5%	8.2%	0.002
Walking speed (m/s)	0.96 ± 0.22	0.90 ± 0.23	<0.0001
IADL impairments (number)	0.7 ± 1.2	0.9 ± 1.4	<0.0001
Femoral neck bone mineral density [c]	0.66 ± 0.11	0.60 ± 0.10	<0.0001

[a] Measurements from Visit 4

[b] Comorbidity included diabetes, stroke, hypertension, congestive heart failure, myocardial infarction, and chronic obstructive pulmonary disease

[c] Measurement from Visit 2.

Table 2

Health Care Utilization (Inpatient Stays) by Prevalent Radiographic Vertebral Fracture Status within 5-year Fee-for-Service + Kaiser Calculation using Logit-Poisson Hurdle model; bootstrapped confidence interval's presented for annualized rate of inpatient days

	Components of Hurdle Model		Annualized Rate of Inpatient Days (95% CI) among ALL patients	
Model	**OR (95% CI) of Hospitalized**	**RR (95% CI) of Inpatient Days among those Hospitalized**	**No Vertebral Fractures**	**Prevalent Vertebral Fractures**
Age-Clinic Adjusted				
Prevalent Vertebral Fracture	1.29 (1.12, 1.49)	1.10 (1.00, 1.23)	1.76 (1.66, 1.85)	2.16 (1.95, 2.38)
MV Adjusted [a]				
Prevalent Vertebral Fracture	1.21 (1.02, 1.44)	1.04 (0.94, 1.16)	1.48 (1.38, 1.57)	1.67 (1.49, 1.84)

[a]Adjusted for age, clinic, weight, health status, walking speed, femoral neck BMD, number of instrumental activities of daily living difficulties and number of comorbidities (diabetes, stroke, congestive heart failure, myocardial infarction or chronic obstructive pulmonary disease).

Table 3

Health Care Utilization (Inpatient Stays) by Prevalent Radiographic and Clinical Vertebral Fracture (VFx) Status within 5-year Fee-for-Service + Kaiser Calculation using Logit-Poisson Hurdle model; bootstrapped confidence interval's presented for annualized rate of inpatient days

	Components of Hurdle Model		Hurdle Model Annualized Rate of Inpatient Days (95% CI) among ALL patients
Model	**OR (95% CI) of Hospitalized**	**RR (95% CI) of Inpatient Days among those Hospitalized**	**No Vertebral Fractures**
Age-Clinic Adjusted			
No Prevalent Radiographic VFx/ No Incident Clinical VFx	1.00 (referent)	1.00 (referent)	1.71 (1.61, 1.81)
No Prevalent Radiographic VFx/ Incident Clinical VFx	5.77 (2.23, 14.96)	1.17 (0.90, 1.49)	3.25 (2.30, 4.11)
Prevalent Radiographic VFx/ No Incident Clinical VFx	1.25 (1.08, 1.45)	1.06 (0.95, 1.18)	2.01 (1.79, 2.23)
Prevalent Radiographic VFx/ Incident Clinical VFx	2.72 (1.41, 5.23)	1.61 (1.14, 2.23)	3.90 (2.72, 5.93)
MV Adjusted [a]			
No Prevalent Radiographic VFx/ No Incident Clinical VFx	1.00 (referent)	1.00 (referent)	1.42 (1.32, 1.51)
No Prevalent Radiographic VFx/ Incident Clinical VFx	5.33 (1.81, 15.71)	1.14 (0.91, 1.46)	2.63 (1.89, 3.34)
Prevalent Radiographic VFx/ No Incident Clinical VFx	1.18 (0.99, 1.42)	1.03 (0.92, 1.16)	1.58 (1.40, 1.78)
Prevalent Radiographic VFx/ Incident Clinical VFx	2.13 (1.05, 4.33)	1.21 (0.93, 1.55)	2.30 (1.61, 3.11)

[a] Adjusted for age, clinic, weight, health status, walking speed, femoral neck BMD, number of instrumental activities of daily living difficulties, smoking status, and number of comorbidities (diabetes, stroke, congestive heart failure, myocardial infarction or chronic obstructive pulmonary disease).