



Published in final edited form as:

J Am Geriatr Soc. 2020 August ; 68(8): 1803–1810. doi:10.1111/jgs.16455.

Racial Disparities Exist in Outcomes After Major Fragility Fractures

Nicole C. Wright, PhD, MPH^{*}, Ligong Chen, PhD^{*}, Kenneth G. Saag, MD, MSc[†], Cynthia J. Brown, MD, MSPH^{‡,§}, James M. Shikany, DrPH[¶], Jeffrey R. Curtis, MD, MS, MPH[†]

^{*}Department of Epidemiology, University of Alabama at Birmingham, Birmingham, Alabama;

[†]Division of Clinical Immunology and Rheumatology, University of Alabama at Birmingham, Birmingham, Alabama;

[‡]Division of Gerontology, Geriatrics, and Palliative Care, University of Alabama at Birmingham, Birmingham, Alabama;

[§]Birmingham/Atlanta VA Medical Center Geriatric Research, Education, and Clinical Center, Birmingham, Alabama;

[¶]Division of Preventive Medicine, University of Alabama at Birmingham, Birmingham, Alabama.

Abstract

BACKGROUND: Fractures associated with postmenopausal osteoporosis (PMO) are associated with pain, disability, and increased mortality. A recent, nationwide evaluation of racial difference in outcomes after fracture has not been performed.

OBJECTIVE: To determine if 1-year death, debility, and destitution rates differ by race.

DESIGN: Observational cohort study.

SETTING: US Medicare data from 2010 to 2016.

PARTICIPANTS: Non-Hispanic black and white women with PMO who have sustained a fragility fracture of interest: hip, pelvis, femur, radius, ulna, humerus, and clinical vertebral.

Address correspondence to Nicole C. Wright, PhD, MPH, Department of Epidemiology, University of Alabama at Birmingham, 1665 University Blvd, RPHB 230N, Birmingham, AL 35294. newright@uab.edu; Twitter handle: @Nic_Wego.

Author Contributions: N.C.W.: Study concept and design, acquisition of data, interpretation of data, and preparation of manuscript.

L.C.: Acquisition of data, analysis and interpretation of data, and preparation of manuscript.

K.G.S.: Study concept and design and preparation of manuscript.

C.J.B.: Study concept and design, interpretation of data, and preparation of manuscript.

J.M.S.: Study concept and design, interpretation of data, and preparation of manuscript.

J.R.C.: Study design, acquisition of data, interpretation of data, and preparation of manuscript.

Conflict of Interest: N.C.W.: Research grants: Amgen; consultant: NortonRose Fulbright/Pfizer.

L.C.: Research grants: Amgen.

K.G.S.: Consultant: Gilead and Radius; research grants and consultant: Amgen.

C.J.B.: None.

J.M.S.: None.

J.R.C.: Research grants and consultant: Amgen, Lilly, and Radius.

Sponsor's Role: The National Institute of Arthritis and Musculoskeletal and Skin Diseases did not play a role in the design, methods, recruitment, data collection, analysis, or preparation of this article.

MEASUREMENTS: Outcomes included 1-year: (1) mortality, identified by date of death in Medicare vital status information, (2) debility, identified as new placement in long-term nursing facilities, and (3) destitution, identified as becoming newly eligible for Medicaid.

RESULTS: Among black and white women with PMO (n = 4,523,112), we identified 399,000 (8.8%) women who sustained a major fragility fracture. Black women had a higher prevalence of femur (9.0% vs 3.9%; $P < .001$) and hip (30.7% vs 28.0%; $P < .001$) fractures and lower prevalence of radius/ulna (14.7% vs 17.0%; $P < .001$) and clinical vertebral fractures (28.8% vs 33.5%; $P < .001$) compared with white women. We observed racial differences in the incidence of 1-year outcomes after fracture. After adjusting for age, black women had significantly higher risk of mortality 1 year after femur, hip, humerus, and radius/ulna fractures; significantly higher risk of debility 1 year after femur and hip fractures; and significantly higher risk of destitution for all fractures types.

CONCLUSIONS: In a sample of Medicare data from 2010 to 2016, black women with PMO had significantly higher rates of mortality, debility, and destitution after fracture than white women. These findings are a first step toward understanding and reducing disparities in PMO management, fracture prevention, and clinical outcomes after fracture.

Keywords

disparities; epidemiology; fractures; osteoporosis

Osteoporosis, the most common age-related metabolic bone disease, affects more than 11 million adults aged 50 years or older in the United States, of which, more than 8 million are women.^{1,2} An additional approximate 35 million adults have low bone mass,^{1,2} which, in the presence of other clinical risk factors, increases the risk for fractures. Hip fractures are the most adverse fracture type associated with osteoporosis. In the United States, a woman's annual lifetime risk of hip fracture is equal to that of breast cancer, ovarian cancer, and uterine cancer combined.³

Studies have found that 25% of patients die within 1 year of experiencing a hip fracture,⁴⁻⁷ with increases in mortality also present following vertebral and other non-vertebral fractures.^{4,6-14} It has also been reported that 50% of hip fracture patients do not return to their prior level of functioning, 20% require extended time in skilled nursing facilities, and the medical expenses associated with fractures result in 10% requiring financial assistance.¹⁵

The vast majority of studies evaluating outcomes after fragility fracture have been performed in primarily non-Hispanic white populations. The few studies that have stratified results by race and ethnicity have found racial differences in outcomes, particularly mortality.¹⁶⁻¹⁸ Data from these studies are relatively old and/or had regional samples, which limits the generalizability of findings, warranting a current national evaluation. There has also been limited research on racial differences in other nonmortality outcomes after fracture.

Given the significant adverse outcomes associated with fragility fractures, and the growing number in older persons of color, it is important to determine whether racial disparities are present in postfracture outcomes. Using a cohort of non-Hispanic black and white women with postmenopausal osteoporosis (PMO) from 2010 to 2016 US Medicare data, the goal of

our study was to determine if racial differences exist in the year after a fragility fracture for the following outcomes: death, debility, and destitution.

METHODS

Population

Our cohort of women with PMO was previously assembled as a part of the Food and Drug Administration 10-year, claims-based pharmacovigilance study of denosumab, 60 mg, for the treatment of PMO.¹⁹ Women with PMO were identified based on age of 65 years or older and any one of the following: osteoporosis diagnosis code, fracture history, or osteoporosis medication at the time of cohort entry. Women were required to have Medicare Parts A, B, and D for at least 12 continuous months before cohort entry, not be enrolled in a Medicare Advantage Plan (Part C), and not have claims related to cancer (ignoring nonmelanoma skin cancer) or Paget's disease 12 months preceding cohort entry.¹⁹ For our evaluation, we further excluded women from other racial and ethnic groups.

Identifying Fragility Fractures

We used a validated fracture identification algorithm²⁰ to identify the fragility fractures most associated with osteoporosis, including hip, pelvis, femur, radius/ulna, humerus, and clinical vertebral, in women with PMO between 2010 and 2015. The fracture algorithm identifies incident fractures using claims meeting one of the following criteria: (1) fracture *International Classification of Disease (ICD)* diagnosis on an inpatient claim in the primary (first) position; (2) fracture *ICD* diagnosis on an inpatient claim in a nonprimary position; or (3) fracture discharge diagnosis on an outpatient physician evaluation and management (E&M) claim paired with a fracture repair code of the same fracture site as the diagnosis code. Incident clinical vertebral fractures can meet criteria 1, 3, or 4. Criterion 4 requires a fracture *ICD* diagnosis on an outpatient claim paired with a physician E&M code and a spine imaging code within 10 days.²⁰ We utilized both *ICD, Ninth Revision (ICD-9)*, and *ICD, Tenth Revision (ICD-10)*, codes for fracture identification. Based on a validation study of 520 fractures that were clinically adjudicated from a large National Institutes of Health-funded cohort study linked to Medicare claims data, our fracture episode algorithm was found to have positive predictive values to identify the fracture sites of interest ranging from 90.9% to 98.6%.²⁰

We further excluded women whose incident fracture had a trauma indicator (*ICD-9E* codes; *ICD-10S*, V-Y codes), women with multiple fractures on the same day who had trauma indicators on the nonincident fracture episode, women who did not have Medicare A + B + D – C coverage at least 12 months before the fracture episode start date, and those whose fracture episode start date did not allow for 1-year follow-up (ie, fracture start date and/or outcome date occurring on same day or fracture occurred on the last day of follow-up) (Figure 1).

Identifying Outcomes

The primary outcomes of this study were death, debility, and destitution. Follow-up for each outcome started at episode start date and ended 1 year after fracture start date or December

31, 2016. We used the date of death from the vital status information from the Medicare beneficiary summary file. The death dates reported by the Centers for Medicare and Medicaid Services (CMS) are linked to multiple databases, including the Medicare Common Working File, the Railroad Retirement Board, and the Social Security Administration, with 99% of death dates having been validated.²¹

We defined debility as new placement in a long-term nursing facility. To identify debility, we used a modified definition of the incident long-term nursing home placement claims-based algorithm developed by Yun and colleagues.²² In our modified definition, the nursing facility claim was required to not be between the admission date and discharge date of a skilled nursing claim.

We defined destitution as becoming newly eligible for Medicaid. We identified Medicaid enrollment by the Medicaid buy-in (payment of Medicare premiums) variable or those who were newly eligible for Part D low-income subsidies.

For both the debility and destitution outcome, we excluded those who either had long-term nursing home stays or Medicaid coverage during the 12-month baseline period (long-term nursing home = 8.3%; Medicaid coverage = 22.1%) (Figure 1).

Statistical Analyses

We described brief demographic characteristics (age, region, Charlson comorbidity index) and PMO indicators of the women with fractures by race using *t*-test for continuous variables and χ^2 test for categorical variables. We calculated the overall incidence of each outcome by race and by fracture site. Next, we calculated the age-standardized 1-year outcome incidence rates (IRs) per 1,000 person-years by race for each fracture site, standardizing the rates to the 2010 Census population aged 65 years or older. We also calculated a composite outcome of all three outcomes. To do so, we used the earliest date of any of the outcomes, censor date (eg, loss of coverage), or 365 days after fracture start date and the follow-up date for the composite outcome. We then used Poisson regression to test if racial differences existed in outcome IRs, with adjustment for age.

We performed a sensitivity analysis in the Medicare 5% sample, a random sample of all Medicare beneficiaries created by CMS for research. The 5% sample was not selected on the basis of osteoporosis, thus allowing us to compare the results between a general sample of older black and white women (who may and may not have osteoporosis) and those selected with PMO. We again calculated outcome incidence and age-standardized IR, and we tested racial differences using Poisson regression.

Last, we evaluated a metric of racial disparity using the number needed to harm principles from clinical trials. Calculated as $[1,000/(\text{outcome IR in black women} - \text{outcome IR in white women})]$, this metric summarizes the expected number of black and white women with fracture to follow for 1 year to observe one additional adverse outcome among black women. The smaller the number, the greater the disparity between the races in the outcomes after fracture.²³

We used SAS version 9.4 (SAS Institute Inc) and Stata v. 16 (Stata Corp) to conduct all analyses. The research was approved by the University of Alabama at Birmingham Institutional Review Board.

RESULTS

Of the 4,523,112 black and white women with PMO from 2000 to 2015, we identified 422,543 (9.3%) women who sustained a fracture, of whom 409,238 (96.9%) sustained one of the major fragility fractures of interest. After exclusions (Figure 1), our final analytic sample included 399,000 women, of whom 11,168 (2.8%) were non-Hispanic black. There were no differences in age at PMO index date (79.3 years; $P = .94$); however, there was a larger prevalence of women in the youngest age group (65–74 years) in black women than in white women (24.8% vs 22.3%; $P < .001$) at the time of fracture. Black women were more likely to have an osteoporosis diagnosis or osteoporosis treatment on the PMO index date compared with white women. The complete descriptive characteristics of the sample are shown in Table 1.

The most prevalent fractures in our sample included clinical vertebral (33.4%), hip (28.1%), and radius/ulna (16.9%) (Table 1). Black women had a significantly higher prevalence of femur (9.0% vs 3.9%; $P < .001$) and hip (30.7% vs 28.0%; $P < .001$) fractures than white women; whereas they had a significantly lower prevalence of radius/ulna (14.2% vs 17.0%; $P < .001$) and clinical vertebral (28.8% vs 33.5%; $P < .001$) fractures (Table 1).

The prevalence of women who experienced death, debility, and destitution outcomes within 1 year of their fracture was 15.5%, 4.0%, and 2.1%, respectively, with 20.3% of women experiencing any one of the three outcomes. Overall, we observed significant differences by race, with black women having significantly higher 1-year mortality (19.6% vs 15.4%; $P < .001$), destitution (2.4% vs 2.0%; $P = .006$), and composite outcome (24.6% vs 20.2%; $P < .001$) (Table 1). When evaluating crude outcome incidence by fracture site, compared with white women, black women had significantly higher incidence of death 1 year after femur, hip, humerus, and radius/ulna fractures (Table 2). Black women had a significantly higher 1-year incidence of debility following femur fractures (6.6% vs 3.9%) compared with white women (Table 2); however, we did not observe any racial differences in 1-year debility after other fracture types evaluated. Black women had a significantly higher incidence of 1-year destitution following femur, hip, humerus, pelvis, and clinical vertebral fractures compared with white women (Table 2). When considering the combination of any one of the three outcomes, compared with white women, black women had significantly higher 1-year outcome incidence, ranging from 13.7% vs 10.3% for radius/ulna fractures to 33.5% vs 26.1% for femur fractures (Table 2).

After accounting for age and standardizing to the 2010 US population aged 65 years or older, we observed similar trends to the crude incidence (Table 2). For example, for hip fracture, the age-standardized IRs per 1,000 person-years in black women were 38.6%, 45.3%, 202.5%, and 37.3% higher for death, debility, destitution, and the composite outcome, respectively, than the IRs in white women (eg, death IR [95% confidence interval {CI}] for $IR_{\text{Black}} = 263.5$ [238.4–290.5] and for $IR_{\text{White}} = 290.1$ [186–193.9]) (Table 2).

To formally test the racial disparity, we used age-adjusted Poisson regression models. Figure 2 displays the IR ratio and the 95% CI by fracture type and outcome. We observed significant racial differences in all outcomes for both femur and hip fractures. For example, for hip fracture, compared with white women, black women had a significant ($P < .001$) 24%, 22%, 2.5-fold, and 22% higher age-adjusted risk of death, debility, destitution, and the composite outcome, respectively, 1 year following fracture (Figure 2). Black women also had significantly higher risk of death, destitution, and the composite outcome in both humerus and radius/ulna fractures (Figure 2). In pelvis fractures, black women had a lower age-adjusted risk of debility (0.72; 95% CI = 0.54–0.96), but had a 2.1-fold higher risk of destitution (2.09; 95% CI = 1.67–2.62) (Figure 2). For clinical vertebral fractures, black women had a 2.3-fold higher risk in 1-year destitution than white women (2.33; 95% CI = 2.09–2.61), with no observed differences in the IRs of the other outcomes of interest (Figure 2).

Sensitivity Analysis in 5% Sample

Using the same inclusion and exclusion with the exception of requiring PMO (no osteoporosis diagnosis codes, medications, or fractures), we identified 55,438 women with fragility fractures from the CMS 5% sample, of whom 2,162 (3.9%) were black. Similar to the PMO results, a larger proportion of black women with fractures were in the 65 to 74 years age group, and there was a higher prevalence of femur and hip fractures and a lower prevalence of radius/ulna and clinical vertebral fractures than in white women. Although point estimates differed, the racial differences in outcomes were similar. Black women in the 5% sample, compared with white women, had on average 62.9%, 19.9%, 186.4%, and 54.0% higher age-standardized 1-year death, debility, destitution, and composite IRs per 1,000 person-years, respectively, for all fractures combined. Likewise, using Poisson regression, we observed that black women had significantly 32%, 2.4-fold, and 24% higher risk of death, destitution, and composite when compared with white women for all fractures combined (data not shown).

Racial Disparity

The racial disparity metric or number needed to harm varied by outcome and fracture site (Table 3). For every 14 hip fractures occurring in black and white women with PMO, one additional black woman died; whereas 74 clinical vertebral fractures are needed for one additional death to be experienced in black women (Table 3). Likewise, for every 11 hip fractures in black and white women, one additional black woman experienced any one of the three outcomes. The disparity in outcomes is greater for more adverse fracture types, like femur and hip, and the disparity is greater for more severe outcomes (eg, death).

DISCUSSION

In this analysis of a national sample of US Medicare data comprising all non-Hispanic black and white women with PMO, we found that between 2010 and 2015, approximately 9% of women sustained one of the six fragility fractures of interest. The black women in our sample had a larger prevalence of femur and hip fractures and a lower prevalence of radius/ulna and clinical vertebral fractures compared with white women. Data on prevalence of

fractures by race and ethnicity are limited, but a study utilizing 1986 to 1990 data from the Medicare 5% sample found that compared to white women, black women had lower rates of many fragility fractures, including 75% lower rates of proximal humerus, 70% lower rates of distal radius/ulna, 69% lower rates of pelvic, and 62% lower rates of hip fracture; whereas there were no significant differences in rates of femur fractures.²⁴ Similar to the previous study, we found lower prevalence of radius/ulna fractures in black women, but unlike this study, we found higher prevalence of hip and femur fractures in black women. Although both studies utilized Medicare data, the previous study utilized the 5% sample, whereas our study utilized women with PMO, who may have an inherent higher fracture risk given the osteoporosis status.

Our primary objective was to evaluate racial differences in the three postfracture outcomes: death, debility, and destitution. Overall, we found that black women with PMO had significantly higher incidence of death compared with white women with PMO. The same was true when observed by fracture site, clearly indicating a racial disparity in 1-year mortality after fracture. We did not observe a racial difference in the overall incidence in 1-year debility. However, we observed differences in debility incidence by fracture site in black compared with white women with PMO, which was limited to the most adverse fracture types (eg, femur and hip). We observed significant racial differences in the overall incidence of destitution after fracture overall as well as by fracture site. The risk of destitution in black women with PMO was twice to three times higher than white women with PMO. Although it is well documented that black women have a lower prevalence of osteoporosis^{1,25} and incidence of hip fractures,²⁶ our findings show that compared with white women with PMO, black women with PMO who fracture have significantly worse clinical outcomes after hip and several other types of fragility fractures.

To our knowledge, there has only been one study evaluating the three outcomes we described. In their analysis of the Medicare 5% sample, Tajeu and colleagues at our institution used propensity score matched hip fracture patients to women without hip fractures.¹⁵ They identified death, debility, and destitution in 28.6%, 20.1%, and 6.6% of hip fracture patients, respectively, but did not evaluate racial differences in the outcomes.¹⁵ Prior studies evaluating racial differences in mortality rates have concentrated on hip fractures, with higher mortality rates observed in black women, ranging from 33% in a study using 1984 to 1987 Medicare data¹⁷ to 13% in an analysis of all New York State hip fractures.¹⁶ Although our study controlled only for age, whereas other studies have adjusted for potential cofounders other than age, our results with respect to hip fracture mortality are in line with previous studies. The goal of this study was to describe the clinical experience of black and white women with fractures; thus, other confounders were not considered at this time. Our study is the first to evaluate racial differences in other fracture outcomes (debility and destitution) and, to our knowledge, there are no studies evaluating racial differences in mortality outcomes for other fracture types, specifically focusing on black and white populations.

A major strength of our study was the use of a cohort that captures all women with PMO in Medicare; however, this comes with some limitations. These women had to meet coverage requirements and not be enrolled in a Medicare Advantage Plan. Medicare Advantage Plans

are not required to submit individual claims, thus making outcome and exposure ascertainment more difficult. Although excluding these individuals is common practice in Medicare-based studies, it does limit the generalizability of findings. Although the use of the PMO cohort is a strength, women with PMO may have higher overall fracture incidence, again limiting our generalizability. To evaluate our findings in a more generalizable cohort of Medicare beneficiaries, we conducted a sensitivity analysis in the Medicare 5% sample. The women in the 5% sample analysis did not have to meet the PMO criteria, and although point estimates were different, we observed similar increases in each of the outcomes among black women in the 5% sample as we did in the women with PMO. For both the debility and destitution analyses, we excluded women with evidence of long-term nursing home and Medicaid coverage in the baseline period, resulting in a reduction in sample size, again limiting generalizability of our study. Although excluding women with a history of long-term nursing home stays reduced our sample size, it provided an unbiased estimate of new debility. Excluding women with Medicaid coverage in the baseline had a more significant impact on our sample size, particularly our black population. According to CMS, nearly 40% of those with dual Medicare-Medicaid coverage are persons of color.²⁷ The exclusion of dual eligible women could have implications of healthcare utilization, medication coverage, and facility quality metrics; however, this was not the goal of our study. One of our goals was to evaluate how a fracture impacts finances in older women, and our findings clearly show that a fracture is associated with detrimental financial effects on black women at greater rates than white women. Last, although our study also utilized a highly valid algorithm to identify fractures, our algorithm was designed to have higher specificity than sensitivity, potentially missing real fractures that were neither hospitalized nor repaired.

CONCLUSIONS

To our knowledge, this is the first comprehensive evaluation of fracture events and novel outcomes after fracture by race. Our study shows that black women with PMO experience worse outcomes after fragility fractures than their white counterparts. Future studies are needed to explain why these disparities exist, with ultimate goals of developing interventions and/or programs to mitigate and reduce disparities in fracture outcomes.

ACKNOWLEDGMENTS

Financial Disclosure: This work was sponsored by the National Institutes of Health/National Institute of Arthritis and Musculoskeletal and Skin Diseases 1K01AR068400.

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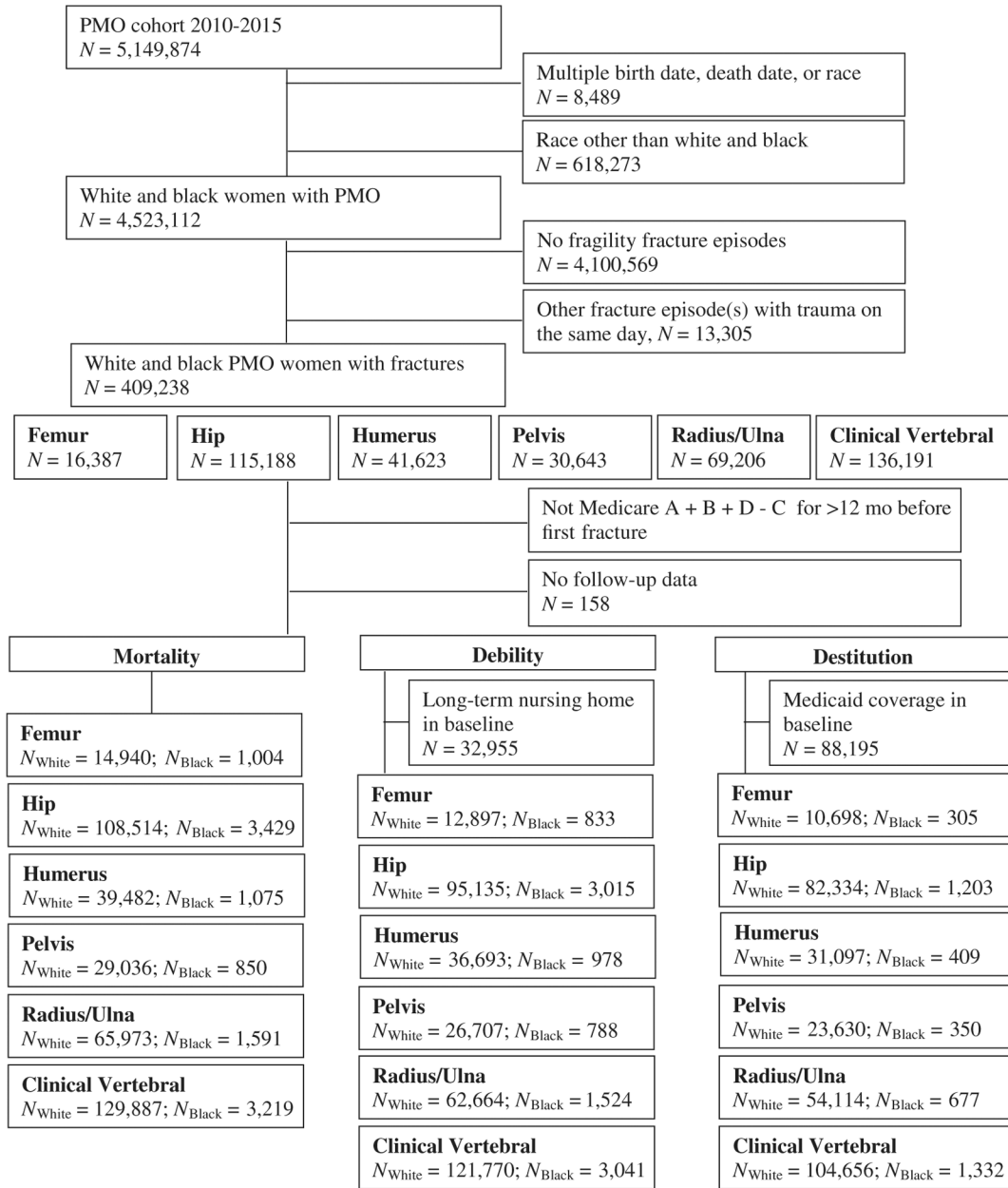


Figure 1. Identification of white and black postmenopausal osteoporosis (PMO) with fractures by outcome.

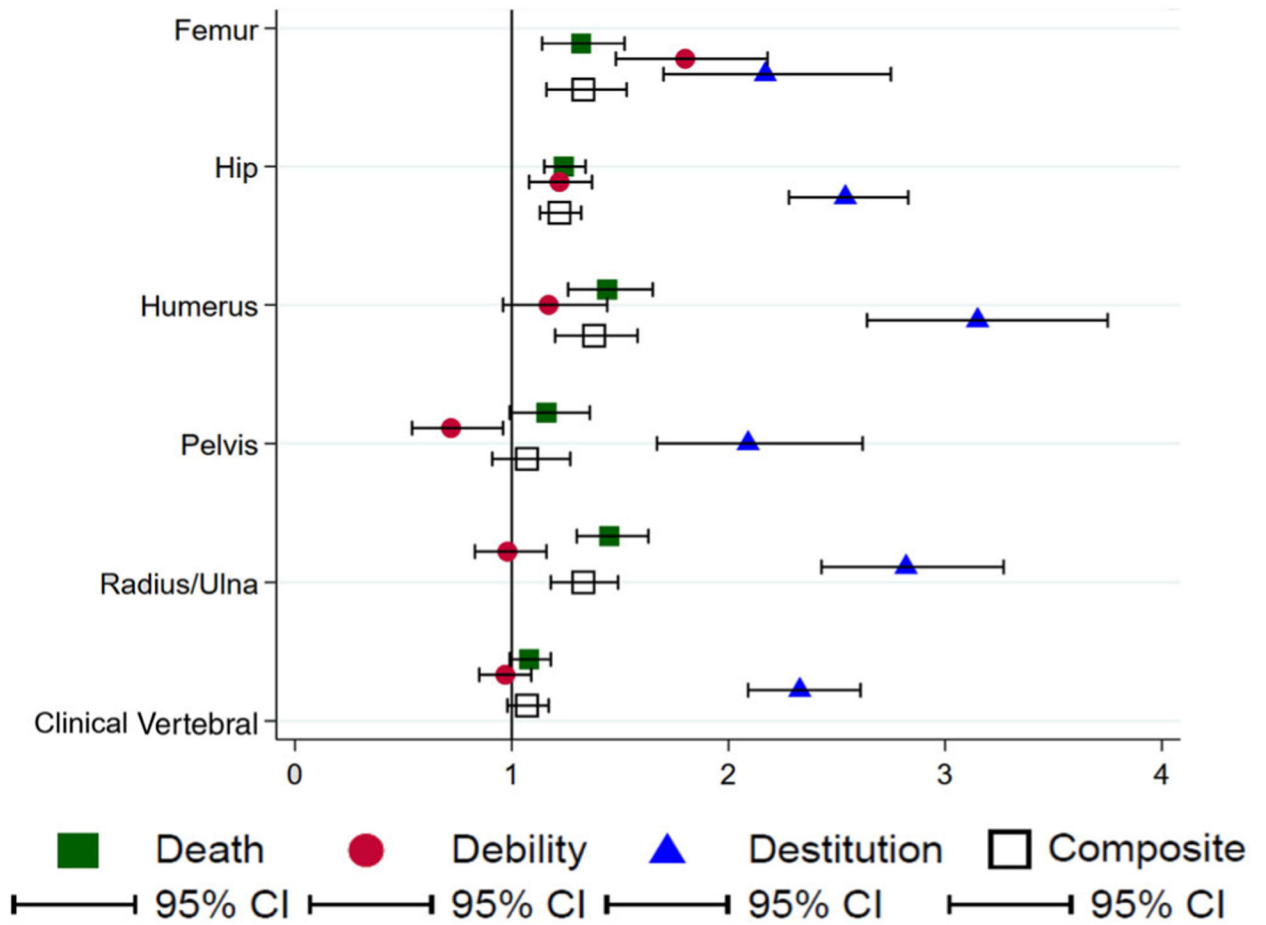


Figure 2. Incidence rate ratio of postfracture outcomes by fracture type in black women compared to white women with postmenopausal osteoporosis. To the right of the line of unity (1), a higher incidence rate of postfracture outcomes in black women compared with white women; to the left of the line, a lower incidence rate of postfracture outcomes in black women compared with white women. If the confidence interval (CI) crosses the line the unity, then no difference in risk is observed between black and white women.

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Demographic and Outcome Characteristics of Women With PMO With Fragility Fracture Identified in 2010 to 2015 by Race

Table 1.

Characteristics	Total (N = 399,000)	White (N = 387,832 [97.2%])	Black (N = 11,168 [2.8%])	P Value ^a
Age on PMO date, mean (SD), y	79.3 (8.0)	79.3 (8.0)	79.3 (8.5)	.94
PMO indicators, No. (%) ^b				
OP diagnosis	37,206 (9.3)	35,726 (9.2)	1,480 (13.3)	<.001
Fragility fracture diagnosis	4,084 (1.0)	3,928 (1.0)	156 (1.4)	<.001
OP treatment	13,836 (3.5)	13,268 (3.4)	568 (5.1)	<.001
Age on fracture date, mean (SD), y	81.5 (8.0)	81.5 (8.0)	81.3 (8.6)	.05
Age on fracture date, y, No. (%)				
65–74	89,326 (22.4)	86,552 (22.3)	2,774 (24.8)	<.001
75–84	155,206 (38.9)	151,087 (39.0)	4,119 (36.9)	
85	154,468 (38.7)	150,193 (38.7)	4,275 (38.3)	
Region, No. (%)				
Northeast	82,369 (20.6)	80,487 (20.8)	1,882 (16.9)	<.001
Midwest	103,618 (26.0)	101,541 (26.2)	2,077 (18.6)	
South	160,119 (40.1)	153,583 (39.6)	6,536 (58.5)	
West	52,894 (13.3)	52,221 (13.5)	673 (6.0)	
Charlson score, No. (%) ^c				
0	165,757 (41.5)	163,045 (42.0)	2,712 (24.3)	<.001
1	50,425 (12.6)	48,977 (12.6)	1,448 (13.0)	
2	182,818 (45.8)	175,810 (45.3)	7,008 (62.8)	
Fracture site, No. (%)				
Femur	15,944 (4.0)	14,940 (3.9)	1,004 (9.0)	<.001
Hip	111,943 (28.1)	108,514 (28.0)	3,429 (30.7)	<.001
Humerus	40,557 (10.2)	39,482 (10.2)	1,075 (9.6)	.06
Pelvis	29,886 (7.5)	29,036 (7.5)	850 (7.6)	.62
Radius/ulna	67,564 (16.9)	65,973 (17.0)	1,591 (14.2)	<.001
Clinical vertebral	133,106 (33.4)	129,887 (33.5)	3,219 (28.8)	<.001
Outcomes, No. (%)				
Death	61,913 (15.5)	59,724 (15.4)	2,189 (19.6)	<.001

Characteristics	Total (N = 399,000)	White (N = 387,832 [97.2%])	Black (N = 11,168 [2.8%])	P Value ^a
Debility	16,103 (4.0)	15,642 (4.0)	461 (4.1)	.62
Destitution	8,203 (2.1)	7,933 (2.0)	270 (2.4)	.01
Composite	80,944 (20.3)	78,199 (20.2)	2,745 (24.6)	<.001

Abbreviations: OP, osteoporosis; PMO, postmenopausal osteoporosis.

^a P-value assessed via χ^2 test for categorical variables and t-test for continuous variables.

^b PMO indicators on PMO index date.

^c Charlson score calculated using Romano version.²⁸

Table 2.

Incidence and Age-Standardized IRs of Postfracture Outcomes by Race and Fracture Site

Femur												
Outcome	White (N = 14,940/12,897/10,698/14,940) ^d					Black (N = 1,004/833/305/1,004) ^d						
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)
Death	3,245	12,614	21.7	185.4 (177.7–193.4)	285	803	28.4**	280.6 (240.8–325.1)				
Debility	499	10,869	3.9	39.7 (35.7–44.0)	55	648	6.6**	67.2 (47.3–92.7)				
Destitution	368	9,068	3.4	33.7 (29.6–38.2)	21	236	6.9**	83.8 (45.6–141.2)				
Composite	3,893	12,117	26.1	240.0 (230.9–249.3)	336	757	33.5**	358.7 (312.3–410.2)				
Hip												
Outcome	White (N = 108,514/95,135/82,334/108,514) ^d					Black (N = 3,429/3,015/1,203/3,429) ^d						
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)
Death	24,825	90,938	22.9	190.1 (186.4–193.9)	957	2,775	27.9**	263.5 (238.4–290.5)				
Debility	3,041	79,461	3.2	34.2 (32.3–36.1)	113	2,396	3.7	49.7 (37.4–64.9)				
Destitution	3,038	68,441	3.7	36.2 (34.1–38.5)	107	945	8.9	109.5 (76.3–152.3)				
Composite	29,519	87,489	27.2	245.3 (240.9–249.8)	1,115	2,650	32.5	336.8 (306.9–368.8)				
Humerus												
Outcome	White (N = 39,482/36,693/31,097/39,482) ^d					Black (N = 1,075/978/409/1,075) ^d						
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)
Death	4,790	36,363	12.1	101.3 (98.0–104.7)	184	958	17.1**	161.0 (135.8–189.5)				
Debility	1,784	32,831	4.9	43.0 (40.8–45.3)	55	849	5.6	56.5 (41.4–75.4)				
Destitution	723	28,567	2.3	21.2 (19.4–23.1)	29	360	7.1	82.2 (51.5–124.6)				
Composite	6,775	34,779	17.2	152.9 (148.8–157.2)	248	910	23.1	236.7 (204.7–272.2)				
Pelvis												
Outcome	White (N = 29,036/26,707/23,630/29,036) ^d					Black (N = 1,075/978/409/1,075) ^d						
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)
Death	5,242	25,502	18.1	145.5 (138.6–152.6)	175	738	20.6	188.6 (149.9–234.4)				
Debility	1,315	22,776	4.9	46.8 (42.5–51.3)	28	671	3.6	36.2 (21.4–57.2)				

Radius/Ulna										
Outcome	White (N = 65,973/62,664/54,114/65,973) ^d					Black (N = 1,591/1,524/677/1,591) ^d				
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)		
Death	4,112	63,614	6.2	51.7 (50.0–53.4)	144	1,509	9.1**	80.4 (67.0–95.5)		
Debility	2,480	59,031	4.0	34.8 (33.4–36.3)	61	1,412	4.0	36.0 (27.2–46.8)		
Destitution	791	52,056	1.5	13.1 (12.1–14.1)	27	638	4.0	36.0 (23.2–53.5)		
Composite	6,820	61,639	10.3	90.4 (88.1–92.7)	218	1,457	13.7	126.6 (109.5–145.7)		

Clinical Vertebral										
Outcome	White (N = 129,887/121,770/104,656/129,887) ^d					Black (N = 3,219/3,041/1,332/3,219) ^d				
	N _E	PY	I	Age-Standardized IR (95% CI)	N _E	PY	I	Age-Standardized IR (95% CI)		
Death	17,510	118,980	13.5	113.2 (111.0–115.3)	444	2,960	13.8	126.7 (113.6–141.0)		
Debility	6,523	108,113	5.4	44.4 (43.1–45.7)	149	2,705	4.9	48.5 (40.0–58.2)		
Destitution	2,345	95,417	2.2	20.1 (19.0–21.2)	66	1,214	5.0**	46.4 (34.6–60.9)		
Composite	24,376	113,761	18.8	164.8 (162.2–167.5)	615	2,827	19.1	187.2 (170.7–204.9)		

Note. I = (NE/NPopulation) * 100; IR = (NE/PY) * 1,000. IRs standardized to 2010 US Census. Incidence *P* values calculated based on two-sample test of proportions.

Abbreviations: CI, confidence interval; I, incidence; IR, incidence rate; NE, number of events; PY, person-years.

^dTotal population count by outcome: death/debility/destitution/composite.

** *P* < .001.

Table 3.

Racial Disparity in Composite Outcome by Fracture Type

Outcome	Femur	Hip	Humerus	Pelvis	Radius/Ulna	Clinical Vertebral
Death	11	14	17	23	35	74
Debility	36	65	74	-94	833	244
Destitution	20	14	16	33	44	38
Composite	8	11	12	28	28	45

Note. The racial disparity calculated as $[1,000/(IR_{Black} - IR_{White})]$ summarizes the expected number of black and white women with fracture to follow for 1 year to observe one additional adverse outcome among black women. The smaller the number, the greater the disparity between the races in the outcomes after fracture.