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Prevalent Vertebral Fractures in Black Women and White Women

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ABSTRACT: Vertebral fractures are the most common osteoporotic fracture. Hip and clinical fractures are less common in black women, but there is little information on vertebral fractures. We studied 7860 white and 472 black women ≥65 yr of age enrolled in the Study of Osteoporotic Fractures. Prevalent vertebral fractures were identified from lateral spine radiographs using vertebral morphometry and defined if any vertebral height ratio was >3 SD below race-specific means for each vertebral level. Information on risk factors was obtained by questionnaire or examination. Lumbar spine, total hip, and femoral neck BMD and BMC were measured by DXA. The prevalence of vertebral fractures was 10.6% in black and 19.1% in white women. In age-adjusted logistic regression models, a 1 SD decrease in femoral neck BMD was associated with 47% increased odds of fracture in black women (OR = 1.47; 95% CI, 1.12–1.94) and 80% increased odds in white women (OR = 1.80; 95% CI, 1.68–1.94; interaction $p = 0.14$). The overall lower odds of fracture among black women compared with white women was independent of femoral neck BMD and other risk factors (OR = 0.51; 95% CI, 0.37–0.72). However, the prevalence of vertebral fractures increased with increasing number of risk factors in both groups. The prevalence of vertebral fractures is lower in black compared with white women but increases with age, low BMD, and number of risk factors.
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Key words: osteoporosis, vertebral fracture, race/ethnicity, black, white, women

INTRODUCTION

Vertebral fractures are the hallmark of osteoporosis. They are the most common osteoporotic fracture, with prevalence estimates ranging from 10–15% among women 50–59 yr of age to 50% among women ≥85 yr of age.[1–5] About 700,000 vertebral fractures occur each year in the United States. Women with vertebral fractures experience decreased survival[6–9] and are at an increased risk of future vertebral, hip, and other nonspine fractures.[10–13] Vertebral fractures are also associated with chronic back pain, limitations with common activities of daily living, and reduced quality of life.[14,15]

The lifetime risk of any fracture in black women[16–18] is about one half that for white women, but these figures are primarily based on nonvertebral fractures. Jacobsen et al.[19] compared hospital discharge rates for vertebral fractures using the Medicare tapes in white women and black women. The greatest rate of discharge at 17.1 per 10,000 person-years was found for white women compared with 3.7 per 10,000 person-years for black women. The prevalence of vertebral fractures was probably underestimated because the study was limited to clinical vertebral fractures that were identified at hospital discharge. Clinical vertebral fractures account for ~27% and ~23% of all fractures in white women and black women, respectively.[20] Only about one fourth to one third of vertebral fractures are clinically recognized.[21,22] To our knowledge, no study has examined morphometrically defined vertebral fractures in black versus white women.

In this study, we examined the prevalence of radiographic vertebral fractures in 472 black women and 7860 white women ≥65 yr of age enrolled in the Study of Osteoporotic Fractures (SOF). We tested the hypothesis that low BMD will be associated with an increased likelihood of having a prevalent vertebral fracture and that the magnitude of the association will be similar in black women and white women. We examined the prevalence of vertebral fractures by age and number of risk factors in both black women and white women. Finally, we tested the hypothesis

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that a lower prevalence of vertebral fractures among black women will be independent of BMD and other risk factors for vertebral fractures.

MATERIALS AND METHODS

Study population

We enrolled 9704 white women into the SOF from 1986 to 1988 using population-based listings in Baltimore, MD; Minneapolis, MN; Portland, OR; and the Monongahela Valley near Pittsburgh, PA. To be eligible to participate, women had to be ≥65 yr of age and ambulatory. We excluded women who reported a bilateral hip replacement. Details of the cohort study have been published.[23] In this study, we analyzed 7860 white women who had a technically adequate hip BMD measurement at the second examination (1988–1990) and vertebral morphometry from spinal radiographs (1986–1988).

Black women were originally excluded from the SOF because of their low incidence of hip fractures. At a sixth SOF examination conducted between 1996 and 1998, we enrolled 662 black women ≥65 yr of age. Of these, 472 black women returned for a clinic visit 2 yr later (1998–2000). BMD and lateral spine films were obtained at this second visit. Race was self-declared, and only women designating themselves as black were enrolled. Because the black women were recruited later in SOF, we targeted women ⩾70 yr of age.

Bone measurements

BMC and BMD of the total hip and the femoral neck were measured by DXA using Hologic QDR 1000 and 2000 scanners (Bedford, MA, USA). Lumbar spine BMD and BMC was measured in white women using QDR 1000. For black women, we estimated lumbar spine BMD from whole body scans, and the region of interest (ROI) differs from the lumber spine ROI. Details of the measurement and densitometry quality control procedures have been published elsewhere.[24,25] In brief, a random sample of scans was reviewed by technicians at a quality control center. In addition, all scans flagged by the technicians for certain problems (such as difficulty defining bone edges) were reviewed at the quality control center. To assess longitudinal performance of the scanners, an anthropometric spine phantom was scanned daily, and a hip phantom was scanned once per week at each clinic. We calculated T-scores for the femoral neck based on race-specific reference values using the National Health and Nutrition Examination Survey (NHANES III).[26] Areal BMD measurements are based on bone length and width. Because they do not include bone depth, the measurements only partially adjust for bone size. To test whether a volumetric measurement of BMD is a better predictor of fracture occurrence, we also calculated the femoral neck bone mineral apparent density (BMAD) using the formula[27] BMC per area^2 (g/cm^3).

Vertebral morphometry

Lateral radiographs of the thoracic and lumbar spine were taken in accordance with current guidelines.[28] Quantitative vertebral morphometry was performed as previously described[29] to calculate the anterior (Ha), middle (Hm), and posterior (Hp) height for each vertebral body from T_4 to L_4. For white women, radiographs were first screened for probable fractures, using methods described previously[30] to reduce the number undergoing morphometric measurements. Briefly, highly trained technicians separated sets of radiographs into three groups: normal, uncertain, and probably fractured, using a binary semiquantitative grading scheme that classified women by the most abnormal vertebral level on her follow-up films. Those that were uncertain were further classified by the study radiologist as normal or probably fractured. Morphometry on paired films was performed for women classified as probably fractured. For black women, we performed morphometry an all radiographs to generate race-specific normal means and standardizations for vertebral heights and their ratios. As shown in Figs. 1A–1F, the norms for the vertebral height ratios were similar in white and black women across each vertebral level. All discrepancies between the morphometry and initial review of radiographs were adjudicated.

Definitions of vertebral fractures

A vertebra was classified as having a prevalent fracture on the baseline radiograph if any of the following ratios were >3 SD below the trimmed normal mean[31] for that vertebral level: (Ha/Hp), (Hm/Hp), or a combination of (Hpi/Hpi±1 and Hai/Hai±1).[30] 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 fracture, as defined in this study, was 97%.[30,32]

Other measurements

Body weight was measured using a balance beam scale and height was measured using the Harpenden stadiometer (Holtain, Crymych, UK). Body mass index (BMI) was calculated as the weight in kilograms divided by the square of height in meters. Participants were asked to stand up from a chair without using their arms five times. This was coded as able or unable; if able, time to complete the five chair stands was recorded in seconds. Grip strength (kg) was measured in both arms using a hand-held dynamometer. The average of both the right and left grip was used in the analyses. Participants also completed a questionnaire and interview that collected information on demographics, lifestyle (current smoking, alcohol use), fractures and falls history, and medical and family history. Information was obtained on whether participants walked as a form of exercise and whether they had difficulty performing any of the following instrumental activities of daily living (IADLS): walking two or three blocks, climbing up 10 steps, walking down 10 steps, preparing meals, doing heavy housework, or grocery shopping. The number of difficult activities was summed. Participants were asked to bring all prescription and over-the-counter medications to the clinic for verification of use. Dietary calcium intake was estimated using a modified Block food frequency questionnaire[33] and ex-

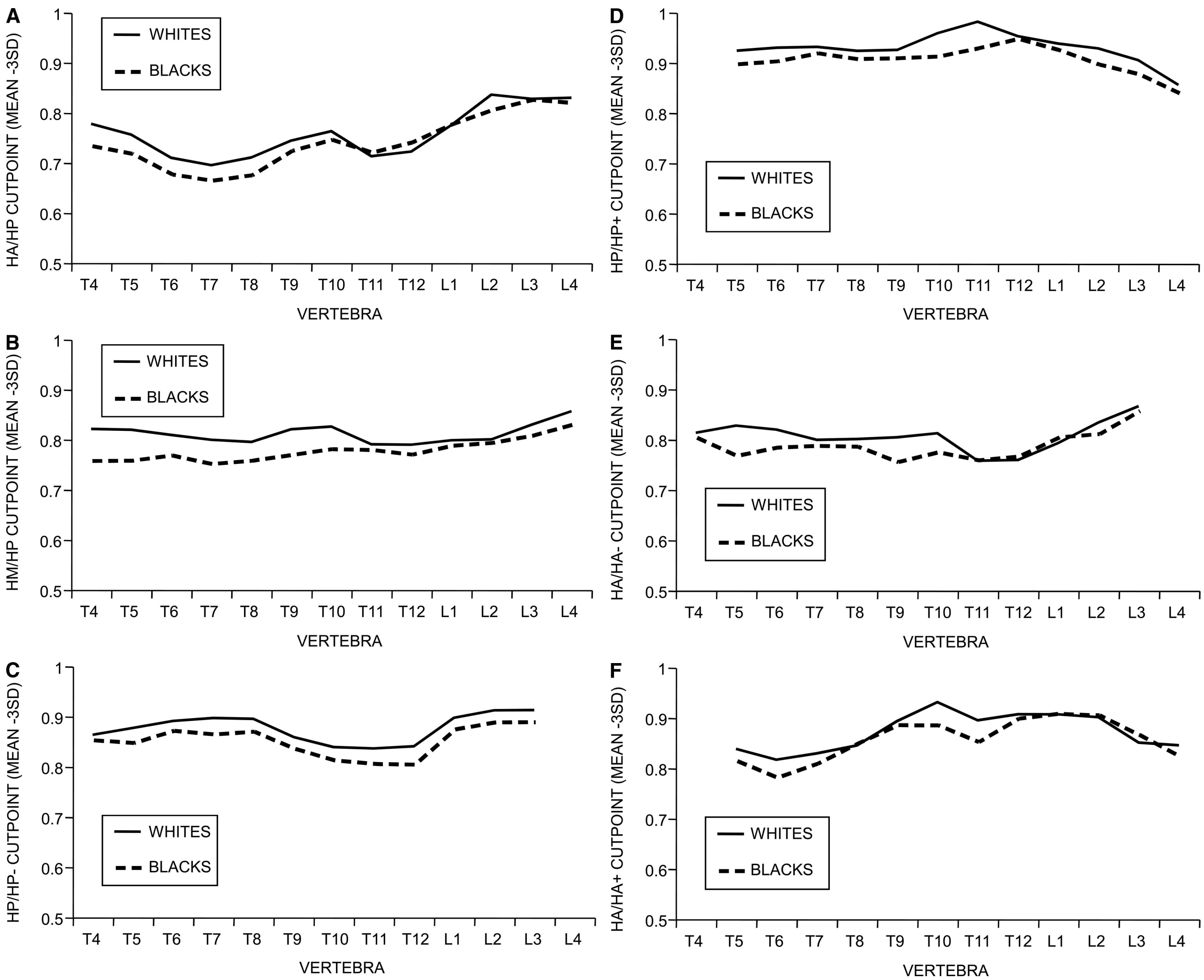

FIG. 1. Mean normative vertebral height ratios for white and black women by vertebral level: (A) Ha/Hp; (B) Hm/Hp; (C) Hp/Hp−; (D) Hp/Hp+; (E) Ha/Ha−; and (F) Ha/Ha+.

pressed in milligrams per day. Self-reported health status in comparison with women of the same age was reported as excellent, good, fair, poor, or very poor.

Statistical analyses

The characteristics of black women and white women who had a fracture were compared with women who did not have a fracture within race/ethnic group using *t*-tests for continuous variables and χ^2 tests for categorical variables. We used least squared means to test whether the bone measures differed by prevalent vertebral fracture status adjusting for age. We used logistic regression models to estimate the OR of fracture and the 95% CI for each SD decrease in BMC, BMD, or BMAD. Tests for race × bone measure interactions were carried out. The SD for each site was determined from the combined cohort of women. To compare the predictive value of various measurements, we analyzed the areas under receiver operating characteristic curves using the C statistic. We initially examined the age-adjusted relationship between BMD and prevalent vertebral fracture. Because of the major effect of body weight on BMD,[34] we adjusted separately for age and body weight. Variables were included in the multivariable model if they differed by fracture status ($p < 0.10$) in either ethnic group. In the multivariable model, we adjusted for age, body weight, height, grip strength, uses arms to stand, walks for exercise, current calcium supplements, past and current hormone use, fracture history, health status, difficulty with ≥1 IADLS, falls in the past year, diabetes, and chronic obstructive pulmonary disease (COPD). Multivariable models were run in the combined sample with race/ethnicity coded as a dummy variable (black = 1; white = 0). We calculated the odds of having a vertebral fracture in black women compared with white women after adjusting for age, BMD, and other risk factors. If differences in BMD and risk factors contribute to ethnic differences in vertebral fractures, we would expect to see attenuation in the OR for race in analyses adjusting for these factors. Finally, we examined the prevalence of vertebral fractures by age and number of risk factors. We included the risk factors that were significant at $p < 0.10$ in the femoral neck multivariable BMD model. For continuous variables, women were consid-

TABLE 1. CHARACTERISTICS OF WHITE WOMEN AND BLACK WOMEN BY PREVALENT VERTEBRAL FRACTURE STATUS: MEAN (SD) OR PERCENT

	White		*Black*	
	No fracture	*Fracture*	*No fracture*	*Fracture*
N (%)	6360 (80.9)	1500 (19.1)	422 (89.4)	50 (10.6)
Age (yr)	70.9 (4.9)	72.9 (5.6)*	76.9 (4.8)	78.7 (4.9)†
Weight (kg)	67.7 (12.4)	65.6 (12.0)*	75.8 (15.6)	68.0 (17.1)†
Height (cm)	159.7 (5.9)	158.1 (6.2)*	157.9 (6.3)	156.4 (5.9)
BMI (kg/m^2)	26.5 (4.6)	26.2 (4.3)‡	30.4 (6.0)	27.7 (6.4)†
Grip strength (kg)	21.2 (4.2)	20.4 (4.6)*	19.7 (5.1)	17.8 (5.3)‡
Uses arms to stand (%)	2.6	5.2*	17.1	16.0
Walk for exercise (%)	52.8	50.1	40.5	36.0
Alcohol (1+ drinks/last month) (%)	29.1	29.0	28.7	30.0
Current smoker (%)	9.2	10.8	7.6	10.0
Past smoker (%)	30.3	28.9	31.7	40.0
Dietary calcium intake (mg/d)	718 (421)	723 (433)	638 (352)	626 (430)
Current calcium supplement (%)	41.3	50.7*	29.0	29.2
Current hormone use (%)	14.5	13.9	16.1	11.1
Past hormone use (%)	28.9	25.2	21.2	26.7
Health status				
Fair, poor, very poor (%)	14.6	17.9†	31.1	42.0
Difficulty ≥ 1 IADLS (%)	32.3	37.2†	49.3	56.0
Any falls last 12 mo (%)	29.1	31.4	27.1	38.0
Fall ≥ 2 last 12 mo (%)	10.0	11.3	9.5	16.0
Fractures after age 50 (%)	32.4	51.2*	21.1	36.0‡
Diabetes (%)	6.8	5.5	16.2	24.0
COPD (%)	8.5	11.4†	13.5	20.0
Hypertension (%)	37.3	39.3	64.5	54.0
Osteoarthritis (%)	19.6	19.1	20.0	30.0

* $p < 0.0001$.
† $p < 0.01$.
‡ $p < 0.05$.

ered to have the risk factor if they were in the lowest tertile. Risk factors included low femoral neck BMD (<0.60 g/cm^2), using arms to stand, height (≤156.7 cm), health status (fair or worse), calcium supplement use, estrogen use (past or current), COPD, diabetes, and positive fracture history. χ^2 tests were carried out to examine whether the prevalence of fracture differed by the number of risk factors in both white women and black women and the interaction between race and number of risk factors.

RESULTS

Overall, black women were older, had a greater body weight and BMI, were more likely to report fair, poor, or very poor health status, and were less likely to report a fracture after age 50, to walk for exercise, or to currently use calcium supplements than white women (Table 1). Use of hormone therapy did not differ by race, nor did alcohol use or smoking status. A higher proportion of black women were not able to stand from a chair without using their arms and reported difficulty with at least one IADL. Compared with white women, COPD, diabetes, and hypertension were more common among black women. A similar proportion of both races reported osteoarthritis and a history of at least one fall in the past year.

Eleven percent of black women had at least one prevalent vertebral fracture compared with 19.1% of white women (Table 1). Of those with a fracture, 32% of black women compared with 40% of white women had two or more prevalent fractures. The black women who had a prevalent vertebral fracture were older and had a lower body weight, BMI, and grip strength than black women who did not have a prevalent vertebral fracture (Table 1). Compared with white women who did not have a prevalent vertebral fracture, white women who had a fracture were older, had a lower body weight and BMI, lower grip strength, were twice as likely to use their arms to stand from a chair, and were more likely to report calcium supplement use, fair/poor or very poor health status, difficulty with at least one IADL, fracture after age 50, and a history of COPD. A higher proportion of women with a vertebral fracture reported falls in the past year, but this observation was of borderline significance in whites ($p = 0.07$) and blacks ($p = 0.10$).

In both white women and black women, the mean BMD and BMC of the total hip, femoral neck, and lumbar spine and femoral neck BMAD were lower among women who had a prevalent vertebral fracture compared with women who did not have a fracture (Table 2). A higher proportion of both white (41.7%) and black women (30%) who had a fracture had a femoral neck T-score of –2.5 or less.

In white women and black women, respectively, after adjusting for age, the OR of vertebral fracture per 1 SD decrease in BMD was 1.88 (95% CI, 1.75, 2.01) and 1.85

TABLE 2. AGE-ADJUSTED MEAN BMD, BMC, OR BMAD (95% CI) BY PREVALENT VERTEBRAL FRACTURE STATUS IN WHITE WOMEN AND BLACK WOMEN

	White		*Black*	
	No fracture (n = 6360)	*Fracture (n = 1500)*	*No fracture (n = 422)*	*Fracture (n = 50)*
Total hip				
BMD (g/cm^2)	0.77 (0.768, 0.774)	0.70 (0.698, 0.711)*	0.83 (0.82, 0.85)	0.75 (0.71, 0.79)*
BMC (g)	29.5 (29.4, 29.7)	27.3 (27.0, 27.6)*	29.0 (28.4, 29.5)	26.3 (24.7, 27.9)†
Femoral neck				
BMD (g/cm^2)	0.66 (0.656, 0.661)	0.61 (0.60, 0.61)*	0.75 (0.74, 0.76)	0.69 (0.65, 0.73)†
BMC (g)	3.2 (3.19, 3.22)	3.0 (2.9, 3.0)*	3.9 (3.8, 3.9)	3.6 (3.4, 3.8)‡
BMAD (g/cm^3)	0.14 (0.138, 0.139)	0.13 (0.126, 0.129)*	0.15 (0.14, 0.15)	0.14 (0.13, 0.15)‡
Femoral neck T-score§				
T-score (mean)	–1.71 (–1.74, –1.69)	–2.16 (–2.21, –2.11)*	–1.41 (–1.51, –1.32)	–1.81 (–2.09, –1.54)†
T-score > –1	20.6%	9.3%	29.6%	18.0%
T-score < –1 and > –2.5	58.6%	48.9%	56.4%	52.0%
T-score ≤ –2.5	20.8%	41.7%*	14.0%	30.0%‡
Lumbar spine BMD¶				
BMD (g/cm^2)	0.87 (0.866, 0.875)	0.80 (0.789, 0.807)*	0.96 (0.939, 0.981)	0.86 (0.798, 0.923)†
BMC (g)	49.2 (48.86, 49.46)	44.0 (43.32, 44.57)*	48.2 (46.58, 49.83)	39.2 (34.40, 44.03)*

* $p < 0.001$ for no fracture vs. fracture within race.
† $p < 0.01$ for no fracture vs. fracture within race.
‡ $p < 0.05$ for no fracture vs. fracture within race.
§ Race-specific reference values used for calculation of T-scores.
¶ Lumbar spine BMD and BMC estimated from whole body scans in black women.

(95% CI, 1.36, 2.52) for the total hip and 1.80 (95% CI, 1.68, 1.94) and 1.47 (95% CI, 1.12, 1.94) for the femoral neck; all increases were statistically significant ($p < 0.05$; Table 3). Similar associations were found for BMAD and lumbar spine BMD. The areas under receiver operating characteristic curves (AUCs) for BMD of the total hip, femoral neck, and lumbar spine were similar in white women and black women. The association between bone mass measurements and prevalent vertebral fracture did not differ by race (femoral neck BMD × race interaction, $p = 0.14$; BMC × race interaction, $p = 0.95$; BMAD × race interaction, $p = 0.86$). Additional adjustment for body weight and other risk factors had only a modest effect on the association between BMD and prevalent vertebral fractures in white women but resulted in greater attenuation of the OR in black women.

Total hip, femoral neck, and lumbar spine BMC were related to prevalent vertebral in white women but not in black women. Within each racial group, the prevalence of vertebral fractures was highest among women with the lowest tertile of femoral neck BMC, BMD, and BMAD (Fig. 2). Nevertheless, at every bone mass level, the prevalence was lower in black women.

The prevalence of vertebral fracture increased with increasing age and number of risk factors in each group (Fig. 3). The prevalence of vertebral fractures was two to three times higher in women with four to eight risk factors compared with women with zero to one risk factors at every age group.

In age-adjusted models, black women had 67% lower odds of having a vertebral fracture (Table 4). Further adjustments for femoral neck BMD and other risk factors resulted in some attenuation, but the odds of having a prevalent vertebral fracture was still ~50% lower for black women compared with white women.

DISCUSSION

The prevalence of vertebral fractures was 11% in black women compared with 19% in white women; this prevalence was 45–50% lower among black women compared with white women even after adjusting for age, BMD, and other risk factors for fracture. The lower prevalence of vertebral fractures among black women is consistent with the lower incidence of all fractures including hip fractures observed in black women.[16–18] Age-specific prevalence of vertebral fractures have been reported for European women,[35] U.S. white women,[36] Asian women in Hawaii,[37] Hiroshima,[37] Taiwan,[38] and Beijing,[39] and Latin Americans.[40] The prevalence of vertebral fractures is on average in all these groups ~25%, >2-fold higher than we observed among black women. Despite large geographic differences in hip fracture across the world, the prevalence of vertebral fractures is actually very similar. In contrast, black women have a lower prevalence of both vertebral fractures and hip fractures.

We showed that reduced BMD of the total hip and femoral neck is associated with increased odds of having a prevalent vertebral fracture in both black women and white women. The magnitude of the association between low total hip BMD and prevalent vertebral fracture was similar in both groups. However, the association between femoral neck BMD and prevalent vertebral fractures was weaker and nonsignificant in multivariable-adjusted models in black women. The association between BMC and vertebral fractures was weaker than observed for BMD in white women and nonsignificant in black women. This may be because BMC makes no correction for bone size. These results are similar to what we observed for incident nonspine fractures.[41]

TABLE 3. OR (95% CI) FOR PREVALENT VERTEBRAL FRACTURE FOR 1 SD DECREASE IN BMD, BMC, OR BMAD: AGE, AGE AND BODY WEIGHT, AND MULTIVARIABLE-ADJUSTED MODELS

	White		*Black*	
	OR (95% CI)	*AUC*	*OR (95% CI)*	*AUC*
Age alone*	1.42 (1.35, 1.49)	0.603	1.40 (1.07, 1.84)	0.613
Total hip BMD				
Age adjusted	1.88 (1.75, 2.01)	0.681	1.85 (1.36, 2.52)	0.694
Age and body weight	2.08 (1.92, 2.25)	0.689	1.70 (1.20, 2.41)	0.692
Multivariate†	2.03 (1.87, 2.20)	0.712	1.49 (1.00, 2.23)	0.737
Total hip BMC				
Age adjusted	1.53 (1.43, 1.63)	0.649	1.69 (1.20, 2.39)	0.655
Age and body weight	1.69 (1.56, 1.83)	0.655	1.44 (0.95, 2.18)	0.657
Multivariate†	1.60 (1.47, 1.74)	0.686	1.19 (0.75, 1.91)	0.718
Femoral neck BMD				
Age adjusted	1.80 (1.68, 1.94)	0.672	1.47 (1.12, 1.94)	0.655
Age and body weight	1.92 (1.77, 2.08)	0.676	1.32 (0.99, 1.77)	0.659
Multivariate†	1.81 (1.67, 1.97)	0.701	1.12 (0.81, 1.54)	0.718
Femoral neck BMC				
Age adjusted	1.47 (1.38, 1.57)	0.641	1.47 (1.08, 2.00)	0.649
Age and body weight	1.49 (1.39, 1.60)	0.642	1.28 (0.92, 1.78)	0.652
Multivariate†	1.41 (1.30, 1.52)	0.677	1.06 (0.73, 1.52)	0.715
Femoral neck BMAD				
Age adjusted	1.53 (1.43, 1.65)	0.646	1.50 (1.05, 2.15)	0.658
Age and body weight	1.52 (1.41, 1.63)	0.645	1.35 (0.94, 1.95)	0.662
Multivariate†	1.49 (1.38, 1.61)	0.682	1.14 (0.77, 1.69)	0.718
Lumbar spine BMD‡				
Age adjusted	1.78 (1.65, 1.93)	0.660	1.62 (1.17, 2.24)	0.660
Age and body weight	1.87 (1.71, 2.03)	0.662	1.45 (1.03, 2.05)	0.659
Multivariate†	1.82 (1.66, 1.99)	0.695	1.23 (0.85, 1.78)	0.708
Lumbar spine BMC‡				
Age adjusted	1.80 (1.66, 1.96)	0.659	1.74 (1.26, 2.40)	0.672
Age and body weight	1.94 (1.77, 2.13)	0.662	1.60 (1.12, 2.28)	0.670
Multivariate†	1.86 (1.69, 2.05)	0.692	1.34 (0.90, 2.00)	0.707

* OR per 5-yr increase in age.

† Multivariable model includes adjustment for age, body weight, height, grip strength, uses arms to stand, walks for exercise, current calcium supplements, past and current hormone use, health status, difficulty with ≥1 IADLS, falls in past 12 mo, fracture history, diabetes, and COPD.

‡ Lumbar spine BMD and BMC estimated from whole body scans in black women.

AUC, area under receiver operating characteristic curves.

We hypothesized that if BMAD provides an accurate estimate of volumetric BMD, we may find a stronger association because BMAD would compensate for ethnic differences in bone size. However, there was no evidence that our estimate of volumetric BMD was more strongly associated with prevalent vertebral fractures than areal BMD measures of the hip. Nevertheless, we were limited to estimated volumetric BMD at the hip. We did not have volumetric measurements of the spine, and it is possible that associations with spine volumetric BMD may be stronger. We have previously shown that lumbar spine areal BMD was more strongly associated with incident vertebral fractures than hip BMD, at least in white women.[42] In this analysis, there was no evidence in either group that lumbar spine BMD was more strongly associated with vertebral fracture. We were, however, limited to estimating lumbar spine BMD in black women using whole body scans, and the region of interest is not directly comparable to the direct measure of lumbar spine BMD.

At the same BMD level, the prevalence of vertebral fracture was lower among black women. However, areal BMD measures provide little information on the material composition of bone and its structural design, two properties that determine bone strength.[43] Ethnic differences in trabecular number, thickness and connectivity, cortical thinning and porosity, periosteal apposition, and bone remodeling all likely contribute to the lower prevalence of vertebral and hip fractures in black women. Finally, the heritability of BMD is very high,[44] and it is likely that genetic factors contribute to the lower risk of vertebral fracture among black women. Greater European admixture in U.S. blacks has been associated with lower BMD.[45]

The prevalence of vertebral fractures increased with age and number of risk factors in both black women and white women. We included many risk factors for vertebral fractures but it is possible that other factors may also affect the likelihood of fracture such as sex steroid hormones,[46] inflammatory markers,[47] and vitamin D levels, although vitamin D deficiency is more common in blacks than whites.[48] Our results suggest that screening efforts should focus on older women with multiple risk factors to potentially identify women who are likely to have a prevalent vertebral fracture. Underdiagnosis of vertebral fracture is a worldwide problem.[49] Use of DXA to measure vertebral

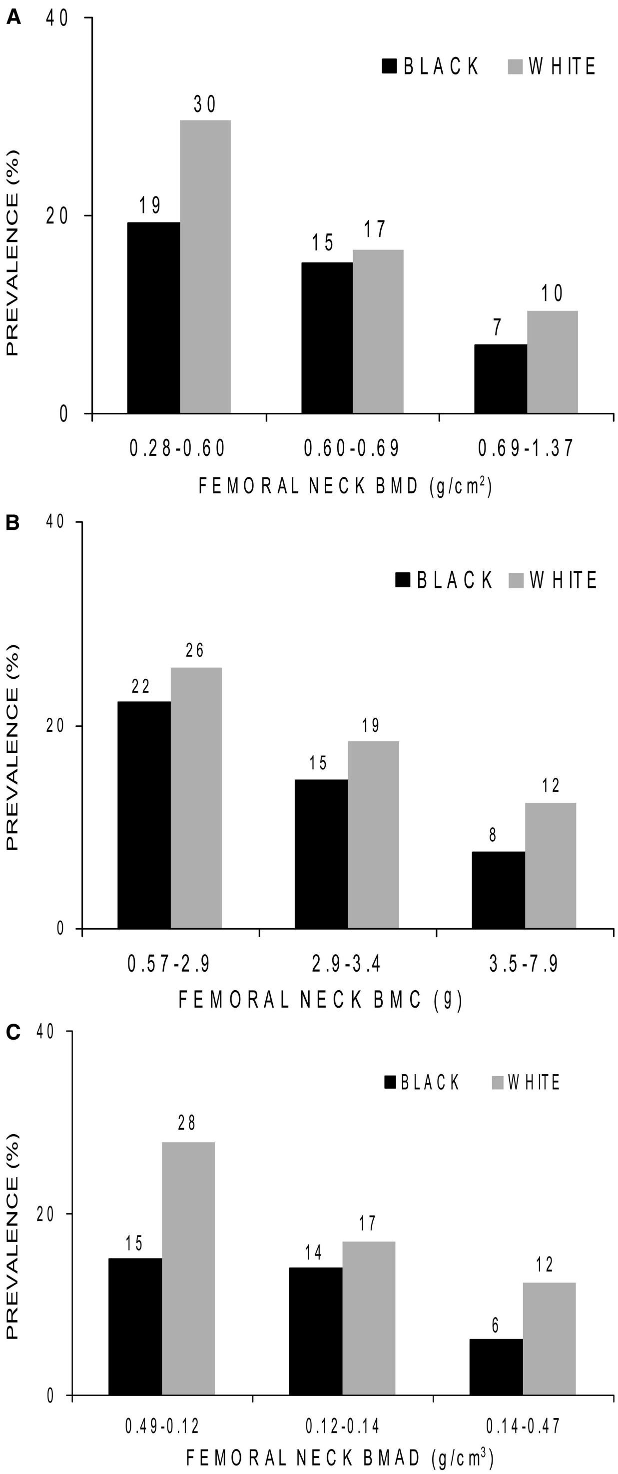

FIG. 2. Prevalence (%) of vertebral fractures by tertiles of femoral neck BMD, BMC, and BMAD in white women and black women.

morphometry may be more cost-effective to identify women with prevalent vertebral fractures who have a high absolute risk of fracture and may be more likely to benefit from pharmacological therapy.[50] Treatment of women

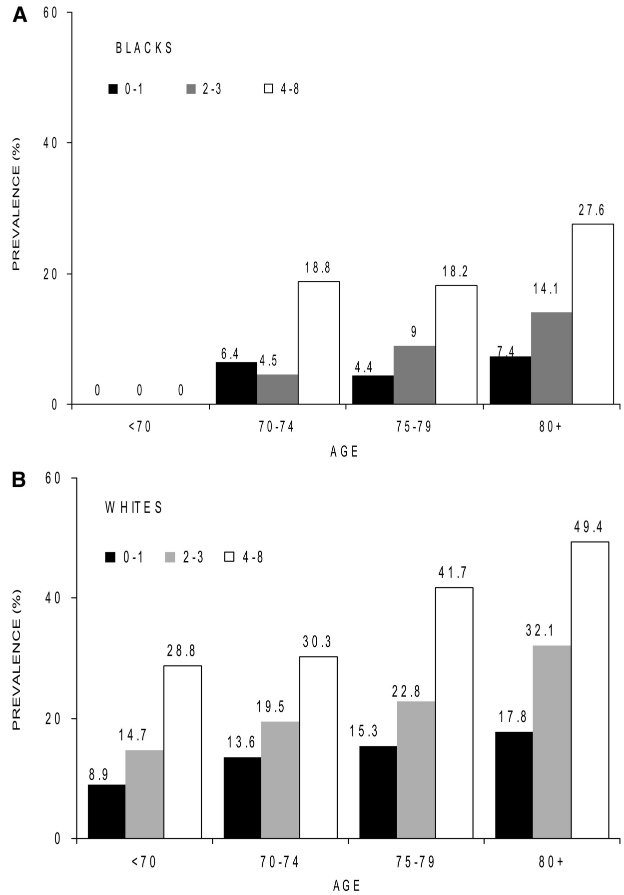

FIG. 3. Prevalence (%) of vertebral fractures by age and the number of risk factors in white women and black women. The number of black women in each age group was as follows: <70, n = 10; 70–74, n = 146; 75–79, n = 168; and 80+, n = 120. The number of white women in each age group was as follows: <70, n = 3382; 70–74, n = 2401; 75–79, n = 1169; and 80+, n = 632. For continuous variables, the risk factor was considered present for women in the lowest tertile. Risk factors included low femoral neck BMD (<0.60 g/cm^2), using arms to stand, height (≤156.7 cm), health status (fair or worse), calcium supplement use, estrogen use, COPD, diabetes, and positive fracture history.

with asymptomatic vertebral fractures has been shown to reduce future hip and vertebral fractures[51–54] and reduce disability.[55]

Strengths of our study include our well-characterized cohort of both black and white community-dwelling women. We used standard clinical measures of BMD, state of the art vertebral morphometry, and included a number of important risk factors for fracture. There are, however, some limitations. Although we used a population-based listing for recruitment, the women were volunteers and thus may be healthier and have a lower prevalence of vertebral fracture. Women in our analytical sample were somewhat healthier than those excluded, which may also contribute to an underestimation of the prevalence of vertebral fractures. However, this healthy bias was present for both white women and black women and should not influence these comparisons. The number of black women was relatively

TABLE 4. OR (95% CI) FOR PREVALENT VERTEBRAL FRACTURE IN BLACK WOMEN COMPARED WITH WHITE WOMEN

Adjustments	*OR (95% CI)*
Age alone	0.33 (0.25, 0.45)
Femoral neck BMD plus	
Age	0.56 (0.40, 0.76)
Age and multivariable model	0.51 (0.37, 0.72)
Femoral neck BMAD plus	
Age	0.40 (0.29, 0.54)
Age and multivariable model[a]	0.40 (0.29, 0.56)
Total hip BMD plus	
Age	0.49 (0.36, 0.67)
Age and multivariable model[a]	0.45 (0.32, 0.63)

Multivariable model = adjustment for age, body weight, height, grip strength, uses arms to stand, walks for exercise, current calcium supplements, past and current hormone use, health status, difficulty with ≥1 IADLS, fracture history, diabetes, and COPD.

small, especially in stratified analyses, and we had limited power to identify correlates of vertebral fractures in this group. We used a cross-sectional design, and prospective studies of risk factors for incident vertebral fractures in black women are needed. Race/ethnicity was self-declared, and we had no information on European admixture, which has been shown to range from 12% to 23% in blacks.[56] Hip BMD was measured 2 yr after the spine radiographs in the white women. Finally, we estimated lumbar spine BMD from whole body scans in the black women and directly measured BMD in the spine in white women. These measurements are not directly comparable.

In conclusion, prevalent radiographic vertebral fractures are more common among older white women compared with black women. They are associated with older age, lower BMD, and a larger number of risk factors in both black women and white women. Identification of women with multiple risk factors and appropriate treatment could reduce their fracture burden.

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