

Osteoporosis Epidemiology, Diagnosis, and Management Across Race and Ethnicity in the United States

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Abstract

Osteoporosis is a systemic skeletal disease of reduced bone strength that leads to an increased risk of fragility fracture. Osteoporosis epidemiology, diagnosis, and management all are influenced by race and ethnicity. Studies have found approximately 40% to 50% lower fracture rates in Black and Asian as compared to White women. Hispanic women have generally been shown to have lower fracture rates than White women, but the magnitude of difference is uncertain. Studies in men are fewer. Substantial differences in bone density and structure contribute to these differences in fracture rates.

The diagnosis of osteoporosis can be made by prior fragility fracture, bone mineral density T-score of less than or equal to -2.5 , or by high calculated fracture score using the Fracture Risk Assessment Tool (FRAX). FRAX in the United States incorporates race, which has the effect of lowering calculated risk for Asian, Black, and Hispanic people by 0.43 to 0.64. In regard to pharmacotherapy, while not all trials have reported efficacy by race, there are not major known differences in osteoporosis treatment efficacy by race. Atypical femur fractures, rare subtrochanteric or diaphyseal fractures, are at least 6 times more common in Asian patients with antiresorptive therapies. Finally, there are important disparities in osteoporosis by race, including lower screening rates, lower treatment rates, and worse outcomes after fracture. Our review examines these racial differences in osteoporosis and provides an approach to incorporate race into the osteoporosis treatment algorithm. We advocate for a more aggressive approach to screening, treatment, and inclusion in research for patients of all races at risk of poor outcomes, acknowledging racial disparities in postfracture outcomes.

Key Words: Osteoporosis, race, ethnicity, Asian, Black, Hispanic

Abbreviations: AFF, atypical femur fracture; ASBMR, American Society of Bone and Mineral Research; BMD, bone mineral density; DXA, dual-energy x-ray absorptiometry; FRAX, Fracture Risk Assessment Tool; HR-pQCT, high-resolution peripheral quantitative computed tomography; NHANES, National Health and Nutrition Examination Survey; TBS, trabecular bone score.

Osteoporosis is a systemic skeletal disease characterized by decreased bone strength and microarchitectural deterioration, leading to increased bone fragility and susceptibility to fractures. In the United States, approximately 54 million adults have osteoporosis or have low bone mass (1, 2). In the United States, race and ethnicity play an important role in the diagnosis, evaluation, and management of osteoporosis. The purpose of this review is to analyze the epidemiology of osteoporosis and fractures as it relates to race in the United States. We will consider the role of race in osteoporosis, evaluate the evidence, and consider if and how race should affect clinicians' management of osteoporosis.

Methods

Our review was written after performing comprehensive literature searches of each individual subtopic (eg, epidemiology, diagnosis, treatment of osteoporosis, and race) using PubMed and Google Scholar. In some cases, individual drug trials were searched. Multiple variants of each key word

were used to capture relevant articles, and we focused on articles that used sound and clear methodology and preferred studies that may better reflect more general populations, rather than studies of individual medical centers.

Terminology

Race is widely recognized as a social construct, often serving as a proxy for factors such as national origin, cultural practices, and various social determinants of health. Importantly, substantial social and genetic diversity exists within racial categories. Race and ethnicity are also self-identified, and people can change their identification over time (3). For these reasons, race is an imprecise variable in clinical decision-making.

In this review, we will refer to people of Hispanic ethnicity within these racial categories, as they are often considered in the context of osteoporosis; however, people of Hispanic ethnicity can be of any race. For the purposes of this review, "White" will refer to non-Hispanic White individuals, "Black" will refer to non-Hispanic Black individuals, and

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“Hispanic” will refer to Hispanic ethnicity individuals of any race.

Epidemiology of Fragility Fractures in the United States

Race plays a role in the evaluation and management of osteoporosis in the United States because large studies have found substantial differences in fracture rates by race (Table 1) (4-14). These studies demonstrate approximately 40% to 50% lower rate of fracture in US Asian and Black women as compared to White women. Native American women have similar rates of fracture as White women, though studies are much fewer. Finally, there is uncertainty about the rate of fracture in Hispanic women with conflicting studies showing widely varying fracture rates. While some studies have suggested fracture rates for Hispanic women to be 50% or lower than White women, others have shown more modest differences (eg, 0%-30% lower) (5, 6, 8-11). It is possible that the conflicting results in these studies are related to methodologies, but it should be noted there is considerable heterogeneity in fracture rates among countries from which Hispanic people originate (Fig. 1) (15). For example, Mexico has a rate of hip fracture of 173 per 100 000, while Brazil has a hip fracture rate of 141 per 100 000 and Columbia has a hip fracture rate of 104 per 100 000. We do not have data for some countries in which there are a considerable number of Hispanic immigrants in the United States, such as the Dominican Republic, Cuba, or El Salvador. This heterogeneity likely appears to apply to US Hispanic people as well—a study demonstrated variability in fracture rates among Hispanic subgroups, showing that, for example, Cuban American women had a 56% higher hip fracture rate than Mexican American women (16). This concept applied to Asian subgroups as well, as studies have shown higher rates of fracture in South Asian and Japanese as compared to Chinese women but lower fracture rates in Filipina women (17, 18). These studies add nuance to our understanding of race and ethnicity and complicate simple categorization. Of note, the majority of fracture studies in US Asian, Black, Hispanic, and Native American people have been in women, and there are fewer studies conducted in men.

Racial Disparities in Fracture Outcomes

There are substantial differences described in outcomes after fracture in different racial and ethnic populations in the United States. Operative management after fracture differs across racial and ethnic groups. A New York–based study of nearly 200 000 patients showed a higher risk of delayed hip surgery after sustaining a hip fracture in Black and Asian patients compared to White patients (19). A meta-analysis of operative management following more than 740 000 hip, distal radius, pelvic, tibial plateau, clavicle, femoral neck, or femoral shaft fractures found White individuals had greater than 30% higher odds of receiving operative management compared to non-White or Black races (20).

Perhaps even more important, studies have also shown differences in morbidity and mortality after fracture. An analysis of Medicare claims data by Wright et al (21) categorized outcomes after fragility fracture in nearly 400 000 Black or White women with postmenopausal osteoporosis and found Black women had higher rates of 1-year mortality (19.6% vs 15.4%), new placement in long-term nursing facilities

Table 1. Large incident fracture studies investigating differences in fracture rates by race and ethnicity

Author, y	Study design	Size	Sex and age, y	Racial composition	Fracture rates by race
Baron et al, 1996 (4)	Retrospective cohort, Medicare patients 1986-1990	94 673 fracture cases	Women and men, >65	Racial composition not provided	For proximal humerus, distal forearm, and hip fractures, rate ratios in Black vs White: Women: ratio 0.25-0.43 Men: ratio 0.45-0.60
Lauderdale et al, 1998 (5)	Retrospective cohort, Medicare patients 1992-1993	897 786 or more	Women and men, >65	Hispanic: 897 786. White and Black comparator groups, not specified	Hip fracture rates per 1000 presented as figure Women: White ~10, Black ~4, Mexican Am ~8.8, Cuban Am ~7.9, Puerto Rican ~6 Men: White ~4, Black ~3, Mexican Am ~4, Cuban Am ~3.0, Puerto Rican ~2.1
Fang et al, 2004 (6)	Retrospective cohort, NY state data 1998-2002	92 276 hip fracture cases	Women and men, >50	Racial composition not provided	Annual age-adjusted hip fracture hospitalization per 100 000: Women White: 459 Black: 137 Hispanic: 143 Asian: 174 Men White: 230 Black: 109

(continued)

Table 1. Continued

Author, y	Study design	Size	Sex and age, y	Racial composition	Fracture rates by race
Cauley et al, 2005 (SOF) (7)	Prospective cohort recruited from 4 US sites	10 340	Women, >65	White: 93.8% Black: 6.2%	Hispanic: 87 Asian: 104 Incidence of nonspine fracture over mean 6.1 y: White: 21.9% Black: 9.1%
Barrett-Connor et al, 2005 (NORA) (8)	Prospective cohort recruited from 4000+ primary care offices in US	162 321 with follow-up fracture data available	Postmenopausal women only, >50	White: 92.1% Black: 3.6% Asian: 0.8% Hispanic: 2.7% Native Am: 0.8%	Annual rate of any fracture: White: 1.5% Black: 0.8% Hispanic: 1.7% Asian: 0.7% Native Am: 1.8%
Cauley et al, 2007 (WHI) (9)	Prospective cohort and clinical trials at 40 US sites	159 579	Postmenopausal women only, 50-79	White: 83.7% Black: 9.2% Hispanic: 4.1% Asian: 2.6% Native Am: 0.4%	Annualized rate of any fracture (except fingers, toes, skull sternum): White: 2.0% Black: 0.9% Hispanic: 1.3% Asian: 1.2% Native Am: 2.0%
Wright, et al, 2012 (10)	Retrospective cohort, Medicare patients 2000-2009	821 475 women, 632 162 men per 2-y period (average)	Women and men, >65	White: 88.3% Black: 7.9% Asian: 1.4% Hispanic: 1.6% Other: 0.7%	Age-adjusted annual hip fracture rate per 100 000 in 2008-2009: Women White: 975 Black: 412 Hispanic: 691 Asian: 494 Men White: 526 Black: 353 Hispanic: 425 Asian: 262
Lo et al, 2014 (11)	Retrospective cohort of patients in managed health care system in California, 2006-2012	10 493	Women, >50	For hip fracture White: 81.2% Black: 2.9% Hispanic 6.5% Asian: 5.4% Other: 3.9% For diaphyseal fracture: White: 47.7% Black: 4.7% Hispanic: 8.3% Asian: 34.7% Other: 4.7%	Age-adjusted incidence in 2012 per 100 000: For hip fracture: White: 288 Black: 87 Hispanic: 198 Asian: 148 For diaphyseal fracture: White: 5 Black: 10 Hispanic: 6 Asian: 27
Berry et al, 2016 (12)	Retrospective cohort, Medicare patients 2007-2010	892 837	Women and men, >65 in long-stay facilities	White: 83.9% Black: 12.0% Hispanic: 1.8% Asian: 1.0%	Incidence rate of hip fracture in ≥85 per 100 person-y: White: 2.6 Black: 1.3

(continued)

Table 1. Continued

Author, y	Study design	Size	Sex and age, y	Racial composition	Fracture rates by race
Amir et al, 2019 (13)	Retrospective cohort, Medicare patients 2008–2013	1 136 262	Women and men, >65 in long-stay facilities	Native Am: 0.4% Other: 0.6%	Hispanic: 2.1 Asian: 2.2 Native Am: 3.7 Lower rates with similar differences by race in ages 65–74 and 75–84
Jain et al, 2025 (14)	Retrospective cohort of patients in managed health care system in California, 2015–2019	96 914	Women and men with diabetes, >65	White: 55.2% Black: 9.7% Asian: 20.7% Hispanic: 14.5%	Standardized incidence ratio of hip fracture per 100 person-y: White: 2.05 Black: 0.82 Native Am: 2.16 Incidence of major osteoporotic fracture over mean 4.3 y: White: 6.8% Black: 2.9% Hispanic: 5.7% Asian: 3.5%

Abbreviations: Am, American; NORA, National Osteoporosis Risk Assessment; SOF, Study of Osteoporotic Fractures; WHI, Women's Health Initiative.

(6.6% vs 3.9%), and becoming newly eligible for Medicaid (2.4% vs 2.0%) compared to White women. Following hip fracture, studies have shown Black, Asian, and Hispanic patients were more likely to be discharged to home, rather than rehabilitation compared to White patients (22, 23). Functional status scores at discharge and at 3- to 6-month follow-up were lower in Black and Hispanic patients (22). Interestingly, in a managed care system (Kaiser Permanente), of more than 17 000 patients who underwent hip fracture surgery, Black patients had a similar 1-year mortality, and Hispanic and Asian patients had lower 1-year mortality compared to White patients (24). This latter study may suggest that many of the disparities seen in Black, Hispanic, and Asian patients after fracture are related to access to care and treatment in the health-care system itself.

Bone Density and Bone Structure

Fracture rates vary across racial and ethnic groups due to differences both in bone mineral density (BMD) and bone structure. Dual-energy x-ray absorptiometry (DXA) reports areal BMD, which is bone mineral content divided by bone area and is expressed as g/cm². This is a 2-dimensional measure that underestimates true volumetric bone density in people with small bones and overestimates BMD in people with large bones (25). Differences in BMD have been consistently observed in different racial and ethnic groups. It should be noted that some of the differences could be related to differences in weight, which is often not controlled in studies looking across race.

In a study of bone mass accrual for healthy participants aged 9 to 25 years, Black females demonstrated 10% higher mean BMD as measured by DXA compared to White, Asian, and Hispanic females. Measures of both volumetric and areal BMD were higher in Black females at all skeletal sites. For young Black males, mean spine BMD was also 3% greater than White males (26). For adults, National Health and Nutrition Examination Survey (NHANES) BMD data from 2005 to 2008 adjusted for age and sex showed that Black participants have 6% higher lumbar spine BMD and 9% to 10% higher femoral neck BMD compared to White participants (27). Despite the higher BMD in Black people, data suggest that BMD may be less predictive of fracture for Black compared to White individuals (9, 28, 29).

In contrast to Black females, Asian females have lower whole-body and femoral neck BMD compared to White and Hispanic females. Using whole-body bone mineral content by height ratio to adjust for bone size, young Asian females had lower measures than White and Hispanic females (26). For Asian women aged 65 to 74 years including Hong Kong Chinese and South Korean women, the total hip and spine BMD is 4% to 7% lower than White women (30). The observed lower BMD in Asian females is significantly affected by body and bone size. High-resolution peripheral quantitative computed tomography (HR-pQCT), a 3-dimensional imaging modality, demonstrated that total volumetric BMD (rather than areal BMD) in young Chinese women was 10.3% higher than in White women with greater cortical thickness and density (31). Thus, the lower areal BMD measurement in Asian people on DXA is an artifact of their small bone size.

There are relatively few data about differences in bone density in Hispanic populations. Interpreting the existing data is more complicated because of the variety of different origins

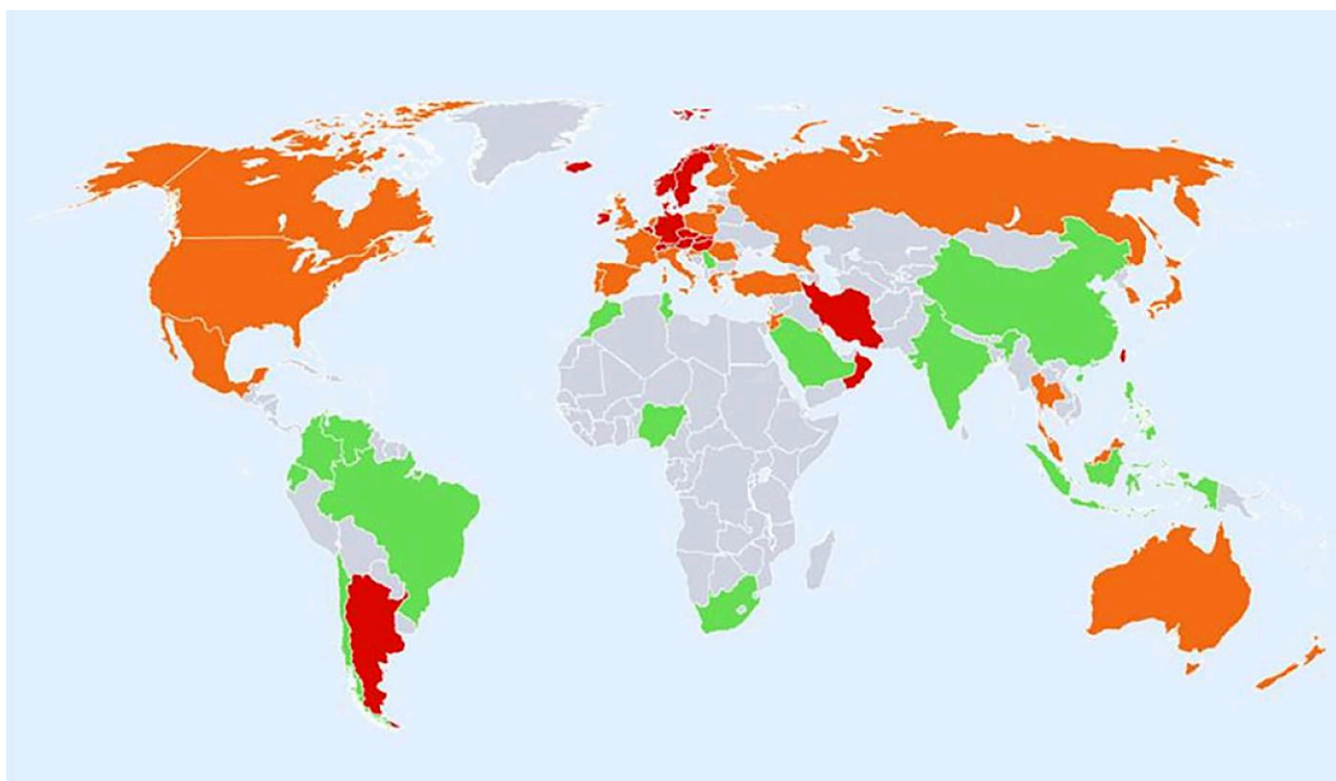


Figure 1. Hip fracture rates for men and women combined in different countries of the world categorized by risk. Where estimates are available, countries are color coded in red (annual incidence >250/100 000), orange (150-250/100 000), or green (<150/100 000). Reproduced with permission from Kanis et al (15).

and races in Hispanic ethnicity. From NHANES 2013 to 2014 data, the age-adjusted rate of osteoporosis based on BMD at either the femoral neck or lumbar spine in Hispanic women was 20.5%, which was similar to non-Hispanic White women (17.0%) and intermediate between non-Hispanic Asian women (40.0%) and non-Hispanic Black women (8.2%) (2). Studies of BMD suggest substantial differences between Hispanic people of different origins throughout the Americas (32).

There has been interest in measures of bone microarchitecture to understand differences in fracture rates between racial and ethnic groups. HR-pQCT is an imaging technique that can visualize the 3-dimensional microstructure of peripheral sites including the distal radius and distal tibia. Using this technique, Black women at the menopausal transition were found to have higher cortical area, thickness, and volume at the radius and tibia compared to White women (Fig. 2) (33). After adjusting for clinical covariates including weight, the differences persisted at the radius but not at the tibia. Asian women have favorable microarchitecture as well, including higher trabecular number and lower trabecular spacing compared to White women, which accounts for lower fracture rates (34). One study of bone structure comparing Caribbean Hispanic to White postmenopausal women using HR-pQCT observed poorer mechanical and microarchitectural properties in Hispanic women at the tibia, including lower trabecular volumetric bone density and trabecular number after adjusting for body mass index (35). The study results seem in contrast to the lower fracture rates of Hispanic women noted in Table 1 as compared to White women, which may reflect the heterogeneity of Hispanic populations more generally.

Anatomic factors implicated in hip fracture risk differ by ethnicity including the hip axis length. Hip axis length measures the distance along the femoral neck axis from the greater trochanter to inner pelvis—longer lengths are associated with hip fracture. The mean hip axis length is shorter in Black women (−1.2 SDs) and Asian women (−0.7 SD) compared to White women, which may contribute to lower hip fracture risk in these groups (36).

Diagnosis

Osteoporosis is diagnosed based on low T-scores from DXA testing, by history of fragility fracture, or high calculated fracture risk (37-40). Race plays an important role in calculated fracture risk, but not in the other criteria for osteoporosis diagnosis.

Diagnosis by Bone Density

For the calculation of T-scores, the International Society for Clinical Densitometry recommends the use of a young, non-Hispanic, White female as the reference for all people (41). While White female was chosen as the reference, any reference data point could have been used. The same reference point in all people allows a clinician to, for example, think about a T-score of −2.3 in one patient to be equal to a T-score of −2.3 in another patient because it is, in fact, the same raw BMD. Since the T-score was meant to be a clinically interpretable output of raw BMD, adjustments by race or ethnicity are not necessary or helpful (42).

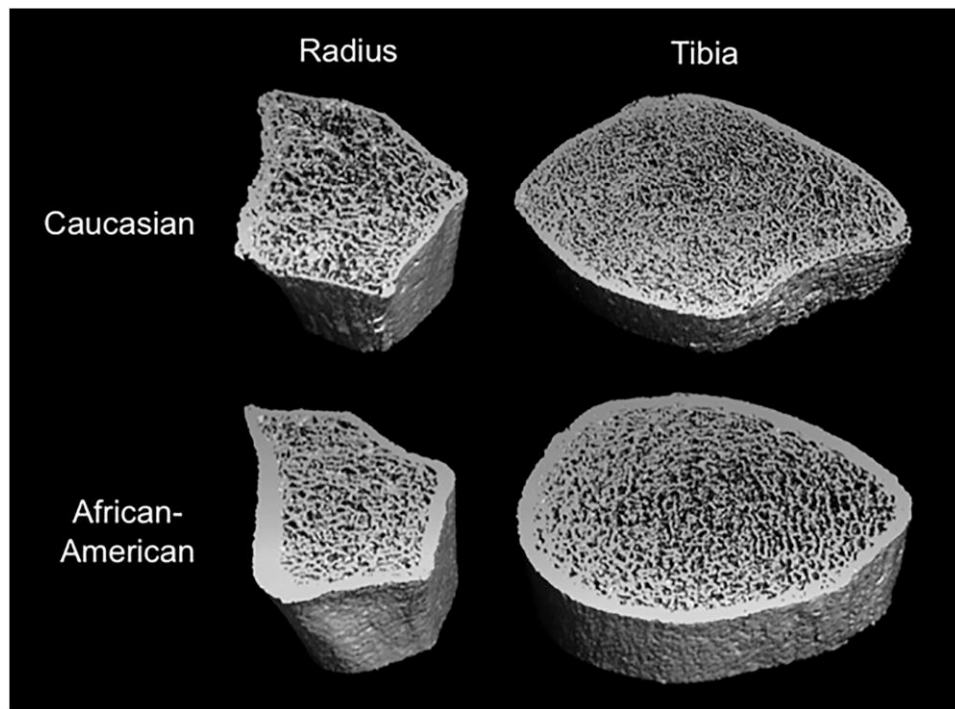


Figure 2. High-resolution peripheral quantitative computed tomography scans of the radius (left) and tibia (right) in a White participant (top) and Black participant (bottom). The thicker cortical and trabecular bone of the Black participant is apparent at both the radius and the tibia. Reproduced with permission from Putman et al (33).

On the other hand, the Z-score uses a reference that is similar in age, race, sex, and sometimes weight and is used for premenopausal women, men younger than 50, and children (39). In this case, race plays an important role due to differences in BMD by race. It should be noted that Z-scores are not always available in multiracial individuals and those who do not identify as White, Black, or Hispanic (“other” race). Even Asian people may not have Z-scores reported depending on the technical settings of the densitometer and which reference data are being used to calculate Z-scores.

Trabecular bone score (TBS) assesses the image texture of the lumbar spine DXA image and serves as an indirect measure of bone structure (43). Some studies, including some of our own studies, have shown lower TBS in Black women as compared to White women, a paradoxical result given the known favorable microarchitecture in Black women (28, 44). However, this is not a uniform finding (45). Regardless, TBS has not been well validated for fracture prediction in Black or Hispanic populations, and its exact role in management in these groups is yet to be defined (46, 47). Among Asian people, small or no differences have been observed in TBS compared to White women (45, 48, 49). Furthermore, TBS appears to predict fractures similarly in populations of Asia as White populations (50).

Disparities in Screening Bone Density

Several large cohort studies have shown underuse of DXA screening for osteoporosis in specific racial and ethnic groups. Gillespie et al (51) analyzed OptumLabs claims data of more than 1.6 million women older than 50 in the United States for bone mass measurement for primary prevention and found Black women were less likely to receive osteoporosis screening compared to all other racial and ethnic groups; conversely,

Asian and Hispanic women were the most likely to receive screening. Amarnath et al (52) studied a California regional health system with a cohort of more than 50 000 women in primary care clinics, and similarly found a lower incidence of DXA screening in Black women compared to White. This lack of screening may have consequences. Among more than 35 000 women with a nontraumatic hip fracture, Medicare claims data showed that Black women were only half as likely and Hispanic women two-thirds as likely as White women to have undergone DXA screening in the 2 years prior (53). Even after hip fracture, Black and Hispanic women remained less likely to receive DXA testing.

Fracture Risk Assessment

High fracture risk is another way to diagnose osteoporosis, and the way in which race is most visibly incorporated into osteoporosis diagnosis. The most used calculator in the United States is the Fracture Risk Assessment Tool (FRAX). FRAX incorporates multiple clinical risk factors to predict fracture risk with or without BMD and, in the United States, requires the input of the patient’s race to be either White, Black, Hispanic, or Asian. It does not allow for “other” or “mixed” race. FRAX lowers the calculated fracture risk in Asian, Black, and Hispanic people—risk is adjusted by a factor of 0.50 for Asian women, by a factor of 0.43 for Black women, and by a factor of 0.53 for Hispanic women vs White women (54-56). There are similar adjustments in men to lower their calculated risk—by a factor of 0.64 for Asian men, by a factor of 0.53 for Black men, and by a factor of 0.58 for Hispanic men vs White men (54-56). These adjustments are substantial, lowering the calculated risk by approximately 36% to 57% as compared to White individuals.

These adjustment factors are, in part, based on the studies listed in [Table 1](#); while evidence exists, particularly for postmenopausal women, data in men and Hispanic people are lacking or conflicting. Whether these adjustment factors improve the predictive performance of FRAX is not clear. In the Women's Health Initiative, FRAX without BMD demonstrated poor discrimination (unable to distinguish between those who will and who will not have a fracture) but adequate calibration (predicted fracture rates matched observed) in younger premenopausal women (aged 50-64) ([57](#)). However, the women were generally low risk for fracture and may not be typical patients often considered for osteoporosis therapy. Our own studies have demonstrated poor performance of FRAX without BMD in racial and ethnic minorities in a primary care population and in those with diabetes ([14](#), [58](#)). For example, we found that FRAX underestimated fractures in Hispanic women, Hispanic men, and Black men with diabetes in a large managed care system in California by 40% to 80%. While it was a single study, the size of the population was notable, with more Hispanic people than the WHI and with the inclusion of men. More studies are urgently needed.

The American Society of Bone and Mineral Research (ASBMR) convened a task force on clinical algorithms for fracture risk to study the issue. In their final report and based on evidence from a meta-analysis, the members concluded there was little justification for estimating fracture risk while incorporating race and ethnicity adjustments ([56](#), [59](#)). They recommended the creation of a single US population-based calculator for all racial and ethnic groups. However, until such a calculator exists, the task force suggested providing a range of fracture estimates for Asian, Black, and Hispanic patients, up to the risk provided to White individuals. The recommendation of a population-based, race-neutral fracture calculator has been controversial, and it is not clear if this recommendation will be followed ([60](#)). We will discuss this issue more in the management of osteoporosis.

Management

Calcium, Vitamin D, and Other Lifestyle Factors

Calcium and vitamin D are recommended for people with osteoporosis. The Institute of Medicine recommends 1000 to 1200 mg of calcium daily through diet or supplements and various osteoporosis guidelines recommend maintaining serum 25-OH vitamin D levels of at least 20 to 30 ng/mL ([38](#), [40](#), [61](#), [62](#)). In regard to dietary calcium intake, studies have shown that Black and Asian people appear to have lower baseline calcium and dairy intake than White and Hispanic people ([63](#), [64](#)). There are known differences in vitamin D levels by race. In particular, it has been noted that Black patients have lower vitamin D levels than White patients. This was often attributed to higher melanin content in the skin contributing to reduced UVB-induced vitamin D synthesis in individuals with darker skin; however, this likely is a small effect ([65](#)). Instead, a key study found that Black patients have lower levels of vitamin D-binding protein than White patients likely due to a high prevalence of a common genetic variant in the vitamin D-binding protein gene ([66](#)). When bioavailable 25-OH vitamin D levels were measured among homozygous participants of the gene, Black participants had similar levels of bioavailable 25-OH vitamin D as White patients overall and within quintiles of parathyroid hormone levels. Asian people were also found to have lower vitamin D levels than

White people, but less is known about vitamin D-binding protein status in Asian people or other races ([67-69](#)). In NHANES, White participants were also more likely to be taking vitamin D supplements than Black or Hispanics participants ([70](#)). Other lifestyle factors important for osteoporosis, such as protein intake and physical activity, seem to be slightly higher in Hispanic people than Black or White individuals ([71](#), [72](#)).

Pharmacotherapy

There are highly effective and safe medications to reduce fractures in people at high risk. As discussed earlier, those with a BMD T-score less than or equal to -2.5 , those with prior fragility fractures, or those with high calculated fracture risk with a fracture calculator are recommended for pharmacotherapy in major osteoporosis guidelines ([37-40](#)). The choice of pharmacotherapy is based on severity of osteoporosis, prior fractures, and comorbidities and incorporates shared decision-making with the patient. Medication options include bisphosphonates, denosumab, teriparatide, abaloparatide, and romosozumab, among others. Well-written guidelines from the Endocrine Society and others can help clinicians in risk-stratifying their patients and choosing a specific therapy ([37-40](#)).

Studies showing drug efficacy have involved participants of various racial and ethnic groups globally. Many of the early studies enrolled overwhelmingly White participants. For example, trials of alendronate and teriparatide enrolled 95% or more White participants ([73](#), [74](#)), though there has been at least one study of alendronate conducted specifically in Black women ([75](#)). Recent studies have included more participants of different races and ethnicities. Though reporting could be improved, many of the recent trials have compared efficacy by region and/or race or ethnicity. This is summarized in [Table 2](#) ([76-79](#)). Most studies of osteoporosis therapies do not suggest major differences in efficacy by race or ethnicity. Romosozumab demonstrated a slight difference in efficacy for nonvertebral fractures in Latin America in the placebo-controlled trial (relative risk reduction of 25% vs 43%), and it was noted in a post hoc analysis that participants in Latin America had much lower baseline fracture risk than the rest of the world ([79](#)). Despite their lower baseline fracture risk, those in Latin America still had similar reductions in vertebral fracture risk as the rest of the trial.

An important consideration for Asian patients when recommending therapy is the higher rate of atypical femur fractures (AFFs) seen in this population ([Fig. 3A](#)). AFFs are rare fractures in the subtrochanteric or diaphysis of the femur with specific radiologic characteristics that, despite their rarity, are more common in patients on bisphosphonates and other anti-resorptive drugs ([80](#)). One study examined AFF risk in the Kaiser Permanente Southern California health system, where they observed higher rates of AFF, 6.0 per 10 000 person-years, in Asian women compared to 1.1 per 10 000 person-years in White women on bisphosphonates ([Fig. 3B](#)) ([81](#)). Black women had a rate of 0.2 per 10 000 person-years, while Hispanic women had a rate of 1.2 per 10 000 person-years. There are multiple proposed mechanisms for this risk, including unique femur geometry leading to higher mechanical loads on the lateral femur, bone microarchitecture differences, and racial variation in pharmacokinetic processing ([82-84](#)). Clinicians treating patients of Asian race for osteoporosis

Table 2. Osteoporosis drug trials where difference in efficacy by race or ethnicity is reported

Trial	Design	Drug and duration	No. of participants	Racial composition	Efficacy difference
HORIZON-PFT, subgroup analysis 2009 (77)	Randomized, double-blind, placebo-controlled trial. Race data presented in BMD subgroup analysis	Zoledronic acid vs placebo at baseline, 12 mo, and 24 mo	3875 in zoledronic acid group vs 3861 in placebo group	Race: White: 79.0%, Asian: 14.5% Other: 6.5% Region: Western Europe: 30.0% Eastern Europe: 20.0% North America or Oceania: 19.8% Latin America: 16.1% Asia: 14.1%	No effect of race or region on efficacy of zoledronic acid for vertebral fracture, nonvertebral fracture, or change in femoral neck BMD
FREEDOM, subgroup analysis, 2012 (78)	Phase 3, double-blind, randomized placebo-controlled trial	Denosumab vs placebo every 6 mo for 3 y	3902 on denosumab vs 3906 on placebo	Race: White: 92.7% All other: 7.3% Region: Western Europe 45.3%, Eastern Europe 35%, Latin America 12%, North America 7.4%, Australia and New Zealand 1.2%	No effect of race (White vs all other) or region on efficacy of denosumab for vertebral fractures
ACTIVE, subgroup analysis 2018 (79)	Phase 3, double-blind, randomized placebo-controlled trial. Region and race-ethnicity subgroup analysis	Abaloparatide vs placebo daily for 18 mo	Total of 1645 with at least 807 on abaloparatide vs at least 808 on placebo; exact numbers not provided	Race: White: 80.1% Asian: 15.7% Black: 3.0% Ethnicity: Hispanic: 24.2% Non-Hispanic: 75.8% Region: North America: 1.8% South America: 26.7% Europe: 56.0% Asia: 15.5%	No effect of ethnicity (Hispanic vs Non-Hispanic) or region on efficacy of abaloparatide for vertebral, nonvertebral, clinical, or major osteoporotic fracture. Race not specifically examined
FRAME, 2016, post hoc analysis (80)	Phase 3, double-blind, randomized placebo-controlled trial. Post hoc analysis due to differences seen in Latin America in main trial	Romosozumab vs placebo for 12 mo followed by 12 mo of denosumab	3589 on romosozumab vs 3591 on placebo	Race White: 57.3% Black: 2.1% Asian: 12.1% Native Am/Alaska Native: 1.8% Other: 26.8% Ethnicity Hispanic: 39.6% Non-Hispanic: 60.4% Region: Latin America: 43.0% Central/Eastern Europe: 29.2% Western Europe, Australia/NZ: 13.6% Asia: 11.5% North America: 2.7%	Significant difference in efficacy in Latin America region of romosozumab for nonvertebral fracture (relative risk reduction 25% vs 42% in rest of world). No efficacy difference for vertebral fracture. Lower baseline fracture risk in Latin America

Abbreviations: BMD, bone mineral density; NZ, New Zealand.

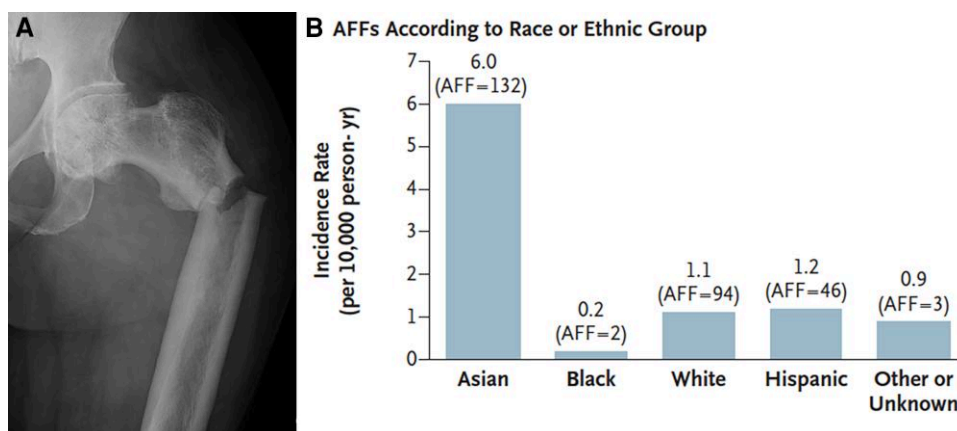


Figure 3. A demonstrates a complete atypical femur fracture. Note the transverse fracture line and minimal comminution. B shows atypical femur fractures by race or ethnic group in the Kaiser Permanente Southern California Health System. Adapted with permission from Black et al (81).

should not be deterred from prescribing antiresorptive therapies. The previously mentioned study directly compared rates of hip fracture to AFFs while on bisphosphonate and found, even in patients of Asian race, the rate of hip fracture was 20.4 vs 6.0 of AFF per 10 000 person-years. This analysis does not account for other benefits of bisphosphonates such as reduction of other fragility fractures. Regardless, clinicians should educate patients about the risk of AFFs, monitor for any prodromal signs and symptoms of AFFs, and consider drug holidays after 3 to 5 years of bisphosphonate therapy. Denosumab is also associated with AFFs, though the association is less well understood. AFFs remain an area in need of further research.

Disparities in Treatment Rates

Differences in osteoporosis medication prescription rates have been shown. In a cross-sectional study, Curtis et al (85) studied 25 000 participants (~50% US geographic South and Southeast) and compared the prevalence of osteoporosis medication prescriptions in Black and White participants. This study found among those with high fracture risk, Black individuals were more than 50% less likely to receive osteoporosis medications. A Medicare claims data study (86) of nearly 36 000 patients with any fragility fracture (humerus, hip, or vertebra) also showed more than 40% lower odds of Black individuals receiving treatment in the 6 months after fracture. In contrast to studies about Black patients, there are limited studies about treatment rates in Hispanic, Asian, Native American, and other racial groups. Fracture liaison services, which identify patients with fractures in the acute setting and coordinate care for outpatient osteoporosis follow-up, could help address this racial disparity, though studies of fracture liaison services often do not report race (87).

A Unified Approach to Osteoporosis Treatment

Given the differences outlined in this review, how might clinicians consider incorporating race into their osteoporosis treatment paradigm? We outline our suggested approach in Fig. 4 for postmenopausal women and men older than 50. The major clinical practice guidelines for osteoporosis recommend pharmacotherapy for osteoporosis in patients with a BMD T-score of less than or equal to -2.5 , those with prior fragility fractures, or those with high fracture risk based on a fracture

risk calculator (37-40). The former two criteria do not consider race and, despite lower fracture rates in some racial groups, should be considered criteria for therapy regardless of race. As we have discussed, some groups are less likely to be treated and have worse outcomes after fracture. Thus, regardless of race, if a patient meets criteria for osteoporosis therapy, it should be offered.

Treatment based on fracture risk calculators pose the most challenging task in clinical practice. More work is needed to better understand if FRAX accurately predicts fractures in all racial groups. Many osteoporosis guidelines recommend treatment if the 10-year major osteoporotic fracture risk exceeds 20% or hip fracture risk exceeds 3%. These numbers come from a pharmacoeconomic analysis written in 2008 (88). It has been noted that if the same quality of life criteria were applied today, the thresholds would be lower for all people (39). There are two further considerations in the context of race. First, we have described that the costs of fracture (eg, the outcomes after fracture) are worse in certain groups. This likely changes the economic analysis, though that is beyond the scope of this review. Second, studies have suggested that FRAX is underestimating fractures in some racial groups. If a clinician were to treat patients using the given FRAX outputs, they are likely to undertreat patients who truly have fracture risks greater than these thresholds. Thus, until new treatment thresholds are examined, changes are made to FRAX, or a new widely validated fracture calculator is developed, we suggest clinicians consider using lower treatment thresholds than 10-year risks of 20% for major osteoporotic fracture and 3% for hip fracture in patients who may be at risk of poor outcomes if they were to fracture. This approach acknowledges existing issues within not only fracture risk tools, but also insurance systems and access to care, in which disparities across race are well recognized. The use of a lower treatment threshold has a similar effect on treatment decisions as removing the effect of the race adjustment that is built into FRAX (0.43-0.64 depending on specific race and sex). Lowering the traditional FRAX thresholds by the conservative end of the race adjustments (ie, 0.64 adjustment factor) would yield treatment thresholds of approximately 15% for major osteoporotic fracture and 2% for hip fracture. The approach of the ASBMR Task Force on Clinical Algorithms for fracture risk to report a range of fracture risk up to the risk of a White individual is also equitable and more individualized, though

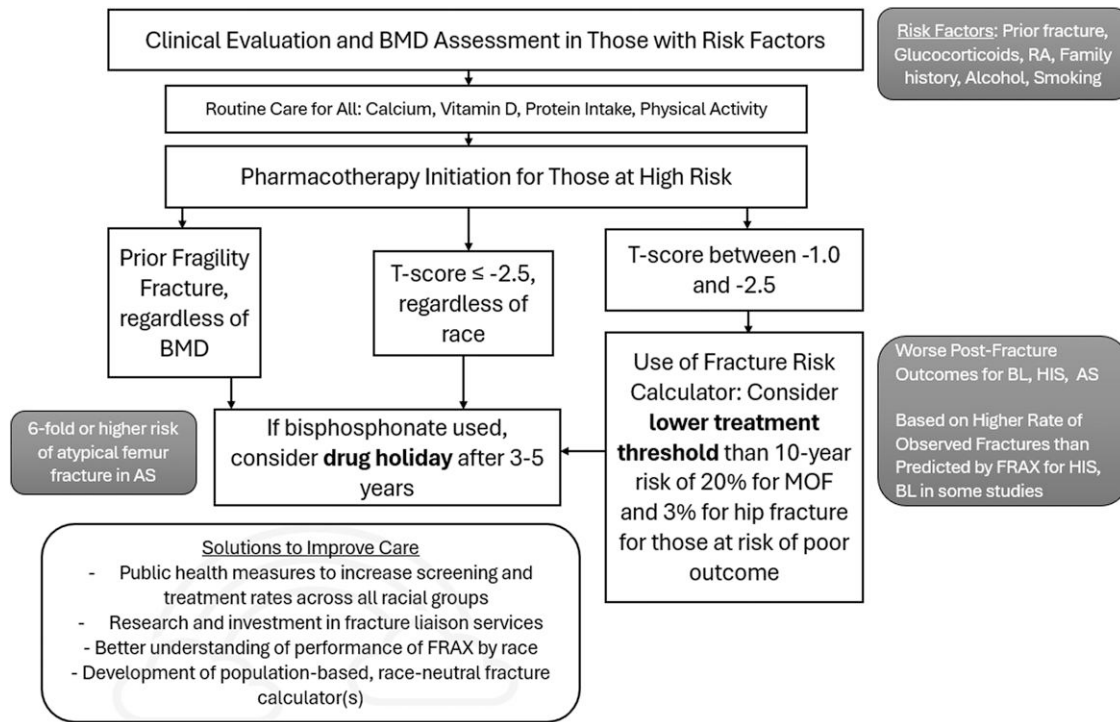


Figure 4. An osteoporosis treatment algorithm for postmenopausal women and men older than 50 with consideration of race and ethnicity in the United States. AS, Asian; BL; Black, BMD, bone mineral density; FRAX, Fracture Risk Assessment Tool; HIS, Hispanic; MOF, major osteoporotic fracture; RA, rheumatoid arthritis.

may be difficult in a busy clinical practice (56). While additional research may be necessary, further development of a single fracture risk calculator, regardless of race, as recommended by the ASBMR Task Force, would eliminate these difficult considerations for busy clinicians.

Conclusion

Many clinicians consider health differences by race to be related socioeconomic differences, income, housing, or racism in the United States. In osteoporosis, there are other factors to consider including crucial differences in fracture rates, bone density, and bone structure. Furthermore, there are differences by race in the tools for osteoporosis (ie, the inclusion of race in FRAX) and side-effect profiles for osteoporosis drugs (ie, increased rate of AFF in Asian patients). While race is often misused as a proxy for genetics, race still provides useful information when considered carefully and can help clinicians provide better care for their patients with osteoporosis.

In this paper, we have reviewed important differences in osteoporosis care by race and highlighted shortcomings in screening, treatment, outcomes, and research among Asian, Black, and Hispanic people in the United States. It is clear that more epidemiological studies, clinical trials, and outcome studies that include diverse people are needed to fill knowledge gaps in osteoporosis and ensure equitable treatments for all people. As genetic information becomes more available and new fracture risk tools are developed, it is likely the role of race could change in osteoporosis. Nonetheless, the concepts in this review provide a solid foundation for clinicians to understand the key differences in osteoporosis by race to help them provide inclusive care.

Disclosures

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Data Availability

Data sharing is not applicable to this article as no data sets were generated or analyzed during the current study.

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