

Racial variance in incidence and risk factors for osteoporotic hip fractures

Christina Gagliardo and Norman A. Walensky¹
¹Department of Exercise Science and Sport Studies,
Rutgers University, New Brunswick New Jersey 08901

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Abstract

Hip fractures are a serious public health problem facing older females, and are associated with high rates of mortality, morbidity, and financial cost.²¹ Racial variation exists in the incidence of hip fractures. Medical records from two hospitals serving ethnically diverse populations show that racial variation exists, with Caucasians having a distinctly higher incidence of hip fracture than their African American counterparts.

Differing degrees of racial protectiveness for certain risk factors may contribute to racial variation in hip fracture incidence. Hip fractures are largely influenced by osteoporosis, decreased bone mineral density (BMD) of the femoral neck, and age-related, menopausal changes resulting in bone mass loss. Factors such as peak skeletal bone mass achieved, rate of bone loss, body mass index (BMI), diet, hormone levels, bone turnover rates, and hip structural geometry all influence an individual's risk for fracture, and each displays racial disparity.

Postmenopausal women need to be aware of the devastating impact of hip fractures, and to understand the racial implications of this clinical condition. Public awareness of this information should dictate the implementation of lifestyle changes to decrease postmenopausal women's risk, and thereby facilitate prevention of hip fracture.

Introduction

Fall-related, osteoporotic hip fractures are a serious public health problem facing older females. According to the United States Centers for Disease Control (CDC), fall injuries are the principal cause of injury-related death and disability in the elderly.⁹ Women are especially concerned with hip fractures, which are caused almost exclusively by osteoporotic falls.⁹ Osteoporosis is characterized by decreased bone mass and a deterioration of bone tissue leading to bone fragility and increased susceptibility to fracture. As the most common bone disease, osteoporosis affects approximately 24 million Americans, 15 to 20 million of whom are women over the age of 45.¹⁴ The incidence of osteoporotic hip fractures varies between races, with the majority of occurrences seen in postmenopausal Caucasian women.

Of all osteoporotic age-related fractures, hip fractures are the most serious, and are associated with the highest rate of incidence, mortality, morbidity, and financial

costs.²¹ With one in four women over age 65 suffering a hip fracture during her lifetime², the resulting effects are devastating to the individual. Hip fractures cause serious health problems and deaths, and are a major cause of morbidity and mortality^{8,12,14} with fatality rates one year after hip fracture as high as 50 percent.⁸ A study from the British Medical Journal (February 5, 2000) reported that in a survey of women over 75 years of age, eighty percent were willing to decrease their life expectancy and longevity⁹ to avoid a debilitating hip fracture depriving them of personal independence and higher quality of life.

The cost of sustaining a hip fracture places an excessive economic burden on the individual and on the health care system in the United States. The total annual costs for osteoporotic hip fractures are estimated to increase from \$7 billion in 1986 to \$62 billion by the year 2020.^{13,17,23} The financial cost placed on the individual, including direct medical care, formal nonmedical care, and informal care by the patient's family and friends, was between \$16,300 and \$18,700 in the first year following the fracture.¹

Reviewing the epidemiology of osteoporosis and hip fracture incidence shows that both have serious implications for elderly, postmenopausal females. Sustaining a hip fracture leads to hospitalization, possible institutionalization, marked loss of independence and quality of life, financial burden, and increased risk of death. However, this devastating injury is extremely prevalent in the elderly female population, and is linked to the individual's race. Understanding the contribution racial ethnicity makes to the different risk factors for hip fracture helps explain the difference in incidence rates between Caucasian and African-American populations.

Osteoporotic changes characterized by increased bone porosity leading to decreased bone mass enhances the risk for a postmenopausal woman to suffer a hip fracture, regardless of race. However, variance exists across these races that predisposes postmenopausal Caucasian women to suffer hip fractures the most, followed by Asians^{16,24}, and African-Americans.^{6,10} This study will assess the racial variance in hip fracture incidence in older females, as demonstrated by various hospital records, and discuss the differing degrees of racial protectiveness.

Subjects and Methods

Subjects for this study were obtained through medical records from hospitals serving multicultural populations in ethnically diverse areas; Robert Wood Johnson University Hospital in New Brunswick, NJ, and JFK Medical Center in Edison, NJ. Subjects forty years or older were identified because of the increased susceptibility to hip fracture as they enter menopausal status. Race was specified as African American, Asian, or Caucasian. The injury had to be non-traumatic in nature to be eligible, due more to osteoporotic conditions than a traumatic accident.

The Robert Wood Johnson data identified females over forty years of age who were diagnosed with a hip fracture defined according to the ninth revised

International Classification of Diseases categories 820.0-820.9: transcervical fractures, peritrochanteric fractures, and fractures of unspecified parts of the neck of the femur.¹⁰ Data were obtained from 1995-2000 medical records. JFK Medical Center classified subjects over 45 years of age according to the same diagnostic criteria, from 1997-1998.

Results

Data from Robert Wood Johnson and from the JFK Medical Center identified a total of 159 and of 260 eligible patients, respectively, in the six year period. Table 1 displays the incidence rates in each racial classification.

Table 1. Incidence of hip fracture in Caucasian and African American women.

	Robert Wood Johnson	JFK Medical Center
Caucasian	146 (93%)	253 (97%)
African American	11 (7%)	7 (3%)
Total	157	260

Each sample of females from the two different hospitals showed Caucasians to have the higher incidence of hip fracture.

Discussion

Microscopic factors influencing hip fracture occurrence are bone mineral density (BMD) of the femoral neck and age-related/menopause associated loss of bone mass. Factors such as peak skeletal bone mass achieved, rate of bone loss, body mass index (BMI), hormone levels, diet, and bone turnover rates all influence an individual's BMD. Racial anthropology reveals variation in bone density that contributes to fracture risk.

In general, Caucasian postmenopausal females sustain hip fractures twice as often and have a doubled risk for hip fractures compared to African Americans. African American women have denser bones than their Caucasian counterparts because they have higher peak bone mass at skeletal bone maturation.^{15,18} Therefore, with comparable age-related bone loss rates, Caucasians will continually have less dense bones, and Caucasian females will reach fracture threshold more often than African Americans.¹⁸ Daniels et al. report that postmenopausal Caucasians experience a greater rate of femoral neck BMD decline than African Americans.⁵ In addition, femoral neck BMD in Caucasians may already be declining while African-Americans of the same age are still experiencing increases in femoral neck BMD, and do not experience bone loss until later in life.^{5,18} The racial difference in hip fracture incidence between Caucasians and African Americans can be partially attributed to

the fact that African Americans have a higher BMD at all ages⁸, and Caucasians have greater osteoporotic conditions and decreased bone mass.

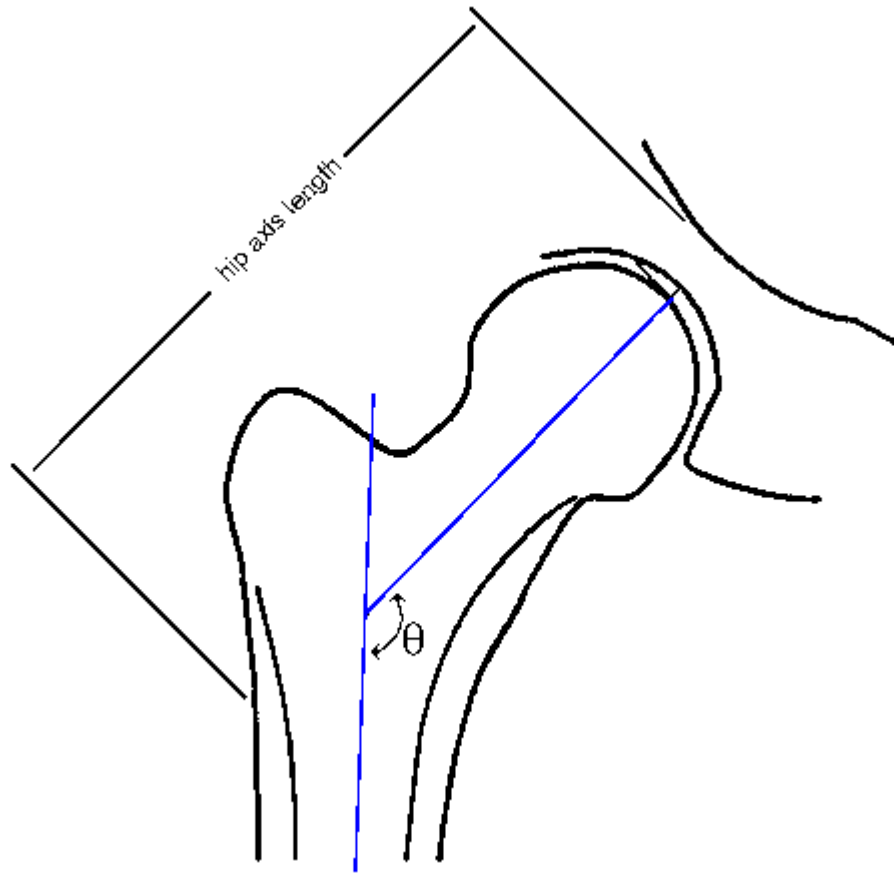
Another factor affecting hip fracture is body mass index (BMI) and obesity because of its effect on BMD and on estrogen levels. Greater body mass and weight reduces a woman's risk of osteoporosis and suffering a hip fracture.^{3,7,11,26} The greater gravitational force increased body mass has on bone mass has a similar effect to weight-bearing exercises that increase bone mass and density. Obesity also causes greater production of extra-ovarian, adipose-based estrogen^{11,15}, an important hormone that protects BMD. In addition, greater body weight may indicate that soft tissue is thicker at the point of impact in a fall, so that less force is transmitted to the femoral neck region^{11,20} and fracture risk is less. As obesity and greater BMI is more common in African American women than Caucasian women¹⁵, African Americans display the increased BMD associated with the positive weight-bearing and increased estrogen effects, and consequently, sustain hip fractures less frequently.

Bone resorption is the breakdown and removal of bone mineral and matrix by specialized cells called osteoclasts.² Bone turnover is the rate at which osteoclasts remove old bone and osteoblasts replace new bone; a rate that increases with lower estrogen levels seen in postmenopausal females. Decreased hormonal levels of estrogen lead to increased osteoclastic resorptive activity, and menopause-induced estrogen deficiency accelerates bone loss¹², and increases risk of hip fracture. Racial differences in hormone levels and activity contribute to the racial variation in hip fracture incidence. Compared to African Americans, Caucasians have lower levels of estrogen that accelerate osteoclastic activity determining resorption, cause higher bone turnover rates, and contribute to a lower bone mass and an increased risk of fracture.^{18,27}

Nutritional status, and in particular calcium and vitamin D intake, also contribute to risk of fracture. Calcium is a central component of bone mass¹⁴ and vitamin D plays an important role in calcium absorption and in mineralization of new bone. Both calcium and vitamin D increase bone density; when deficiencies are present, increased risk of hip fracture results. Calcium levels in Caucasians have been shown to be lower than in African Americans because African Americans absorb calcium better than Caucasians, as demonstrated by increased calcium urinary excretion by Caucasians.²² Inadequate calcium intake and increased excretion of calcium make Caucasians more susceptible to fracture risk than African Americans.

A macroscopic concern regarding the femoral neck that presents a risk is structural hip geometry. Racial variation in hip geometry is manifested by hip axis length ?the distance from the lateral aspect of the greater trochanter, through the femoral neck, to the inner pelvis⁴, and the collodiaphyseal angle made by the neck and shaft of the femur.

Figure 1: Diagram of the hip showing hip axis length and the collodiaphyseal angle (θ).²¹



During a fall, a longer hip axis length contributes to a larger bending moment and increases the risk for fracture, as does a larger collodiaphyseal angle.^{19,20} A larger collodiaphyseal angle and shorter hip axis length are more advantageous because they provide greater resistance to forces experienced during a fall.²⁰ In comparison to Caucasian females, African-American²⁵ women have a more protective hip geometry pattern with a shorter hip axis length, and a larger collodiaphyseal angle. The structural hip geometry of African Americans contributes to their lower incidence of hip fractures than Caucasians.¹⁹

The data obtained in this study show that Caucasians suffer hip fractures more frequently, with African Americans showing the least incidence. The contribution of the various risk factors may account for the racial disparity seen in incidence rates.

Conclusion

The occurrence of osteoporosis and the incidence of hip fractures in postmenopausal females pose a serious threat to longevity and quality of life.

Caucasian women have a higher rate of age-related hip fracture than their African-American counterparts. Because hip fractures occur so frequently, preventative strategies must be developed and implemented to decrease the risk of hip fracture in elderly white females. Focusing on the contribution ethnic differences make to the various risk factors is an important way to determine the optimum prevention strategies necessary for each individual.

Race, bone mineral density, and hip geometry are inherent in each person, but understanding the contribution of additional risk factors can aid women in making lifestyle changes. Mutable factors must be corrected to decrease personal risk. Adequate daily intake of calcium and vitamin D, either through diet or supplements, will help maintain strong, healthy bones. Cessation of smoking and limiting alcohol intake can also protect bone mineral density. Engaging in physical activities involving weight-bearing and resistance exercises will increase bone strength and decrease fracture risk. Another option older females may consider is estrogen replacement therapy, which is the most effective method of treating osteoporosis and decreases fracture rates by 50% in postmenopausal women.¹⁴ Physicians need to educate their elderly white female patients about increased susceptibility to hip fracture, and detail the individual's specific situation that places them at greater risk.

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