

Low Bone Mass Prevalence and Osteoporosis Risk Factor Assessment in African American Wisconsin Women

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ABSTRACT

Background: Post-menopausal osteoporosis is seen in all racial groups. With the increasing population and longevity of minority groups, osteoporosis is becoming an important health concern. Data regarding risk factors for, and prevalence of, low bone mass and awareness of osteoporosis risk in African American (AA) women are limited.

Objective: This article evaluates the risk factors for, and prevalence of, low bone mass in a population of urban AA women in Wisconsin and assesses this group's perceived risk for osteoporosis.

Methods: One hundred fifty consecutive community-dwelling AA women ≥ 45 years old from Milwaukee, Wis were asked to complete a questionnaire based on currently accepted osteoporosis risk factors. Additionally, their perception of osteoporosis risk was assessed using a Likert scale. All subjects underwent quantitative calcaneal ultrasound.

Results: Subject mean age was 54 ± 7 years. Mean T- and Z-scores were 0.5 and 0.4, respectively. Applying World Health Organization criteria, osteopenia (bone mineral density T-score < -1.0) was present in 23.3% and osteoporosis (bone mineral density < -2.5) in 9.3%. Multivariate analysis of risk factors showed that lifetime incidence of at least 1 fracture, multiparity (> 2 children), postmenopausal state, and current smoking were associated with lower calcaneal bone mass. Higher education

and presence of diabetes were associated with a higher bone mass. Only 25% of the women surveyed thought they were at moderate to high risk for osteoporosis.

Conclusions: Low bone mass was present in 33% of these AA women despite their relative young age. Many AA women do not perceive osteoporosis as a health risk. It is necessary to develop strategies to educate AA women regarding osteoporosis risk.

INTRODUCTION

Osteoporosis is a systemic skeletal disease characterized by low bone mass and microarchitectural deterioration of bone tissue with consequent susceptibility to fracture.^{1,2} Though osteoporosis occurs in all racial groups,³ post-menopausal white women are considered to be at highest risk. Available data regarding bone mass in African American (AA) women are limited, and are derived from cross-sectional studies, but do suggest that bone mass is higher in AA women than white women^{4,5} resulting in lower risk of osteoporotic fractures. However, between 80%-95% of fractures in AA women over age 64 are due to osteoporosis and, as AA women age, their risk for hip fracture doubles approximately every 7 years.⁶ In addition, certain diseases more prevalent in the African-American population, such as sickle-cell anemia and systemic lupus erythematosus, are associated with higher osteoporosis risk. Recent studies have suggested that AA women probably fracture at a lower rate when compared to whites with same the bone mineral density,⁷⁻⁹ but when they do fracture they have higher mortality and morbidity rates.^{10,11} Despite the aforementioned substantial prevalence and adverse consequence of osteoporotic fracture, there appears to be a perception among health care professionals, and AA women themselves, that osteoporosis is uncommon in this population. The single study that evaluated risk factors and awareness of osteoporosis in this population suggests that there is an enormous need for osteoporosis education and preventive strategies among AA women.¹²

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Most preventive strategies are directed toward women of European origin, whereas guidelines for diagnosis and prevention of osteoporosis in AA women have not yet been proposed. As the size of minority populations in the United States—and their longevity—increases, a larger number of AA women will be at risk for osteoporotic fractures in the future. Thus, improved understanding of low bone mass prevalence and attitudes towards osteoporosis in these individuals is necessary.

The purpose of this study was to evaluate risk factors for and prevalence of low bone mass in a population of AA women. Additionally, their perception of osteoporosis risk was explored.

METHODS

Subjects

The study subjects consisted of 150 community-dwelling, cognitively intact AA women who were ≥ 45 years old from Milwaukee, Wis. Subjects were enrolled through informational flyers posted in a primary care clinic and its affiliated hospital. Most subjects were affiliated health care personnel, outpatients coming to the primary care clinic, or visitors to the hospital. Persons with known osteoporosis or hospitalized patients were excluded. This protocol was approved by the Human Subjects committees at Aurora Sinai Medical Center, Milwaukee and the University of Wisconsin Medical School, Madison.

Bone Mass Measurement

All subjects underwent calcaneal bone mass measurement using a GE Health Care Lunar Achilles Express™ (Madison, Wis) bone ultrasonometer. The Achilles Express is a quantitative ultrasonometer that measures ultrasound properties of the heel and automatically calculates the patient's Stiffness Index, which is compared to young adult and age-matched references to provide both a T-score and a Z-score. As recommended by the International Society for Clinical Densitometry, T-scores are defined as number of standard deviations above or below the mean value in young white adults of the same sex. Z-scores are defined as number of standard deviations above or below the mean value in white individuals of the same age and sex. Since an AA reference database was not available with the above instrument, the white database was used to derive both T-scores and Z-scores.

Risk Factor Assessment

All subjects were asked to complete a questionnaire that included demographic information, medical history, medication use (including over-the-counter medications), smoking history, alcohol use, and reproductive

history. These questions were based on known and suspected osteoporosis risk factors.¹² All the information was self-reported and no independent confirmation was undertaken, though study staff reviewed the questionnaire with the subjects to assure completion. Awareness of participant-perceived osteoporosis risk was assessed using a Likert scale.

Statistical Analysis

Data were expressed as mean \pm standard deviation. The data were analyzed using SPSS Windows (Version 11.5; SPSS, Inc., Chicago, Ill). Descriptive statistics and frequencies were generated for demographic, osteoporosis risk factor data, and subject perception of osteoporosis risk. Multivariate logistic regression was used to predict risk odds ratios of low bone mass related to risk factors. The overall significance of the final model was $P < 0.001$. The Hosmer-Lemeshow statistic indicated good model fit. This statistic compares the observed probabilities to those predicted by the model and tests the null hypothesis that the model fits. A non-significant statistic indicates the model does fit the data. Since the P value is $> .05$, we cannot reject the null, and the conclusion is that the model is a good fit.¹³

RESULTS

Subjects

All subjects were enrolled between November 2002 and April 2003. Their mean age was 54 ± 7 years. All subjects were currently living in Milwaukee, Wis, and their mean duration of residence in the midwestern part of the United States was 43 years (range 10–79 years). Two thirds of the study participants reported mixed racial origin when asked what their ethnic background was. Additional demographic data is presented in Table 1.

Bone Mass Measurement

The mean calcaneal T-score was -0.5 (range -5.0 to $+2.5$) and mean Z score was 0.4 (-4.6 to $+3.4$). As is often the case in population studies utilizing peripheral bone mass measurement technology, World Health Organization (WHO) diagnostic criteria were applied to classify the subjects.^{8,14} In this population, osteopenia (T-score < -1.0) was present in 23.3% and osteoporosis (T-score < -2.5) in 9.3% resulting in an overall prevalence of low calcaneal bone mass of 32.6% (Table 3). Of the subjects over age 60, 43% (13/30) had osteoporosis or osteopenia (T-score < -1.0). Since 50% of the subjects had a prior hysterectomy, and blood was not drawn for the determination of hormonal status, confirmation of postmenopausal status was not possible in the subjects in the perimenopausal age group.

Table 1. Subject Demographics

Subject Characteristics	N	Mean SD	Range
Age (years)	150	54.1 + 7.4	45-79
Education (years)	114	13.0 + 2.5	7-20
Body Mass Index (kg/m ²)	150	32.0 + 6.7	19.4-63.4
Years in Midwest	147	43.1 + 19.6	10-79
Parity	150	3.0 + 2.4	0-11
Age at birth of first child	129	20.1 + 4.5	13-43
Pack years (smokers)	82	17.8 + 15.6	1-82

Table 2. Subject Risk Factors, Comorbidities, and Bone Mass Status

Risk Factor	N	Frequency	Percent
Diabetes			
No	150	119	79.3
Yes	150	31	20.7
Hypertension			
No	150	71	47.3
Yes	150	79	52.7
Asthma			
No	150	122	81.3
Yes	150	28	18.7
Fracture History			
Never	150	101	67.3
Any lifetime	150	49	32.7
Calcium Supplement			
No	150	110	73.3
Yes	150	40	26.7
Smoking Status			
Never	150	66	44.0
Past	150	47	31.3
Current	150	37	24.7
Alcohol Use			
Never	144	41	28.5
Occasional	144	88	61.1
Moderate	144	5	3.5
Excessive	144	10	6.9
Menopausal Status			
Premenopausal	150	19	19.3
Perimenopausal	150	4	2.7
Postmenopausal	150	42	28.0
Hysterectomy	150	75	50.0
Oophorectomy			
No	148	113	76.4
Yes	148	35	23.6
HRT Use			
None or use <1 year	150	90	60.0
Past use >1 year	150	34	22.7
Current use	150	26	17.3
Lactose Intolerance			
No	150	71	47.3
Yes	150	79	52.7
Milk Intake			
None	149	58	38.9
Occasional	149	30	20.1
Regular	149	61	40.9
Self-Reported Ethnic Mixture			
AA*	49	87	33.8
AA + Native American	53	87	36.6
AA + Caucasian	8	87	5.5
Other Mixed Race	35	87	24.1

N does not equal 150 in some cases due to missing values (refusal/don't know).

*AA=African American

Table 3. Bone Mineral Status

Bone Mineral Status	N=150		
	Frequency	Percent	95% CI
Normal (T-score >-1.0)	101	67.3	59.4-74.3
Osteopenic (T-score <-1.0)	35	23.3	17.3-30.7
Osteoporotic (T-score <-2.5)	14	9.3	5.6-15.0

Risk Factor Assessment

Table 2 lists the risk factors that were considered. Multiple logistic regression analysis (Table 4) was used to estimate the odds ratio of low bone mass (T-score <-1.0) related to potential risk factors. A number of factors (diabetes, asthma, fracture history, alcohol use, education, reproductive history, hysterectomy, oophorectomy, current use of hormone replacement therapy, number of years of education, smoking status, and menopausal status) were included in the initial model and a backwards stepwise procedure was used to reach a final model. Backward stepwise is a regression modeling method that initially places all potential predictors in the model and then removes those that do not make a statistically significant contribution. At each step the model is re-estimated and predictors removed until all predictors in the model are statistically significant.

In the final model, lifetime incidence of at least 1 fracture, multiparity, post menopausal state, and current smoking were associated with higher risk for low bone mass. No association was noted with past history of smoking or the number of packs smoked per year. The presence of diabetes and having more years of education emerged as being protective. Diabetes showed a protective effect ($P=.014$) irrespective of Body Mass Index (BMI). Higher BMI was not found to be protective against low bone mass in our study subjects. Estrogen therapy, either current or past, did not confer statistically significant protection from low bone mass.

Subject Perception

The subjects were asked if they considered themselves to be at high, medium, or low risk and if they were aware of any risk at all. This risk was not further quantified. Many of the subjects (46%) did not know what their risk for osteoporosis was, whereas 21% felt that they were at low risk. Only 31% of the subjects thought they were at moderate to high risk for osteoporosis (Figure 1). There was no correlation between the perceived risk and prevalence of low bone mass. The correlation between perceived risk and T-score was 0.095 (Kendall's tau), $P=0.13$ (Table 5).

DISCUSSION

This study observes a substantial prevalence of low bone mass among AA women in Milwaukee, Wis. Specifically, based upon calcaneal bone mass measurement, 23.3% of these AA women >45 years were osteopenic and 9.3% were osteoporotic. Moreover, almost half of the women >60 years had low calcaneal bone mass. This is in accordance with other population-based studies that showed similar prevalence patterns,^{8,15} however, this study is the first to analyze osteoporosis risk factors along with reporting prevalence data. Importantly, approximately two thirds of these AA women did not know whether they were at any risk for osteoporosis, or perceived their risk to be low. These results are in agreement with a previous study evaluating knowledge regarding risk factors and prevention and confirm that there is a significant need to improve awareness of osteoporosis risk factors, prevention, and treatment among AA women.¹² As bone mass measurement may be a valuable tool in assessing osteoporosis risk, it is important to note that AA women are not screened at the same rate as white women and also not treated to the same extent, even if there is established low bone mass.^{16,17} Clearly, understanding disease perception among AA women, and their physicians, is important in designing optimal prevention strategies and requires investigation.

It is reasonable to assume that such prevention strategies will include optimization of calcium and vitamin D status. Though calcium intake was not formally assessed, half of these women reported lactose intolerance, thereby making dietary calcium inadequacy likely. This is consistent with earlier reports suggesting a high prevalence of lactose intolerance in AA women with consequent low dietary intake of dairy products.¹⁸⁻²⁰ Additionally, only 26% of our subjects were taking any calcium supplements, and not necessarily in adequate amounts. Moreover, due to greater skin pigmentation, AA women synthesize less vitamin D per unit sun exposure than do white women, making vitamin D inadequacy more common.^{21,22} It is probable that this often leads to secondary hyperparathyroidism and subsequent bone loss.^{23,24} Reasons for the low frequency of calcium supplementation could include lack of awareness among patients, absence of specific physician guidelines regarding calcium/vitamin D supplementation in AA women, or the incorrect perception that osteoporosis does not occur in AA women. Further studies are needed to assess the role of calcium and vitamin D in maintaining bone health in AA women.

The high multiracial prevalence in this study emphasizes the heterogeneity present among self-described

Table 4. Multivariable Logistic Regression of Low Bone Mineral Density Risk Factors on Bone Density Status

Risk Factor	Coefficient	SE	Odds Ratio (95% CI)	P value
Diabetes				
No	-1.446	.586	1.00	.014
Yes	-1.446	.586	0.236 (0.075 – 0.742)	.014
Fracture				
No	1.012	.411	1.00	.014
Yes	1.012	.411	2.752 (1.230 – 6.154)	.014
Parity				
<2 children	0.828	.397	1.00	.037
>2 children	0.828	.397	2.289 (1.052 – 4.980)	.037
Education				
< High school graduate	-1.125	.511	1.00	.028
> High school graduate	-1.125	.511	0.325 (0.119 - 0.885)	.028
Smoking				
Never/past	1.095	.458	1.00	.017
Current	1.095	.458	2.988 (1.217 – 7.337)	.017
Menopause				
Pre/perimenopausal	1.298	.545	1.00	.017
Post/hysterectomy	1.298	.545	3.663 (1.258 – 10.660)	.017

Diabetes, fracture, categorical: no=0/yes=1

Parity, categorical: <2 children=0/>2 children=1

Education, categorical: <high school=0/>high school=1

Smoking, categorical: past or never=0/current=1

Menopause, categorical: premenopausal or perimenopausal=0/post=1

Outcome variable: Normal bone density, T score >-1.0; Osteoporosis/osteopenia, T score <-1.0=1; Hosmer-Lemeshow chi-square (df=8) = 9.930 (P=.270); N=150

Table 5. Comparison of Risk Perception and T-Score

Risk Perception	N	Mean T-score (SD)	Group Comparisons Significance (P)*			
			Don't Know	Low	Medium	High
Don't know	69	-.697 (1.5)	—	0.91	0.67	0.74
Low	32	-.406 (1.4)	0.91	—	1.00	1.00
Medium	28	-.261 (1.2)	0.67	1.00	—	1.00
High	18	-.222 (1.3)	0.74	1.00	1.00	—

ANOVA: F ratio=0.996, P=0.397

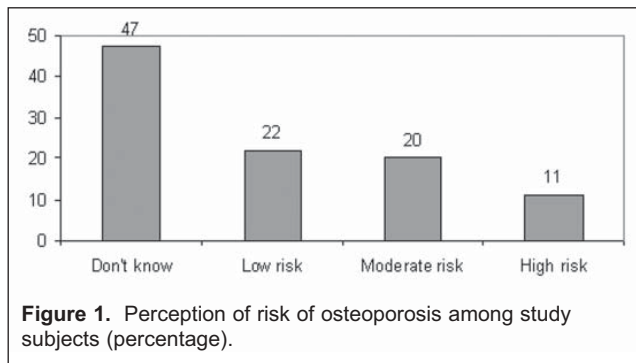
There was no association between perception of osteoporosis risk with calcaneal T-score.

*Hochberg post hoc test

African-American women. This heterogeneity serves as a reminder that utilization of osteoporosis risk factors, for example skin color, do not allow reliable prediction of bone mass. In a similar vein, increased body fat may be viewed as being protective against osteoporosis,^{25,26} when, in fact, we found a high prevalence of low bone mass despite the fact that 50% of our study subjects were obese (BMI ≥ 30). Moreover, regression analysis did not show that higher BMI was protective against bone loss in this study population. Thus, being AA and

overweight does not assure that an individual's bone mass is normal. Recognizing that "risk factors" may not allow prediction of skeletal status in AA women, measurement of bone mass should be considered when such knowledge would alter therapy.

The absence of bone mass protection by estrogen therapy in this study is surprising. However, to our knowledge there are no reports evaluating the skeletal effects of estrogen in postmenopausal AA women. Such absence of data in AA women makes it difficult



for them, and their physicians, to adequately assess the risk benefit ratio of this therapy.²⁷ This emphasizes the need to specifically study the skeletal effects of hormone replacement in AA women rather than simply assume that data generated in largely white populations will be directly applicable.

The relationship between diabetes mellitus (DM) and osteoporosis is unclear; some earlier reports have suggested that older women with Type II DM have higher bone mineral density.^{28,29} Data from our current study also suggest that DM may have a protective effect on bone mass in AA women. This does not appear to simply be weight-related, as DM emerged as a protective factor irrespective of BMI. It is plausible that the lower levels of sex-hormone binding globulin seen in diabetic women, with associated higher free testosterone concentration, could have contributed to the higher bone mass observed.³⁰ Further evaluation of the impact of diabetes on bone mass in AA women is clearly indicated.

Other potential risk factors included education, smoking, and a previous fracture. In this study, greater education showed a protective effect against low bone mass, possibly suggesting that education and awareness may have an important role in preventing and treating this disease. Additionally, current smoking is associated with low bone mass, perhaps due to decreased calcium absorption.^{31,32} Past smoking did not have any impact on the bone mass, suggesting that smoking cessation may be an important preventive measure to prevent future bone loss. Consistent with prior reports, a history of any fracture (traumatic or nontraumatic) in the past is associated with low bone mass and fractures.^{33,34}

A limitation of this study is that ethnicity, health status, and risk factors are self-reported and without independent validation. Moreover, this is a sample of volunteers derived from the community and is not a population-based study. Finally, it could be argued that application of the WHO criteria to calcaneal ultrasound is inappropriate.³⁵ However, recent large studies continue

to apply the WHO criteria to peripheral measurements and suggest that peripheral bone density results were highly predictive of fracture risk.^{8,14} Other studies have also suggested that the ability of low bone mass (as measured by calcaneal ultrasound) to predict future fracture risk is similar to dual energy x-ray absorptiometry, the current diagnostic gold standard.³⁶⁻³⁹ Thus, while application of arbitrary diagnostic cutoff points of -1.0 and -2.5 may be controversial, this does not negate the observation that many AA women have “low” bone mass.

CONCLUSION

Our study is the first to assess the prevalence and awareness of low bone mass in urban-dwelling African American Wisconsin women. One third of AA women ≥ 45 years and almost half >60 years have low calcaneal bone mass. One could postulate that this higher-than-expected prevalence in these relatively young women (mean age 54 ± 7 years) is related to inadequate vitamin D status related to limited sun exposure during the winter, especially given the geographic location of this study population and a mixed racial profile despite the broad self-reported category of being an African American. Low awareness about this disease among AA women suggests that there is a greater need for education regarding osteoporosis. Larger epidemiological studies with validated screening instruments for risk assessment need to be conducted to further assess the preliminary findings of our study.

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Wisconsin Medical Journal

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