

The Incidence of Osteoporosis Among Filipinos Based on Calcaneal Quantitative Ultrasonography

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With the aging of the world's population, osteoporosis has emerged as a formidable health concern. Bone mineral density (BMD) is the only available clinical parameter for bone strength evaluation and is determined through the use of dual energy x-ray absorptiometry (DEXA), the gold standard for the diagnosis of osteoporosis, and peripheral DEXA, such as calcaneal quantitative ultrasonography (QUS). This is a cross-sectional, descriptive study which aimed to determine the prevalence of osteoporosis among Filipinos, based on T-scores utilizing calcaneal quantitative ultrasonography. Baseline bone mineral density of 20,726 Filipinos were gathered based on the T-scores from calcaneal quantitative ultrasound results. The WHO criteria standardized the classification of BMD based on T-scores. Results showed that 3 percent of Filipinos were osteoporotic, 22 percent were osteopenic, while the rest were normal. The female sex and advanced age were key determinants of osteoporotic risk whereas geographic location appears to have no influence.

Key words: osteoporosis, calcaneal quantitative ultrasonography

Introduction

Elderly people are the fastest growing population in the world. Based on the physiology of aging, as people age, bone mass declines. Osteoporosis is a disease characterized by reduction in the bone mass and disruption of bone architecture leading to impaired skeletal strength and an increased susceptibility to fractures. The social and economic burden of osteoporosis is increasing steadily because of the aging of the world population. As the average life span increases, osteoporosis is a growing health concern in both the developed countries in Europe and North America and the developing countries in Asia and Africa. Women especially, are at higher risk than men of developing osteoporosis as a result of naturally lower peak bone mass and rapid bone loss after menopause. Currently, about 200 million women are afflicted with this condition throughout the world, making osteoporosis a major issue in the area of women's health. To address this concern, the North American Menopause Society has already come-up with an evidence-based position

statement in the management of osteoporosis in postmenopausal women.

Although commonly affecting post-menopausal women, the prevalence of osteoporosis in the older age groups and in the male population, should not be overlooked. More than 10 million people in the United States are afflicted with this condition and is 4 million more Americans are projected to have in the next ten years. Based on these statistical figures, osteoporosis, without a doubt, is the most common bone disorder affecting humans. It is a skeletal disorder characterized by compromised bone strength predisposing a person to fractures. Bone strength, and as a consequence, fracture risk, is dependent on bone quality and BMD, which is a function of peak bone mass and how much bone is subsequently lost. Key determinants of an individual's bone mineral density include race, behavior, nutrition, co-existing medical conditions, sex and age. Osteoporosis in postmenopausal women demonstrates the interplay of these important factors. Other qualities of bone such as degree of mineralization, collagen structure and heterogeneity of

bone microstructure are difficult to measure in clinical practice, making BMD the only measurable clinical parameter of bone strength. Therefore, assessment of existing bone mass, determining the fracture risk based on this clinical assessment, and making decisions regarding the appropriate therapeutic intervention, are the ultimate goals when evaluating a patient for osteoporosis.

The WHO established diagnostic criteria on the basis of the BMD T-scores. The T-score describes the patient's BMD in terms of the number of standard deviations by which it differs from the mean peak value in young, healthy persons of the same sex. A threshold of 2.5 SDs below the mean of young adult women was set as the threshold for the diagnosis of osteoporosis. The criterion for a diagnosis of osteopenia or low bone mass, is more than 1.0 SD but less than 2.5 SDs below the reference mean. With BMD as the standard tool used in the diagnosis of osteoporosis, several methods of imaging have been developed to measure BMD. Central Dual Energy X-ray Absorptiometry (DEXA) is considered the gold standard of methods used to diagnose osteoporosis. This test is capable of measuring bone mineral content at any site in the body but usually is used at central sites such as the lumbar spine and the proximal femur. Peripheral DEXA techniques analyze BMD at other sites such as the distal radius and the calcaneus. Although less useful in the determination of the actual presence of osteoporosis as compared to measurements made in the proximal femur and spine, BMD values obtained by peripheral techniques are still useful for screening patients who would warrant further assessment. The Quantitative Ultrasound (QUS) Method utilizes the basic principles used in ultrasonography in determining bone mineral density. It is a more affordable and radiation-free technology and can identify women who are likely to experience osteoporotic fractures. QUS directly measures skeletal parameters involved in bone biomechanical resistance, hence reflecting fracture risk. Despite several investigations showing that QUS displays diagnostic properties similar to those of BMD, the ability of QUS to quantify the risk of future fracture has been disputed. Recent studies have proven however its utility in the determination of fracture risk.³ It is now the most commonly employed method of determining BMD and has gained importance in situations where DEXA is not available. Aside from being cost effective, it lacks deleterious effect of radiation. It is portable and can be an indispensable tool in the screening for osteoporosis so that intervention can be done early to such patients.

The clinical and economic burden of osteoporosis can be staggering when quantified. Hip fractures, long considered more devastating than any other type of osteoporotic fractures are projected to quadruple in the next 40 years.¹ Vertebral fractures, are also associated

with an increased incidence of morbidity including back pain, height loss, deformity, disability and mortality. The direct medical cost from these represents a greater burden than the projected annual costs of stroke, breast cancer, diabetes or chronic lung disease. Clearly, the clinical and economic consequences of osteoporosis call for a concerted effort to assess patients at risk to allow for prevention and early intervention when appropriate.

The tremendous impact of osteoporosis undoubtedly makes it a major public health concern. In the Philippines, the exact prevalence of people with osteoporosis, or at least those with increased fracture risk, is still undetermined. This study was thus undertaken to determine the incidence of osteoporosis among Filipinos based on determination of calcaneal qualitative ultrasonography in representative populations in key locations in the archipelago. Knowledge of such can help direct public health efforts in coming up with programs addressing prevention to help decrease the socio-economic burden of this condition.

Objectives

General Objective

To determine the prevalence of osteoporosis among Filipinos, based on T-scores utilizing calcaneal quantitative ultrasonography.

Specific Objectives

1. To determine the percentage of normal, osteopenic and osteoporotic Filipinos based on T-scores utilizing calcaneal quantitative ultrasonography.
2. To determine the prevalence of osteoporosis among Filipinos in different age groups.
3. To correlate age, sex and geographic location with fracture risk among Filipinos.
4. To identify the factors influencing risk among Filipinos.

Materials and Methods

Study Design

We performed a cross-sectional, descriptive study of baseline bone mineral density of Filipinos based on T-scores gathered from calcaneal, quantitative ultrasound results of the 20,726 subjects included in this study. Age distribution was as follows: 18-25 (N=2026), 26-35

(N=4600), 36-45 (N=4904), 46-55 (N=4767), 56-65 (N=2722) and >65 (N=1707). The data were collected from different schools, community centers, offices and hospitals throughout the archipelago, covering Luzon, Visayas and Mindanao.

Patient Population

The patient population in this study included Filipino males and females, aged 18 years old and above, who consulted for bone mineral density determination at the different testing centers of an osteoporosis awareness advocacy group, which included schools, community centers, offices and hospitals located in Luzon, Visayas and Mindanao, from August 2006 to May 2007.

Methodology

Demographic and socioeconomic measures used in this analysis were taken prior to testing, including age at enrollment, race and sex. The categories of the participants' geographic region were Luzon, Visayas and Mindanao.

Bone mineral density was measured at the calcaneus by quantitative ultrasonography (QUS) using the Achilles InSight QUS System (General Electric Healthcare) and T-scores were computed based on the WHO criteria. Trained technicians used standard protocols for positioning and analysis. Analysis of the collected data was performed to determine the prevalence of individuals with normal BMD, with osteopenia and with osteoporosis based on predetermined categories such as sex, age and geographical location.

Statistical Analysis

Descriptive statistics was used to analyze the data gathered from this study.

Results

A total of 20,726 subjects were included in the study. Fifteen thousand one hundred one (72.86%) of the population were of females. The 36-45 age group had the most number of enrolled subjects (Table 1). Seventy four percent of the total population were normal as per WHO criteria T score (Table 2), whereas 4638 (22%) had osteopenia and 718 (3%) had osteoporosis.

Among the total osteopenics, the highest incidence was noted in the 46 to 55 age group at 1135 (24%) followed by those in the 56 to 65 age group at 1037 (22%). The

Table 1. Distribution of subjects by sex and age.

Age	Male	Female
18-25	449	1577
26-35	1218	3382
36-45	1466	3438
46-55	1323	3444
56-65	795	1927
>65	574	1333
TOTAL	5625 (27%)	15101 (73%)

Table 2. Distribution of subjects with normal bone mineral density, by sex and age.

Age	Male	%	Female	%	Total	%
18-25	417	10	1364	12	1781	12
26-35	1048	25	2825	25	3873	25
36-45	1175	28	2742	25	3917	25
46-55	967	23	2533	23	3500	23
56-65	446	10	1097	10	1543	10
>65	214	5	342	5	756	5

osteoporotic population, consisted mostly of the greater than 65 age group with 332 subjects (46%). This is followed by the 56 to 65 age group with 142 (20%) and the 46 to 55 age group with 132 (18%). Following the age-wise trend, more than 80 percent of those diagnosed with osteoporosis belong to the older age bracket, specifically, those greater than 45 years old. The incidence of osteopenia followed a similar trend, with more than 50 percent falling under the greater than 45 age group.

Among the male subset of the population, 4267 (76%) have normal bone mineral densities while 22 percent (1232) were osteopenic and 22% (126) were osteoporotic. The proportion of normal, osteopenic and osteoporotic subjects in the subgroup of the women follow the same pattern with 11103 (74%) being normal, 3406 (23%) being osteopenic and 718 (4%) being osteoporotic. Among the osteoporotic women, 51 percent were in the greater than 65 age group. A point by point comparison with the same

age group in the male osteoporotic subset showed a prevalence of 28 (22%). Thirty seven percent of the male osteoporotics belonged to the 56 to 65 age group (Table 3). The prevalence of osteopenia in the different age groups in both sexes had comparable values (Table 4).

Table 3. Distribution of subjects with osteoporosis, by sex and age.

Age	Male	%	Female	%	Total	%
18-25	2	2	1	0	3	0
26-35	3	2	36	6	39	5
36-45	15	12	55	9	70	10
46-55	32	25	100	17	132	18
56-65	46	37	96	16	142	20
>65	28	22	304	51	332	46

Table 4. Distribution of subjects with osteopenia, by sex and age.

Age	Male	%	Female	%	Total	%
18-25	30	2	212	6	242	5
26-35	167	14	521	15	688	15
36-45	276	22	641	19	917	20
46-55	324	26	811	24	1135	24
56-65	303	25	734	22	1037	22
>65	132	11	487	14	619	13

While studying the correlation between osteopenia and osteoporosis and other variables, it was noted that the prevalence of osteoporosis in the different regions of Luzon, Visayas and Mindanao were 4 percent (256), 3 percent (238) and 4 percent (252), respectively. Two hundred thirty six (1%) of the subjects with osteoporosis came from Luzon, while 239 (1%) came from the Visayas, and 243 (1%) came from Mindanao.

Discussion

Osteoporosis is a skeletal disorder characterized by low bone mineral density with compromised bone strength leading to increased susceptibility to fractures, especially of the hip, spine and wrist.⁴ It is the most common bone disease affecting more than 25 percent of Americans, 80

percent of whom are women, mostly from the postmenopausal age group. At present, there is no available data in literature documenting the actual incidence of osteoporosis in Filipinos. Considering the tremendous impact of this disease process, such figures can result in ground-breaking changes in both individual and public health concerns in the country. The present study utilized T-scores as determined by bone mineral density based on calcaneal quantitative ultrasonography (QUS). Although central DEXA remains to be the gold standard for the diagnosis of osteoporosis, calcaneal QUS is utilized when dual-energy x-ray absorptiometry is not available or affordable. The Philippine health system, at present, is not armed with the logistics to support central DEXA screening for its people. Hence, calcaneal QUS is becoming a widely-used tool for peripheral bone densitometry. This study realizes the limitations of the calcaneal QUS in the diagnosis of osteoporosis but recognizes its clinical utility in screening for the likelihood of osteoporosis and whether further evaluation is warranted.

From the data gathered, only 3 percent Filipinos were osteoporotic based on calcaneal QUS results. This would mean that this percentage of the population is considered to be at high risk for fracture. The percent estimates of osteoporotics among Americans and Filipinos are wide apart. This could be ascribed to the differences in bone mineral density determination. In the American estimate, DEXA was used. Although the coefficients of variance between ultrasonography and DEXA at the same skeletal sites have been found to be as high as 0.8 and 0.9, QUS measurements at peripheral skeletal sites do not correlate with DEXA measurements at central sites sufficiently to allow quantitative ultrasonography as a substitute for DEXA for diagnostic testing. However, a recent meta-analysis on the accuracy of quantitative ultrasound for identifying patients with osteopenia showed that there are no available well-designed studies which would totally invalidate the utility of QUS in osteoporosis diagnosis.² It is prudent at this point to interpret results from QUS with caution. But, with a specificity of 71 percent and a sensitivity of 87 percent, its prime clinical use as an aid to therapeutic decision-making in patients with osteoporosis, cannot be undermined.¹⁹ While the American and Filipino prevalence rates cannot be accurately compared due to the different modes of diagnosis, the reliability of the determined values from this study cannot be easily disregarded.

Aside from the difference in the method of diagnosis used, race could be a significant variable influencing the disparity between the American and Filipino values. For the purposes of this study, this assumption is difficult to quantify. In the study of Women's Health Across the Nation, it was observed that ethnic variations in the bone

mineral density. African Americans were noted to have the highest lumbar bone mineral density value compared to other races.³ White and Asian races are considered to be risk factors for osteoporosis.

The current study noted that 84 percent of those at high risk are women. This signifies the strong correlation between fracture risk and sex, independent of race. This also demonstrates that there is still a correlation between data gathered from central DEXA and calcaneal QUS, giving support to the role of the latter in osteoporosis screening. By age 50, a white woman has about a 40 percent lifetime risk of a fracture of the hip, spine or distal forearm, whereas a white man of this age has a 13 percent risk.² This signifies the role of hormone levels and bone mineral density in women. Menopause further characterizes how associated withdrawal of circulating estradiol and progesterone can produce injurious effects on bone metabolism. Such mechanisms are not at play in the physiology of the aging male. Therefore, more significant than sex, the role of a woman's age in fracture risk is recognized. Eighty one percent of those with T-scores in the osteoporotic range were women 46 years old and older. The increased rate of bone resorption immediately after menopause clearly indicates a hormonal influence on bone density in women. This increased resorption is secondary to drop in ovarian estrogen production that accompanies menopause. Decreases in estrogen levels increase bone resorption by lengthening the life span of osteoclasts and decrease bone building by shortening the life span of osteoblasts.¹

On the other hand, age is an important risk factor in fracture risk among males. Though males of the same age group comprised only 13 percent of the total osteoporotics in this study, 83 percent of them come from the "greater than 45 years" age group. This could be attributed to age-related changes in bone metabolism at play in both men and women. Bone mass declines progressively with advancing age, regardless of sex. Aging leads to increased bone loss, leading to low bone density, and finally resulting to increased susceptibility to fractures.¹ Efforts to prevent and treat osteoporosis should not be exclusively focused on females. Based on the results of this study, the incidence of osteoporosis in the younger age groups, those 45 years old and younger, is only 1 percent or less. Since aging may not be the likely causative factor in these cases, investigation for other causes of bone loss should be conducted. This however, is beyond the scope of the current study.

There's almost equal geographic distribution of patients with osteopenia and osteoporosis. Even the incidence rates of osteoporosis and osteopenia in Luzon, Visayas and Mindanao are comparable. Geographic location is thus not a major determining factor for the risk of osteoporosis among Filipinos. This factor could be

significant in situations when it can affect the lifestyle of a certain population and predispose them to the development of osteoporosis. Several lifestyle factors are associated with the risk of low BMD and fracture. These include nutrition and physical activity.³

Calcium and Vitamin D have well-known roles in bone metabolism. Adequate intake of calcium and vitamin D is required throughout life to achieve the genetically determined peak bone mass and maintain optimal bone mass and strength. The maximum amount of bone an individual acquires during the first two decades of life is an important determinant of bone mass throughout the rest of life and probably of subsequent fracture risk.² The incidence of osteoporosis in the youngest age group 18 to 25 in this study is less than 1 percent, while the incidence of osteopenia is 12 percent. Knowing the physiology of bone strength acquisition, preventive bone health in terms of dietary supplementation with calcium and vitamin D would logically be most effective in this age group. Calcium supplementation especially in girls two years after the onset of menses, enhances bone mineral acquisition.⁴

While there are notable differences in the incidence of osteoporosis between sexes and across age groups in this study, the prevalence of osteopenia is similar in males and females, with gradual increase in the incidence as the age advances. This group of patients may provide a window of opportunity for intervention. In a study published in the *Cleveland Clinic Journal of Medicine* in 2006, it was recommended that if DEXA is unavailable or unaffordable, treatment to prevent fractures should be considered for patients with a quantitative ultrasonographic T-score of 1.0 or lower. Based on this recommendation, patients diagnosed with osteopenia by QUS would warrant calcium and vitamin D supplementation. Since more data are needed to develop for using quantitative ultrasonography effectively for screening, and since differences in machines, reference databases and skeletal sites measured make it impossible to establish universal screening thresholds, it may be prudent to follow this recommendation at this time.

Conclusion

This research aimed to determine the incidence of osteoporosis among Filipinos. Based on the results of this study, the prevalence of osteoporosis is 3 percent. The incidence of osteopenia is 22. Osteoporosis were noted to be more prevalent in women, with most of the subjects in the "46 years old and above" age group. Whereas age and sex are important risk factors, geographic location does not appear to influence the incidence of osteoporosis among Filipinos. There is still debate regarding the utility

of calcaneal quantitative ultrasonography in the diagnosis of osteoporosis, in cases where DEXA is unavailable or unaffordable, treatment to prevent fractures should be considered for patients with a quantitative ultrasonographic T-test of -1.0 or lower.

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