ORIGINAL ARTICLE

Major and minor discordance in the diagnosis of postmenopausal osteoporosis among Indian women using hip and spine dual-energy X-ray absorptiometry

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ABSTRACT

Objective: To determine discordance in the diagnosis of osteoporosis among postmenopausal Indian women using hip and spine Dual-energy X-ray Absorptiometry.
Materials and Methods: The study included postmenopausal women who underwent bone mineral densitometry (BMD) for suspected osteoporosis at a referral hospital at Hyderabad, India. The BMD measures at the hip and spine were used to derive T-scores and to determine the prevalence of discordance. Factors potentially associated with discordance were explored in univariate and a multivariate regression model.
Results: The mean age of the 348 postmenopausal women in the study was 53.62 ± 8.94 years (median 53.00 years, range 27.00 to 84.00 years). Major discordance was seen in 16.67% (95% confidence intervals [CI]: 12.73, 20.60) of the study population and minor discordance in 34.48% (95% CI: 29.46, 39.50%) of the study population. Age >50 years (adjusted odds ratios [OR]: 2.60, 95% CI: 1.24, 5.46, *P* value = 0.01), premature menopause (adjusted OR: 2.94, 95% CI: 1.27, 6.81, *P* value = 0.03), and multiple pregnancies (adjusted OR: 2.64, 95% CI: 1.28, 5.41, *P* value = 0.008) were found to be significantly associated with major discordance.
Conclusions: The large prevalence of discordance may reflect the differences in osteoporosis in different populations and suggests the need to redefine ranges and risk factors used for the diagnosis of osteoporosis in India.

Key Words: Bone mineral density, discordance, dual-energy X-ray absorptiometry, osteoporosis

INTRODUCTION

Osteoporosis in postmenopausal women is a major public health problem worldwide. There is an increasing incidence of osteoporosis worldwide as the population demographics shift toward aging. Currently, approximately 30% of postmenopausal Caucasian women in the USA have Osteoporosis with the proportion of women with osteoporosis increasing to 70% in women over the age of 80 years.[1] A major effect of osteoporosis is fractures with nearly 1.5 million fractures annually attributable to osteoporosis.[2] Nearly 50% of women and one in eight men over the age of 50 years may have an osteoporosis-related fracture in their lifetime.[3] An estimated 61 million women are affected with osteoporosis in India.[4-8] Studies have reported lower bone density among Indian women with osteoporotic fractures occurring 10 to 20 years earlier among Indians compared to their North American or European counterparts.[4]

The diagnostic workup of osteoporosis currently involves the risk factor assessment and the bone mineral density (BMD) measurements at two sites—the hip and the lumbar spine.[9] These are used to derive T-scores for the hip and spine that denote the difference in the BMD of a patient and the mean BMD of a normal population aged 20 to 30 years. The World Health Organization (WHO) classifies osteoporosis as a T-score < −2.5 and osteopenia as a T-score between −1 and −2.5.[9,10] The FRAX module includes specific risk factors and BMD at hip.

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The tests measurement of BMD at two different sites may differ leading to discordance of the results. Discordance in the diagnosis of osteoporosis using BMD will involve different categories of T-scores (normal, osteoporosis, and osteopenia) at the two sites of a patient.[11] Discordance is further classified as major and minor discordance. Major discordance occurs when the T-score at one site indicates osteoporosis and normal at the other site.[12] Minor discordance occurs when the T-score at one site indicates osteoporosis and osteopenia at the other site, or osteopenia at one site and normal at the other site.[12] Concordance occurs when the T-scores at both sites indicate osteoporosis or osteopenia or normal. Early identification of osteoporosis is essential to prevent or delay the possibility of osteoporotic fractures and their consequences and discordance assumes significance as it can alter the diagnostic and therapeutic plan for a patient.

This study aimed to determine the prevalence of discordance in the diagnosis of osteoporosis using Dual-energy X-ray Absorptiometry (DXA) at the hip and spine, and to determine if there are any risk factors that may predict discordance.

MATERIALS AND METHODS

The study included postmenopausal women who underwent BMD as part of a diagnostic workup of osteoporosis at a referral hospital over a period of one year at Hyderabad, India. Women were enrolled into the study after providing details of DXA and its routine use as part of the diagnostic work up, and after obtaining informed consent. The study adhered to the tenets of the Declaration of Helsinki. We defined menopause as the complete cessation of menstrual cycles and women with menopause from natural causes for a period of at least 1 year were included in the study. Women who had undergone hysterectomy and who had taken hormone replacement therapy or any anti-osteoporotic medication within the past 6 months were excluded from the study.

Each enrolled woman completed a questionnaire that collected sociodemographic details and known or suspicious risk factors for osteoporosis. The risk factors of interest included age at menopause, fragility fractures in the individual and family, calcium supplementation, steroid administration, alcohol intake, caffeine intake, the use of medications like eltroxin and anticonvulsants, history of multiple pregnancies, rheumatoid arthritis, diabetes mellitus, malabsorption, and prolonged lactation. Caffeine intake was defined as high if a person took more than 3 cups of coffee each day (each cup of 60 ml measure). A woman was categorized with history of multiple pregnancies if she had more than 3 pregnancies. Prolonged lactation was defined as lactation for more than 1 year. Medical risk factors and the use of medications were confirmed through patient medical records.

The height of each subject was measured using a standard tape and corrected to the nearest centimeter. The weight of each subject was recorded using a standard platform weighing scale and corrected to the nearest 0.5 kg. Body mass indices for each subject were calculated from the height and weight measures and were used to classify subjects as normal or obese.

Ethical consideration

The study was approved by the Independent Ethical Committee, Hyderabad.

Statistical analysis

BMD was measured at the lumbar spine and total hip with DXA (Hologic) by a trained operator who also calibrated the instrument as per the manufacturer's instructions.

The BMD measures at the hip and spine were used to derive T-scores and to determine the prevalence of discordance. Factors that may be associated with discordance were explored in a univariate analysis using the Chi-square test for categorical variables and the *t*-test for continuous variables. Factors that were found significant (P value < 0.25) in the univariate analysis were included in a multivariate logistic regression model that reported adjusted odds ratios (OR) and 95% confidence intervals (95% CI) around the adjusted OR. We considered a P value of <0.05 as statistically significant for the multivariate model. All statistical analyses were performed using STATA Version 8.0 (STATA Corporation, College Station, Texas).

RESULTS

The study included 348 postmenopausal women. The mean age of women in the study was 53.62 ± 8.94 years (median, 53.00 years; range, 27.00 to 84.00 years). The characteristics of women in the study are as shown in Table 1. Discordance is shown in Table 2.

Prevalence of osteoporosis

Osteoporosis

- Total hip - 4.26% (95% CI: 2.2, 6.3)
- Lumbar spine - 22.07% (95 CI: 17.86, 26.28)

Osteopenia

- Total hip - 17.82% (95% CI: 13.91, 21.70)
- Lumbar spine - 35.11% (95% CI: 30.26, 39.95)

Perfect concordance was seen in 170 (48.85%) subjects (Normal: 120, Osteoporosis: 11, Osteopenia: 39) [Table 2].

Table 1: Characteristics of the study population

Parameter	Concordance (*n*=170) (%)	Discordance (Minor and Major) (*n*=178) (%)	*P value*
Mean age	52.93±9.19	54.29±8.66	0.16
Mean age at menopause	44.78±5.77	43.89±5.96	0.21
Premature menopause	30 (17.75)	56 (31.64)	0.003
Calcium supplementation	112 (65.88)	105 (58.99)	0.18
Fragility fractures	21 (12.43)	21 (11.86)	0.87
Family history fragility fractures	25 (14.71)	31 (19.66)	0.22
Steroid administration	11 (6.47)	11 (6. 18)	0.91
Alcohol	3 (1.76)	5 (2.81)	0.52
High caffeine	65 (38.24)	61 (34.27)	0.44
Eltroxin	16 (9.41)	25 (14.04)	0.18
Anticonvulsants	2 (1.18)	5 (2.81)	0.28
Multiple pregnancies	50 (29.59)	54 (30.34)	0.88
Rheumatoid arthritis	26 (15.29)	21 (11.80)	0.34
Prolonged lactation	47 (27.65)	49 (27.53)	0.98
Diabetes mellitus	16 (9.41)	19 (10.67)	0.70
Malabsorption	12 (7.06)	15 (8.43)	0.63
Obese	132 (78.11)	136 (77.71)	0.93

Table 2: Discordance in the T-scores using dual-energy X-ray absorptiometry

Hip	Spine			Total
	Normal	Osteoporosis	Osteopenia	
Normal	120	56	92	268
Osteoporosis	2	11	1	14
Osteopenia	11	16	39	66
Total	133	83	132	348

Of the 178 subjects with discordance, 58 (32.58%) had major discordance and 120 (70.58%) had minor discordance. Overall, major discordance was seen in 16.67% (95% CI: 12.73, 20.60) of the study population and minor discordance in 34.48% (95% CI: 29.46, 39.50%) of the study population.

The mean BMD hip (0.89 ± 0.19, 95% CI: 0.87, 0.92) was significantly lower (*P* = 0.003) than the mean BMD spine (0.94 ± 0.20, 95% CI: 0.92, 0.96). However, in subjects with discordance, the BMD spine was significantly lower than the BMD hip (0.71 ± 0.13 and 0.87 ± 0.12, respectively, *P* value = 0.0002). The mean age of women with osteoporosis by the hip DXA (63.60 ± 7.70 years) was significantly different (*P* = 0.01) from the mean age of women diagnosed with osteoporosis by the spine DXA (57.36 ± 9.07). The mean age of women with osteopenia by the hip DXA (55.38 ± 8.80 years) did not differ significantly (*P* = 0.16) from the mean age of women diagnosed with osteopenia by the spine DXA (53.59 ± 8.30).

In a multivariate logistic regression model, age >50 years (adjusted OR: 2.60, 95% CI: 1.24, 5.46, *P* value = 0.01), premature menopause (adjusted OR: 2.94, 95% CI: 1.27, 6.81, *P* value = 0.03), and multiple pregnancies (adjusted OR: 2.64, 95% CI: 1.28, 5.41, *P* value = 0.008) were found to be significantly associated with major discordance. Premature menopause was significantly associated with minor discordance (adjusted OR: 2.73, 95% CI: 1.47, 5.07, *P* value = 0.001).

DISCUSSION

A significant proportion (51.15%) of subjects in this study showed discordance in the diagnosis of osteoporosis using the WHO classification based on T-scores obtained through DXA at two sites. Minor discordance was more common (70.58% of all discordance) and probably was due to minor differences in the BMD technique or minor physiologic dissimilarities. Minor discordance may not influence the therapeutic plan unless one site is normal and the other site is determined to have osteopenia. It will be more appropriate in such situations to consider other risk factors and plan the management accordingly. Nearly one in five subjects (16.67%) had a major discordance. Our results indicate that BMD measurement at two sites is necessary among women aged >50 years, women with multiple pregnancies, and with premature menopause.

The causes for discordance can include physiologic causes, pathophysiologic causes, anatomic causes, artifacts, and technical problems in measurement.[12] Differential bone loss among different bones in the body may possibly explain the difference in BMD measures for the spine and hip.[13] Trabecular bones usually have a faster rate of loss compared to cortical bones like the femur.[14] Additionally, most

etiologies of secondary osteoporosis first affect the spine.[15] Weight bearing is also a cause for physiologic dissimilarity with increased bone density in the hip and femur region.[16]

Clinicians need to be aware of the possibility of discordance even with the gold standard test, DXA, and plan management strategies appropriately.[17-20] It is a moot point if the large prevalence of discordance is related to the cutoffs for definition of osteoporosis and osteopenia used by the WHO. Indian women suffer from osteoporotic fractures 10 to 20 years earlier and have lower BMDs compared to their American or European counterparts.[21,22] The lower bone density among Indians and the earlier onset of osteoporotic fractures among Indians indicate that the cutoffs may need to be revised appropriately for early identification of osteoporosis among Indians. A study on 450 urban healthy women between 25 to 75 years of age that determined the bone mineral density revealed that only 29% had normal T-score.[23] Several studies from India have reported that BMD values in Indian women were approximately 5 to 15% lower than those in Caucasian women.[24-28] Such a variation was also seen among Asian women residing in America.[29] Studies have reported that menopause occurs at a younger age in women in India compared to Caucasian populations.[30] Studies have also reported low Vitamin D levels in the Indian population.[31] Decrease in serum concentrations of vitamin D would induce reduction in density of cortical bones and may have a supportive role for density of trabecular bones.[32]

The results of our study cannot be generalized to a larger population (considering that the study center was a tertiary care referral center and that the patient characteristics may not be representative of the population at large); however, the majority of patients accessing our center belong to the middle socioeconomic class. Our results indicate that it is necessary to re-calculate ranges for the definition of osteoporosis and osteopenia specific to India and to use both hip and spine DXA for management of postmenopausal osteoporosis.

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