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Research Article

Prevalence and risk factors of low bone mineral density with quantitative ultrasonography among south Indian postmenopausal women

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ABSTRACT

Background: With increasing population and longevity of postmenopausal women, osteoporosis is becoming a public health concern. Community based studies regarding prevalence of low bone mineral density and related risk factors are limited in India. Objective of the study was to determine the prevalence of low bone mineral density among postmenopausal women using qualitative ultrasound method and to assess related risk factors.
Methods: This community based study comprised of 260 postmenopausal women aged 41-70 years living in rural and urban areas of Hyderabad, South India. A two stage simple random sampling technique was used. Data was collected on socio-demographic characteristics, fracture history, family history of fracture and osteoporosis, nutritional factors, lifestyle, personal and reproductive history from each subject. Bone mineral density was assessed by the speed of sound (m/sec) using a quantitative ultrasound device at distal forearm site. Descriptive statistics and frequency were generated for socio-demographic data. Risk factors were compared using Chi-square test for categorical variables on univariate analysis. Binary logistic regression model was used to identify significant factors independently associated with the low bone mineral density measurement
Results: The mean age at menopause was 44.7±5.4 and 44.9±5.2 years in rural and urban areas respectively. Osteopenia was present in 16% and 38% of rural and urban study subjects. Osteoporosis in 51% and 35% of rural and urban study subjects respectively. Significant independent risk factors for low bone mineral density were parity, duration following menopause and intake of calcium poor food.
Conclusions: The high prevalence of low bone mineral density among postmenopausal women in South India is a major public health concern which is amenable for prevention.

Keywords: Low bone mineral density, Osteoporosis, Post menopause, Ultrasonics, Risk factors

INTRODUCTION

Osteoporosis is often called the silent disease because bone loss occurs without symptoms. Osteoporosis is the most common among post-menopausal women due to the accelerated loss of bone mineral of 2-5% per year which is attributed to the loss of protective effect of estrogen.[1]

The prevalence of osteoporosis in Asia and Africa (developing countries) varies very widely from 5% to 68% among women aged greater than 50 years and the osteoporotic fractures estimation given by WHO in South East Asia was found to be 17.4%.[2] International osteoporosis fact sheet forecasts the worldwide cost burden of osteoporosis to increase to USD 131.5 billion

by 2050.[3] Therefore, osteoporosis is considered as a significant Public Health problem having a great impact on physical, psychological development, work performance and quality of life. It depends on the interaction of genetic, hormonal, environmental and nutritional factors. Thus, for the purposes of prevention and control, there is great interest in conducting epidemiologic surveys of the prevalence of osteoporosis and related risk factors in communities.

The optimal method for diagnosing osteoporosis is to measure bone mass by dual-energy X-ray absorptiometry (DEXA) at the hip and lumbar spine. However, it is very difficult to apply this procedure in community-based studies because of lack of portability, significant doses of ionizing radiation and cost. Quantitative ultrasound (QUS) measurement, a technique for measuring the peripheral skeleton, has been proposed because as it is relatively inexpensive, portable and involves no ionizing radiation. It has also been shown that ultrasound measurements of bone are highly reproducible (precision error of about 2-3%) and are comparable to dual-energy x-ray absorptiometry in predicting fracture risk by International quantitative ultrasound consensus group.[4]

In India very few studies have been carried out to determine the prevalence of osteoporosis among post menopausal women in rural/urban areas and most studies were Hospital based.[5,6] Therefore the purpose of the present study was to determine the prevalence of low bone mineral density using QUS method and related risk factors among postmenopausal women.

METHODS

Study design and study setting

A cross sectional study was conducted during November 2012 to April 2013 in rural and urban field practice areas of Osmania Medical College located at Hyderabad, capital city of Andhra Pradesh in Southern India. The rural health center has included three sub centers located 33kms from the college; the urban health center included 14 urban slums located 3 kms from the college.

Study subjects

Inclusion criteria: The study population comprised of - (a) Post-Menopausal women for at least 1 year and had attained natural menopause (WHO criteria); (b) Age group between 41 years to 70 years (The age of 40 years old was chosen as the first cut off point based on the WHO definition on natural menopause (WHO, 1980) and also based on pilot study.[7] The age of 70 years old was chosen as the second cut off point to avoid a recall problem); (c) Ambulatory and able to perform day-day activities.

Exclusion criteria: Premature menopausal (ovarian failure), surgical menopausal women, and women suffering with established diabetes, hypertension, thyroid disorders, renal disorders, bed ridden or currently taking oral contraceptives, hormone replacement therapy or steroid treatment were excluded.

Sample size calculation: The published figure of prevalence of osteoporosis among postmenopausal women by Indian Menopause Society is 30%.[8] The sample size was calculated to detect the prevalence of osteoporosis of 30% with 95% confidence and 20% as relative precision (limitation of financial resources) using $Z2\times p\times q/ d^2$ formula. The number of women needed to study was 233. Study subjects were randomly selected after a house to house survey using two stage sampling (lottery method). Accordingly four urban slums and one sub center having four villages were selected. The total number of women older than 40 years attained menopause were 395 in the Sub center and 458 in the four urban slums(source: household survey). A total about 305 postmenopausal women in rural and 255 women in urban slums were contacted. Of these only 202 rural women and 174 urban women fulfilled the selection criteria. None of them refused for the study. Of these, 130 women in rural and 130 women in urban areas were randomly selected from the eligible women ie.approximately 30-35 women from each village and slums as per feasibility to yield the desired sample. There by a total of 260 postmenopausal women were studied.

The purpose of the study was explained to the study subjects in their local language. Written informed consent in local language / finger print impression was collected from the participants. The questionnaire was translated to local language (Telugu) and back translated into the original (English) language. Ethical clearance for the study was obtained from institutional ethical committee of Osmania Medical College.

Data collection : Pre tested questionnaire schedule was used to collect information on socio-demographic characteristics, fracture history, family history of fracture and osteoporosis, nutritional factors, lifestyle, personal and reproductive history from each subject.

Nutritional history: Food frequency questionnaire was designed adopting Indian dietary guidelines consisting of 14 item calcium rich food such as ragi (finger millet), whole grain cereals, green leafy vegetables, milk, milk products, soya seeds, other soya products, sesame seeds.[9] These food items having taken for less than and equal to three days per week were considered as 'No' for calcium rich food consumption and greater than three days as 'Yes' for adequate calcium rich food consumption.

Physical activity measurement: Classification based on the reports of a joint FAO/WHO Ad Hoc Expert Committee was adopted wherein light physical activity was considered as inactive and moderate, very active and exceptionally active along with any form of interventional exercises was considered as active.[10]

Anthropometry measurement: Height (portable stadiometer with an error of ±0.1cm) and weight (Camry weighing scale with an error ±100 grams (China, Mainland) were measured while subjects were standing, wearing light clothing and no shoes. Body mass index (BMI) was calculated as the ratio of weight (in kilograms) to height (in meters) squared. Grades of obesity for Asians as per WHO were as used for classification.[11]

Bone mineral density measurement: Bone mineral density measurement was assessed by the speed of sound (m/sec) using a quantitative ultrasound device (Sunlight miniomni) manufactured by Beam med Limited (Israel) sponsored by Meyer Vitabiotics (Pharmaceutical company).

Data were collected in the local Panchayath office or Community Halls. For all subjects, speed of sound was measured at the distal end of right radius. The measurement was taken in a temperature controlled environment and was performed by a trained medical technician only. A phantom supplied by the manufacturer was used to calibrate the machine before each screening session.

The reference population consisted of normal young adult Asian subjects (Manufacturers database). The WHO operational definition of osteoporosis is the bone mineral density with T-Score -2.5 or less and osteopenia as bone mineral density between -1.0 and -2.5 was used for low bone mineral density.[12]

Statistical analysis

Data analysis was entered in Microsoft EXCEL 2007 and was analyzed using Statistical package for social sciences (SPSS) version 17. The descriptive statistics and frequency were generated for socio-demographic data. Risk factors were compared using Chi-square test for categorical variables on univariate analysis.

The main outcome variables were binary variables yes/no for a low bone mineral density measurement. Binary logistic regression model was used to identify significant factors independently associated with the outcome variable. A two- sided P-value of less than 0.05 was considered to be statistically significant.

RESULTS

Baseline characteristics of postmenopausal women

The mean age at menopause was 44.7±5.4 and 44.9±5.2 years in rural and urban areas respectively. Majority of the respondents were house-wives. The details of the socio demographic parameters provided in the (table 1).

Table 1: Baseline characteristics of the postmenopausal women.

Variables	Rural (N=130)	Urban (N=130)
Age	58.8± 9.4	55.46±8.4
Age at menopause	44.7± 5.4	44.9±5.2
Parity	3.5±1.7	3.0±1.4
Height	1.498± 0.05	1.47±0.05
Weight	49.41± 9.9	59.48±13.3
Body mass index	22.34±5.3	27.35±5.6
Mean T score	-1.69± 1.9	-1.59±1.6
Socio-economic status (BG Prasad's)		
Upper class	1 (0.8%)	23 (17.8%)
Upper middle	2 (1.5%)	18 (13.8%)
Lower middle	24 (18.5%)	45 (34.6%)
Upper lower	70 (53.8%)	35 (26.9%)
Lower lower	33 (25.4%)	9 (6.9%)
Occupation		
Professional	0 (0%)	1 (0.8%)
Semi professional	0 (0%)	1 (0.8%)
Clerk / shop owner / Farmer	7 (5.3%)	11 (8.5%)
Skilled	3 (2.3%)	9 (6.9%)
Semi-skilled	7 (5.3%)	2 (1.5%)
Unskilled	25 (19.1%)	13 (10%)
Unemployed/House wives	88 (68%)	93 (71.5%)

Unless otherwise noted, values are expressed as mean (standard deviation).

Bone mass measurement

Based on the diagnostic criteria, osteopenia was present in 16% and osteoporosis in 51% of rural study subjects. And osteopenia was present in 38% and osteoporosis in 35% of urban study subjects (Figure 1).

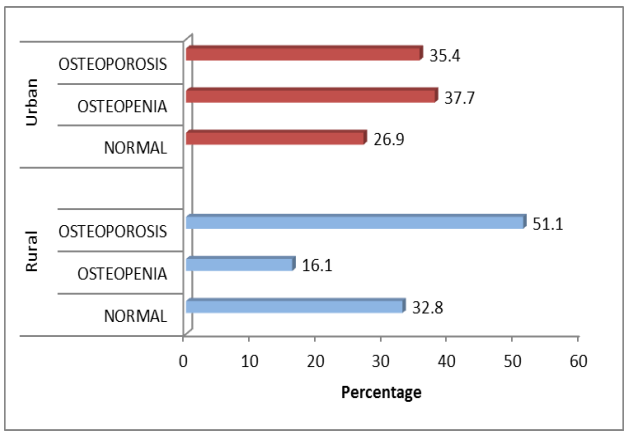

Figure 1: Bone mineral status using quantitative ultrasound technique.

Risk factors associated with low bone mineral density measurement

Table 2 lists the risk factors that were considered. From the univariate analysis - age, parity, duration following menopause, intake of calcium poor food per week, physical inactivity and tobacco usage were found significantly associated with low bone mineral density measurement. Family history of osteoporosis, history of fragile fractures and body mass index were not found significant. Binary logistic regression analysis using forward stepwise method including all these variables showed that age (odds ratio 1.160 per every year, 95% C.I. 1.077-1.249, P, 0.0001) and intake of calcium poor food per week (odds ratio 4.652, 95% C.I. 1.469-14.740, P, 0.009) were independently associated with low quantitative ultrasound values in rural areas whereas in urban areas age (odds ratio 1.101, 95% C.I. 1.010-1.22, P, 0.029), parity (odds ratio 2.018, 95% C.I. 1.262-3.226, P, 0.003) and duration following menopause (odds ratio 1.177 per every year, 95% C.I. 1.043-1.328, P, 0.008) were significant (Table 3).

Table 2: Comparison of the risk factors among normal and low bone mineral density (osteoporotic/osteopenic) subjects.

	Rural(N=130)			Urban (N=130)		
Risk factor	Normal (n=43)	Osteoporotic /Osteopenic (n=87)	P-value	Normal (n=35)	Osteoporotic /Osteopenic (n=95)	P-value
Age group (in years)						
41-50	21 (60%)	14 (40%)	0.0001	21(47.7%)	23 (52.3%)	0.0001
51-60	16 (40%)	24 (60%)		12 (21.1%)	45 (78.9%)	
>60	6 (10.9%)	49(89.1%)		2 (6.9%)	27 (93.1)	
Duration of menopause						
<5 years	16 (64%)	9 (36%)	0.0002	22 (52.4%)	20 (47.6%)	0.0001
5-10 years	15 (44.1%)	19 (55.9%)		10 (27%)	27 (73%)	
>10 years	12 (16.9%)	59 (83.1%)		3 (5.9%)	48 (94.1)	
Number of live borne						
<=3	28 (40%)	42 (60%)	0.070	27 (33.3%)	54 (66.7%)	0.034
>3	15 (25%)	45 (75%)		8 (16.3%)	41(83.7%)	
Intake of any calcium rich food per week						
yes	26 (49.1%)	27 (50.9%)	0.0001	17 (37.8%)	28 (62.2%)	0.042
no	17 (22.1%)	60 (77.9%)		18 (21.2%)	67 (78.8%)	
Physical activity						
Inactive	6 (13.4%)	39 (86.6%)	0.001	19 (27.1%)	51(72.9%)	0.951
Active	37 (45.1%)	48 (54.9%)		16 (26.7%)	44 (73.3%)	
Tobacco usage						
Yes	6 (11.7%)	45 (88.3%)	0.001	8 (36.4%)	14 (63.6%)	0.273
No	37 (46.8%)	42 (53.2%)		27(25%)	81 (75%)	
Body mass index						
Underweight	10 (40%)	15 (60%)	0.705	0 (0%)	0 (0%)	0.166
Normal	18 (32.1%)	38 (67.9%)		6 (18.8%)	26 (81.2%)	
Overweight and obesity	15 (30.6%)	34 (69.4%)		29 (29.6%)	69 (70.4%)	

Table 3: Binary Logistic Regression of low bone mineral density risk factors on bone density status.

Rural area			
Variables	**Odds ratio**	**95% confidence intervals**	**P-value**
Age	1.160	1.077-1.249	0.0001
Calcium poor food	4.652	1.469-14.740	0.009
Urban area			
Age	1.101	1.010-1.22	0.029
Parity	2.018	1.262-3.226	0.003
Years of menopause	1.177	1.043-1.328	0.008

DISCUSSION

The current study undertaken in a random sample of rural and urban postmenopausal women of Hyderabad demonstrated that the prevalence of osteoporosis was 51% and 35% respectively; the prevalence of osteopenia was 16% and 38% respectively.

In middle and low income countries like Korea, Chul Hee-Kim et al 46% of the subjects in this population had low quantitative ultrasound values T-score, <1.0 (osteopenia) estimated by QUS, and 11.8% among them had T-scores of less than 2.5 (osteoporosis).[13]

In India, a study conducted by Acharya Neema and Varade Shweta using QUS reported the prevalence of postmenopausal osteoporosis as 34% and 27% in rural and urban areas of Wardha.[14] Another study among postmenopausal women of rural Haryana and urban Delhi found 78% and 52% of Osteoporosis using DEXA.[15] This high variation of prevalence may be attributed to the technique adopted, site, use of normative data, sample size, setting and racial differences.

In our study statistically significant association of age, duration following menopause, parity, physical inactivity, calcium poor food and tobacco usage with low bone mineral density measurement was observed. These findings were similar to the study conducted in Spain.[16] Contrary to our study Fatemeh et al reported family history of osteoporosis and BMI as significant variables.[17]

Binary logistic regression of risk factors on bone mineral status found that age, parity, duration of menopause and intake of calcium poor food per week as the significant factors in the present study. Similarly a study among Pakistani women used binary logistic regression to determine independent predictors of low bone mineral density found BMI, smoking and family history of osteoporosis as predictors.[18]

The strengths of this study include the community based study, factors associated only with primary osteoporosis and the definition of the menopause using the World Health Organization (WHO) classification. Study limitations include the cross sectional study design, semi quantitative measure for the intake of calcium poor food per week using food frequency questionnaire and financial constraints resulting in not using DEXA method for validation.

Large prospective epidemiological studies for risk assessment need to be further conducted in the future.

CONCLUSION

This study revealed high prevalence of low bone mineral density measurements and their related risk factors which are amenable for prevention by following simple measures such as increasing the intake of calcium rich food, physical activity and adopting small family norms. Since it is related to considerable morbidity affecting quality of life, there is therefore an urgent need to screen for low bone mass and include this most vulnerable group in the existing reproductive and child health program to provide womb to tomb services.

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