Original Research Article

A community-based study to evaluate the prevalence and risk factors for osteoporosis among menopausal and pre-menopausal women

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ABSTRACT

Background: To determine the prevalence of osteoporosis among pre and post menopausal women using quantitative ultrasound of calcaneal bone and to identify the risk factors associated with osteoporosis.
Methods: This prospective community based epidemiological study was conducted during 2019 in a suburban area attached to Sri Muthu Kumaran Medical College Hospital and Research Institute, Chennai. 305 subjects met the inclusion and exclusion criteria. Using a structured questionnaire, demographic details, obstetric, gynaecological and medical history were collected. Quantitative ultrasound of the calcaneal bone was used to calculate the bone mineral density. Using statistical methods, risk factors for osteoporosis were analysed.
Results: The mean age of the participants was 52.67±9.41 years, 62.2% were post menopausal and 37.38% were premenopausal. The BMD 'T' score was normal in 29.8%, osteopenia was diagnosed in 38.4% and osteoporosis in 31.8% of participants. 14% of premenopausal women and 42.4% of postmenopausal women were osteoporotic. Age, menopausal status, duration of menopause, and previous history of fractures emerged as significant risk factors for osteoporosis.
Conclusions: The prevalence of osteoporosis is high among both pre-menopausal and menopausal women, but the awareness is limited. This study highlights the need for screening all women after the age of 40 years which is feasible using portable and easily available technology such as quantitative ultrasound of peripheral bones.

Keywords: Menopause, Osteoporosis, Risk factors, Screening

INTRODUCTION

Osteoporosis is a skeletal disorder which is characterized by reduced bone mass and micro-architectural deterioration of bone tissue, leading to bone fragility and an increased risk of fractures. Osteoporosis is a silent disease; if it remains undiagnosed and untreated nearly 60% of women will sustain fragility fractures during their life time.[1] The reported prevalence of osteoporosis among Indian women varies between 53% to 81%.[2,3] The current life expectancy for India in 2022 is 70.19 years.[4] There is a steady rise in the proportion of elderly population throughout the world.

Projections indicate that, globally, the life expectancy is expected to increase to 77.1 years in 2050.[5] In India, the life expectancy is expected to increase to 71 years by 2025 and to 77 years by 2050.[6]

With increasing life-expectancy more women are going to be diagnosed with osteoporosis and its associated morbidity. Most often, the diagnosis of osteoporosis is made only after the occurrence of the fractures. Osteoporosis related fractures can be prevented, if osteoporosis is diagnosed and treated early.

Objectives

The primary objective of this study was to determine the prevalence of osteopenia and osteoporosis among pre and post menopausal women and the secondary objective was to identify the risk factors associated with low bone mineral density.

METHODS

This was a prospective epidemiological study conducted in 2019 in a suburban area attached to Sri Muthu Kumaran medical college hospital, Chennai. The study was approved by the Institutional Ethics Committee. In order to create awareness among the public, one week prior to the camp, pamphlets describing the purpose and the benefits of the study were distributed in and around the area with the help of voluntary health nurses.

Inclusion criteria

Perimenopausal women ≥40 years and post-menopausal women who had attained surgical/natural menopause were included in the study.

Exclusion criteria

Women with chronic medical illness such as diabetes, renal, thyroid disorders, and those using medications that might affect bone mass such as corticosteroids, diuretics and hormone therapy were excluded from the study.

A total of 305 subjects met the inclusion and exclusion criteria. Informed consent was taken from each participant.

Using a validated structured questionnaire, demographic details, obstetric, gynaecological and medical history were collected. Food-frequency questionnaire (FFQ) was modified and validated to suit our patients and was used to assess the calcium, vitamin D and caffeine consumption pattern. Consuming fish at least once a week, taking 3 eggs a week and drinking 2 glasses of milk everyday was considered adequate for calcium and vitamin D requirement. Details regarding daily activities, sunlight exposure, past history of fractures and awareness about osteoporosis were noted. Sunlight exposure was considered adequate if their face and arms were exposed to the sun light for at least 30 minutes a day. Symptoms such as knee pain, back pain were elicited and BMI was calculated.

After explaining the procedure to the participants, the BMD of the right calcaneal bone was measured using Lunar Achilles Ultrasound Densitometer (software version 1.3) which was calibrated before usage. The machine converts the BMD values into T-score (WHO). A T-score of -1 and above was considered normal; T-score between -1 and -2.5 was considered osteopenia; and T-score -2.5 and below considered osteoporosis. All women were given

advice on prevention of osteoporosis and those diagnosed with osteoporosis were referred for further management.

Statistical methods

BMD measured as T-score was considered as primary outcome variable. Demographic variables, anthropometric parameter, physical activity and food habits were considered as explanatory variables. Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Shapiro-Wilk test was carried out to assess normal distribution. Categorical outcomes were compared between study groups using Chi square test /Fisher's Exact test and p value <0.05 was considered statistically significant. IBM SPSS version 22 was used for statistical analysis.

RESULTS

On demographic analysis (Table 1), the mean age of the participants was 52.67±9.41, range being 40 to 76 years. 31 (10.16%) were nulliparous and 274 (89.8%) were parous women. 191 subjects (62.2%) were post-menopausal and among them 24 had surgical menopause. The mean years of menopause was 11.45±7.22 and the range was 1 to 30 years. 114 (37.38%) were premenopausal. Among the 305 subjects, 291 (95.41%) were indoor and majority of them were involved in household activities and 46 (15.08%) of them had a sedentary lifestyle. Only fourteen women (4.6%) were involved in outdoor activities such as working in paddy field etc. Forty-five women (14.75%) had good exposure to sunlight and the remaining 260 women had either minimal exposure to <1 hour per week or no exposure at all. On analysing the nutritional status, majority of them (97.7%) consumed non-vegetarian diet and the calcium intake was adequate in 141 (46.23%) subjects and was deficient in 164 (53.77%). There was family history of fracture in 47 (15.41%) women. Twenty-seven (8.85%) women have sustained fractures themselves in the past. One hundred and ten women (36%) presented with musculoskeletal symptoms such as back ache and knee pain. The mean BMI in the subjects was 26.49±3.75.

On analysing the BMD measured as T-score, 97 (31.8%) were found osteoporotic, 117 (38.4%) were osteopenic and 91 (29.8%) women had normal BMD (Table 2). Only 14% (43/305) of women were aware of the disease and 4% were aware that osteoporosis is a preventable condition.

In order to identify the risk factors leading to osteoporosis, the association between the BMD scores and various demographic variables and risk factors were statistically analysed (Table 3). In women of more than 50 years of age, the prevalence of osteopenia was 38.9% and that of osteoporosis was 42.28%. On analysing the BMD score across the age groups it was seen that compared to the women aged 40-45 years, the BMD score was low in women aged 56-70 years which was statistically

significant (p value <0.05). The BMD score was not statistically different among nulliparous, para 1 and multiparous women. Among the 114 pre-menopausal women, only 46 (40.35%) women had normal BMD, 52 (45.61%) were osteopenic and 16 (14%) were diagnosed with osteoporosis. Whereas, among the 191 post-menopausal women, 45 (23.5%) were normal, 65 (34%) were found to be osteopenic and 81 (42.4%) were

osteoporotic. The difference in the BMD score between the pre-menopausal and post-menopausal women was statistically significant (p value <0.001). On analysing the BMD scores across the years of menopause, it was seen that, there was a statistically significant low level of mean BMD scores at 2-10 years after menopause when compared to women who attained menopause <2 years (p value <0.05).

Table 1: Descriptive analysis of demographic details and risk factors (N=305).

Variables	Summary
Age in years	
Age mean±SD (range)	52.67±9.41 (40-76)
40-45	97 (31.80%)
46-50	59 (19.34%)
51-55	28 (9.18%)
56 - 60	54 (17.70%)
61 - 70	53 (17.38%)
> 70	14 (4.59%)
Parity	
Nullipara	31 (10.16%)
1	44 (14.43%)
2	148 (48.52%)
3 and above	82 (26.89%)
Menstruation status	
Pre-menopause	114 (37.38%)
Post menopause (natural)	167 (54.75%)
Surgical menopause	24 (7.87%)
Years of menopause (N=191)	
Years of menopause (N=191) Mean±SD (range)	11.45±7.22 (1-30)
<2 years	21 (11.11%)
2-5 years	35 (18.52%)
6-10 years	32 (16.93%)
>10 years	101 (53.44%)
Occupation	
Indoor	291 (95.41%)
Outdoor	14 (4.59%)
Sedentary Life	
Yes	46 (15.08%)
No	259 (84.92%)
Exposure to sunlight	
Adequate	45 (14.75%)
Minimal	215 (70.49%)
Inadequate	45 (14.75%)
Calcium intake	
Adequate	141 (46.23%)
Not adequate	164 (53.77%)
Food habits	
Veg	7 (2.30%)
Non-veg	298 (97.70%)
Excessive coffee intake	
Yes	77 (25.25%)
No	228 (74.75%)
Family history of fracture	

Continued.

Variables	Summary
Yes	47 (15.41%)
No	258 (84.59%)
Previous history of fracture	
Yes	27 (8.85%)
No	278 (91.15%)
Years since fracture	
<5	16 (59.26%)
5-10	3 (11.11%)
>10	8 (29.63%)
Body mass index	
BMI Mean±SD (range)	26.49±3.75 (18-36.76)
18.5-24.5	109 (35.74%)
25-29.9	147 (48.20%)
30 and above	49 (16.07%)
Complaints	
Back ache	60 (19.67%)
Knee pain	50 (16.39%)
Nil	195 (63.93%)

Table 2: Descriptive analysis of BMD measured as T-score (N=305).

BMD measured as T-score	Frequency	Percentage
Normal (-1 and above)	91	29.8
Osteopenia (-1 to -2.5)	117	38.4
Osteoporosis (-2.5 below)	97	31.8

Table 3: Association between the demographic variables and the BMD score.

Demographic variables	BMD score Mean±SD	Mean difference	95% CI Lower	Upper	P value
Age in years					
40-45	-1.01±1.25				
46-50	-1.55±1.33	0.54	0.11	0.97	0.013
51-55	-1.21±1.12	0.19	-0.36	0.75	0.485
56-60	-2.23±1.47	1.22	0.78	1.66	<0.001
61-70	-1.75±1.08	0.74	0.30	1.18	0.001
>70	-1.51±1.98	0.50	-0.23	1.24	0.180
Parity					
Nulli para	-1.49±0.91				
1	-1.53±1.49	0.04	-0.59	0.67	0.904
2	-1.62±1.47	0.13	-0.40	0.66	0.628
3	-1.48±1.08	0.01	-0.60	0.62	0.975
4	-0.95±1.47	0.53	-0.15	1.22	0.128
Menstruation status					
Pre-menopause	-1.14±1.12				
Post menopause	-1.77±1.51	0.62	0.30	0.94	<0.001
Years of menopause					
<2 years of menopause	-0.56±1.47				
2-5 years of menopause	-1.71±1.51	1.15	0.40	1.91	0.003
6-10 years of menopause	-1.6±1.29	1.04	0.28	1.81	0.008
>10 years of menopause	-2.04±1.35	1.47	0.82	2.13	<0.001

The association between the various risk factors for osteoporosis and the BMD score was also analysed (Table 4). The mean difference in the BMD score between the women involved in indoor and outdoor work was

statistically not significant. Similarly, the difference in the mean BMD score was not statistically different among women who had adequate or inadequate exposure to sunlight. On analysing the BMD scores and adequacy of calcium intake, the mean difference between the two groups was statistically not significant.

Table 4: Association between various risk factors and the BMD score.

Risk factors	BMD score Mean±SD	Mean difference	95% CI		P value
			Lower	Upper	
Exposure to sunlight					
Adequate	-1.32±1.16				
Minimal	-1.52±1.38	0.20	-0.24	0.65	0.367
Inadequate	-1.57±1.52	0.25	-0.32	0.82	0.388
Sedentary life					
Yes	-1.76±1.44	0.31	-0.12	0.74	0.155
No	-1.45±1.35				
Food habits					
Veg	-2.31±0.93	0.83	-0.20	1.85	0.115
Non-veg	-1.48±1.37				
Calcium intake					
Adequate	-1.51±1.55	0.02	-0.29	0.33	0.907
Not adequate	-1.49±1.19				
Coffee intake					
Yes	-1.35±1.3	0.20	-0.15	0.56	0.259
No	-1.55±1.39				
Body mass index					
18.5-24.5	-1.77±1.18				
25-29.9	-1.52±1.44	0.25	-0.08	0.58	0.143
30	-0.83±1.34	0.94	-1.40	-0.49	<0.001
Previous history of fractures					
Yes	-2.71±0.71	1.33	0.80	1.85	<0.001
No	-1.38±1.36				
Family history of fractures					
Yes	-1.47±1.31	0.03	-0.40	0.46	0.896
No	-1.5±1.38				
Musculo-skeletal symptoms:					
Yes	-1.77±1.51	0.62	0.29	0.95	<0.001
No	-1.14±1.12				

There was previous history of fracture in 27 (8.85%) women. The mean BMD score of people who had pervious history of fracture was -2.71±0.71 and they had statistically significant low levels of BMD (p<0.001). On comparing the mean of BMD with family history of fractures, it was seen that the mean BMD score of people who had family history of fracture was -1.47±1.31, and it was -1.5±1.38 in people who never had family history of fracture and the mean difference between the two groups was statistically not significant. On analysing the symptoms there was a statistically significant low BMD in those who presented with symptoms (p value 0.001).

DISCUSSION

Osteoporosis is a major global health problem affecting 200 million women worldwide. Approximately one-tenth of women aged 60, one-fifth of women aged 70, two-fifths of women aged 80 and two-thirds of women aged 90 are affected.[7] In a recent systematic review and meta-analysis, the prevalence of osteoporosis among women globally was found to be 23.1% (95% CI 19.8-26.9).[8] Being a major health issue, this study was undertaken to know the prevalence of osteoporosis, its risk factors, the public awareness about the disease, so that preventive measures can be undertaken.

The prevalence of osteoporosis in our study was 31.8% and 38.4% were osteopenic. Similar to our study, other Indian studies have also shown a high prevalence of osteopenia and osteoporosis. Babu et al have reported 44.1% of osteoporosis and 41.1% of osteopenia among 609 women using QUS of distal radius.[9] Number of other studies have also shown a similar finding.[10] In a study from

Mumbai, 81% of women in peri and post-menopausal age group were found to have low BMD.[3]

Ageing is an important risk factor for osteoporosis and the prevalence increases with age. In women, there is gradual loss of skeletal mass beginning in the fourth to fifth decade; after the age of 50 years, the bone is lost at a rate of 0.75% to 1% per year which increases to a rate of 2% to 3% after menopause. Unless timely action is taken, in the years to come, India is going to face an enormous number of elderly populations suffering from osteoporosis and its morbidity. It has been reported that in India 42.5% of women above the age of 50 years suffer from osteoporosis.[11] Similar findings have been reported in postmenopausal women in south India where the prevalence of osteoporosis was 48% at the lumbar spine and 16.7% at the femoral neck region.[12] In our study, in women more than 50 years of age, the prevalence of osteoporosis was 42.28%. In women aged 56-70 years, there was statistically significant (p value <0.05) low levels of BMD. It is important to note that, even younger women suffer from osteoporosis. In a hospital based study by Sharma et al, using QUS scan, it was seen that in women aged >25 years, 20.25% were osteoporotic and 36.79% were osteopenic.[10] In Sridevi et al study, the prevalence of osteopenia and osteoporosis was found to be 27% in women aged 41-50 years.[13] In our study, among women less than 45 years, 42.2% were osteopenic and 15.4% were osteoporotic. Several studies have shown that multiparity is a risk factor for osteopenia and osteoporosis.[14] However, our study did not show a statistically significant difference in BMD score among nulliparous, and multiparous women.

Post-menopausal women are significantly more osteoporotic than menstruating women. Oestrogen acts directly on the osteoblasts promoting bone formation and decreases osteoclastic activity. In the absence of oestrogen, osteoclastic activity predominates resulting in bone resorption. The resultant bone loss initially presents with backaches, joint pains, and painful physical activity eventually leading to fragile fractures. By the combined effect of age and menopause, by the age of 70 a woman would have lost almost 50% of her bone mass. In this analysis, the prevalence of osteoporosis was 42.4% among post menopausal and 14% among pre-menopausal women with postmenopausal women showing significantly low BMD (p value <0.001). As nearly 50% of pre-menopausal women are also osteopenic, it highlights the need for screening all women after the age of 40 years, so that preventive measures can be taken. Besides the absence of oestrogen, the duration of non-exposure to oestrogen is also an important contributing factor for low BMD. When compared to women who attained menopause <2 years, there was a statistically significant low level of mean BMD scores in those who attained menopause >2 years (p value <0.05).

Lack of exercise is found to be significantly associated with lower BMD in Indian women.[2,15] Physical inactivity and a sedentary lifestyle lead to reduced muscle strength, and is detrimental to bone health. In this study, there was no statistically significant difference in the BMD scores whether the women were sedentary or active. Calcium and vitamin D are the two main nutrients involved in bone health and they play a major role in influencing the risk of osteoporosis. Although India is a sun rich country, several reports state that Indians suffer from vitamin D deficiency due to the low sun exposure, traditional clothing, inadequate dietary intake, and highly pigmented skin.[16] In this study, only 14.75% of women had adequate exposure to sunlight. However, the difference in the mean BMD score was not statistically different among those women who had adequate exposure to sunlight and those with inadequate or minimal exposure. Adequate level of calcium intake has a positive effect of on bone health. Decreased intake of calcium is a significant risk factor of osteoporosis. Most Indian diets have a higher ratio of phytates to calcium, which may interfere with calcium absorption from the already calcium-deficient diets, thus predisposing to lower BMD, and increasing the risk of osteoporosis.[17] Using the FFQ tool, 53.7% of women were found to have inadequate calcium intake and 46.3% had adequate calcium intake and statistically, there was no significant difference in the mean BMD between the two groups.

Following a fracture from a simple fall, both men and women have an increased risk of subsequent fractures, especially in the next 5-10 years. In this study, there was past history of fracture in 8.5% of women and their mean BMD was significantly lower than women who never sustained fracture in the past. In spite of the previous fractures, these women have not sought medical advice for further prevention and remained osteoporotic. Though osteoporosis is a silent disease, it does present with symptoms such as chronic backache and bone pains. In this study, nearly 36% of women presented with musculoskeletal aches and pains and there is a statistically significant increase in the prevalence of osteoporosis in those who presented with symptoms. Awareness of osteoporosis is low in India. In our study, only 14% were aware of the disease. Studies have shown that in the urban population only 10-15% are familiar with the disease and the awareness is more in the educated and those with a family history of the fractures.[18]

There is growing interest in the techniques to screen and diagnose osteoporosis. Dual energy absorptiometry (DEXA) remains the gold standard for the measurement of bone mineral density. However, it is expensive, available only in few centres and it cannot be used for screening larger population. Therefore, for the indirect assessment of bone quality, quantitative ultrasonography (QUS) has been used because of its low cost and portability. In this study, QUS was used for community level mass screening.

Limitation of this study is that it is an observational study without follow-up, and therapeutic interventions. This study has not shown a significant association between risk

factors such as lack of sunlight exposure, exercise and inadequate calcium intake and osteoporosis. Therefore, a larger study would be required. The major strength of the study is that it has brought out the burden of osteoporosis in our community which calls for implementing state level/national level osteoporosis prevention strategy.

CONCLUSION

Osteoporotic fractures result in enormous economic and medical burden to the family and society. The World Health Organization (WHO) has identified osteoporosis as an important noncommunicable disease.[19] Early detection and preventive measures are important to avoid morbidity and mortality related to osteoporosis. Our study has shown that the prevalence of osteoporosis and osteopenia is high among both pre-menopausal and menopausal women. Age of the individual, post menopausal status and duration of menopause have emerged as major risk factors related to osteoporosis, however, these are non-modifiable factors. Therefore, the emphasis should be on implementing screening strategies to pick up osteoporosis early and treat it adequately. Adequate calcium and vitamin D intake, encouraging exercise and mobility to build strong bones are also important. As the awareness of osteoporosis is poor among the public, it is preferable to have community based screening programmes such as ours.

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