Original Article

Bone Health after Fifth Decade in Rural Ambulatory South Indian Postmenopausal Women

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Abstract

Background: The incidence of postmenopausal osteoporosis continues to rise, as population ages. The morbidity and mortality associated with osteoporotic fractures have a significant negative impact on the economy and quality of life of the affected individual and the community, at large. **Objectives:** We aimed to study the prevalence of osteoporosis in ambulant rural postmenopausal women, and to look at their dietary calcium intake (DCI) and Vitamin D status. **Subjects and Methods:** This was a cross-sectional study conducted in 1565 ambulant South Indian rural postmenopausal women. Bone mineral density was estimated by a dual-energy X-ray absorptiometry scan at the femoral neck (FN) and lumbar spine (LS). DCI was calculated by recall for the previous week, and the blood bone biochemical profile was measured. **Results:** The mean standard deviation (SD) age and body mass index of this population were 60.7 (7.2) years and 26.2 (4.8) kg/m^2, respectively. The prevalence of osteoporosis was 22% at the FN and 39% at the LS. An increase in the prevalence of osteoporosis was noted at both sites, in successive age categories. Mean (SD) DCI was 420 (282) mg/24 h. Fifty-four percent had Vitamin D deficiency (VDD) (<20 ng/ml) and 6% had severe VDD (<10 ng/ml). **Conclusion:** A significant proportion of this large cohort of south Indian healthy rural postmenopausal women had osteoporosis at either site with advancing age. Most of them had a suboptimal DCI, and over half of them had VDD.

Keywords: Age-stratified, osteoporosis, postmenopausal, South India

Introduction

Osteoporosis is an important noncommunicable disease, and subsequent fragility fractures are associated with increased morbidity and mortality.[1] Osteoporosis is a known health problem in the West and is a growing problem in many parts of Asia, including India.[2] In India, it is grossly underdiagnosed, even in high-risk individuals such as postmenopausal women, elderly men, and subjects with diseases causing secondary osteoporosis, such as glucocorticoid therapy and inflammatory arthritis.[3] Hip fracture is recognized as the most serious consequence of osteoporosis because of its complications, which include pain with distress, disability, decreased quality of life, and early death.[2] The mortality associated with hip fractures was reported to be 20% in a recent study from south India.[4] With rising life expectancy throughout the globe over the past decade, compounded by early onset of menopause in the Indian context (mean 46.2 years), it is estimated that the prevalence of osteoporosis will rise by significantly.[5] There is widely prevalent dietary calcium deficiency and low Vitamin D in all age groups which could adversely affect bone health in many parts of India.[6] Greater awareness is needed among primary physicians for instituting preventive measures such as adequate calcium and Vitamin D nutrition, as well as initiating treatment early, to reduce the risk of osteoporotic fractures with its associated morbidity.[7]

Hence, increasing longevity coupled with a lower age at menopause, widely prevalent Vitamin D deficiency (VDD) and suboptimal recognition and treatment initiation in the current Indian health system predisposes Indian women to osteoporosis and subsequent fragility fractures.[3] These issues are reportedly more common in rural India, placing approximately 50 million rural postmenopausal women at risk for osteoporosis.[8] Many of these risk factors can be modified at the community level by the timely implementation of appropriate policy decisions.

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Access this article online

Quick Response Code:

Website: www.ijcm.org.in

DOI: 10.4103/ijcm.IJCM_161_18

How to cite this article: Binu AJ, Cherian KE, Kapoor N, Jebasingh FK, Asha HS, Paul TV. Bone health after fifth decade in rural ambulatory South Indian postmenopausal women. Indian J Community Med 2019;44:205-8.

Received: 01-06-18, **Accepted:** 20-05-19

Limited literature is available on the prevalence of osteoporosis in rural southern India. Hence, we undertook this study to assess the prevalence of primary osteoporosis, dietary calcium intake (DCI), and Vitamin D status among postmenopausal women.

Subjects and Methods

This cross-sectional study was conducted over 12 months (January–December 2017). Based on a previous study,[9] showing a prevalence of osteoporosis of 14.9% in women above 50 years of age, a sample size of 1225 was required to obtain a 95% level of confidence. Study subjects were recruited from 10 villages (Alangayam, Govindapuram, Kothakottai, Andiyappanur, Kalendira, Alasandapuram, Ambalur, Vadakupattu, Thumberi, and Ramanaickenpettai) of Vaniyambadi taluk of Vellore district of south India.

Details of women above 50 years of age in each village were archived from the district headquarters. Three field workers along with the investigating team organized osteoporosis awareness meetings every fortnight over the study period in these villages. The participants were briefed about the current osteoporosis prevalence study. Postmenopausal women (>50 years of age) keen on participating were requested to arrive in the morning at our center on a fasting state and were enrolled after obtaining an informed consent. Inclusion criteria comprised of ambulant postmenopausal women aged >50 years. Individuals with disorders or medications known to affect bone health were excluded from the study. Overall, 1722 individuals expressed interest in participation in the study. 1604 individuals reached the study site over the study period. Thirty-nine individuals were excluded (8 were below 50 years, 14 individuals were on indigenous medications for which details were not available, 9 on various oral glucocorticoids, 2 breast malignancies, 2 deforming arthritis, 2 chronic kidney disease, one each with hyperthyroidism and active pulmonary tuberculosis). The DCI was assessed and noted by recalling the diet consumed in the previous week using a previously published food composition table describing the nutritive value of Indian foods.[10] Weight was recorded in kilograms using an electronic scale, and standing height was measured to the nearest centimeter with a stadiometer. Fasting venous blood samples were collected for the measurement of serum calcium (8.3–10.4 mg/dL), phosphorus (2.5–4 mg/dL), alkaline phosphatase (40–125U/L), albumin (3.5–5.0 g/dL), creatinine (0.6–1.4 mg/dl), 25-hydroxy (OH) Vitamin-D (30–75 ng/mL), and intact parathormone (8–50 pg/mL). VDD was defined as OH Vitamin D level of <20 ng/ml, and severe VDD as <10 ng/ml.

Bone mineral density (BMD) at lumbar spine (LS) and femoral neck (FN) was assessed using Hologic QDR 4500 Discovery A dual-energy X-ray absorptiometry scanners. A coefficient of variation of 2% was noted at both sites. T score ≤−2.5 at either LS or FN was considered diagnostic of osteoporosis.[7] Study participants were further stratified into different age groups, and the prevalence of osteoporosis was determined.

Statistical methods

Continuous variables were expressed as mean ± standard deviation (SD), while proportions were expressed as percentages. Pearson correlation was used to measure the association between two continuous variables. $P < 0.05$ was considered statistically significant. Statistical software package SPSS (version 16.0; SPSS Inc., USA) was used for analysis. This study was approved by the institutional review board.

Results

One thousand five hundred and sixty-five postmenopausal women were included in the study. The mean (SD) age and body mass index (BMI) of this population were 60.7 (7.2) years and 26.2 (4.8) kg/m^2, respectively. The mean (SD) DCI was 420 (282) mg/24 h. The demographic characteristics and blood biochemistry of study individuals are depicted in Table 1. About 55% had VDD (<20 ng/ml) and 6% had severe VDD (<10 ng/ml). Anthropometry and BMD in various age categories are shown in Table 2.

The overall prevalence of osteoporosis was 22% at FN and 39% at LS. The prevalence of osteoporosis in different groups stratified by age is shown in Table 3. Of all postmenopausal women with osteoporosis ($n = 621$) at LS, 45% ($n = 279$) were below 60 years, and in subjects with FN osteoporosis ($n = 345$), 30% ($n = 104$) were in the sixth decade. As shown in the table, there was a significant increase in the prevalence of osteoporosis at both sites, in successive age categories ($P < 0.001$). The prevalence of osteoporosis at LS was 29%, 45%, 52%, and 71% in age categories 50–59, 60–69, 70–79, and >80 years, respectively. Similarly, the prevalence at FN was 9.8%, 27.2%, 43%, and 71% in the same age categories.

The correlation between variables and BMD at FN and LS is shown in Table 4. There was a significant positive correlation between BMI, 25-OH Vitamin D, and BMD at FN, while at LS, a significant correlation was noted with the BMI only. At both sites, there was a significant negative correlation with number of years elapsed since menopause and parathyroid hormone (PTH).

Table 1: Demography and blood biochemistry of study participants

Parameter	Mean±SD
Years since menopause	11±6
Dietary calcium (mg/day)	420±282
Age (years)	60.7±7.2
BMI (kg/m^2)	26.2±4.8
Albumin (g/dL)	4.12 (0.3
Corrected calcium (mg/dL)	9.3±0.36
Phosphate (mg/dL)	3.3±0.7
Creatinine (mg/dL)	0.8±0.2
Alkaline phosphatase (IU/L)	94±26
25(OH) Vitamin D (ng/ml)	21.2±9.8
Intact PTH (pg/ml)	68±41

SD: Standard deviation, BMI: Body mass index, 25(OH) Vitamin D: 25-hydroxyvitamin D, PTH: Parathyroid hormone

Table 2: Anthropometry and bone mineral density in various age categories

Age	*n*	BMI (kgs/m²)	Lumbar spine (g/cm²)	Femoral neck (g/cm²)
<55	450	26.5 (4.6)	0.715 (0.100)	0.853 (0.164)
56-60	419	26.1 (4.8)	0.672 (0.109)	0.824 (0.136)
61-65	350	26.3 (4.8)	0.650 (0.109)	0.790 (0.285)
66-70	185	25.5 (4.9)	0.607 (0.108)	0.780 (0.164)
71-75	108	26.3 (4.7)	0.622 (0.113)	0.795 (0.146)
>75	53	24.5 (4.3)	0.587 (0.129)	0.787 (0.183)

BMI: Body mass index

Table 3: Age stratified prevalence of Osteoporosis

Age intervals (*n*)	Femoral neck *n* (percentage within age interval)	Lumbar spine *n* (percentage within age interval)
50-55 (450)	23 (5.1)	118 (26.3)
56-60 (419)	83 (19.8)	164 (39.1)
61-65 (350)	88 (25.1)	158 (45.1)
66-70 (185)	81 (43.8)	96 (51.9)
71-75 (108)	40 (37)	55 (50.9)
>75 (53)	30 (56)	30 (56)
50-87 (1565)	345 (22)	621 (39)

Table 4: Correlation between various parameters and bone mineral density

Parameters	Femoral neck		Lumbar spine	
	r	*P*	*r*	*P*
Dietary calcium	0.14	0.223	0.1	0.3
Years since menopause	−0.28	0.007	−0.32	0.001
BMI	0.38	0.001	0.44	0.001
25(OH) Vitamin D	0.29	0.001	0.13	0.056
Intact PTH	−0.27	0.012	−0.19	0.02

BMI: Body mass index, 25(OH) Vitamin D: 25-hydroxy Vitamin D, PTH: Parathyroid hormone

Discussion

The current study looked at the prevalence of osteoporosis in a large sample of ambulatory postmenopausal women from rural Tamil Nadu, a southern Indian state. One-fifth of them had osteoporosis at FN and two-fifth at LS. Overall, there was a decrement in height and BMD at both LS and FN, with advancing age. The mean intake of dietary calcium was low in many of the individuals against the recommended intake for this postmenopausal age group. Even though more than half of the recruited individuals from a rural community had VDD, severe VDD (<10 ng/ml) was present only in about 6% of individuals.

The prevalence of osteoporosis in postmenopausal women, at any site in published Indian studies, varied from 12% to 60% and it has been shown to increase with advancing age.[7,8] Overall prevalence of osteoporosis in India is found to be higher than that reported from other countries, although they were not done in rural setting.[11-13] In our study, it is important to note that rural Indian postmenopausal women in the first two decades following menopause had a higher prevalence of osteoporosis at FN when compared to other countries [Table 5].

The life expectancy of Indian women is 70 years, and mean age of menopause is 46 years.[5] In our study, about 45% of individuals with osteoporosis at LS were aged 50–60 years. Similarly, >30% of those with osteoporosis at FN were below 60 years of age. While considering the number of women in India above 45 years of age (about 96 million) and over half of them residing in rural India, the proportion of postmenopausal women at risk for osteoporosis and fragility fractures is large.[2] The decrease in height noted with advancing age centiles in our study are probably due to narrowing of intervertebral discs, asymptomatic vertebral fractures, and other age-related factors like changes in spinal curvature.[14]

Various international guidelines recommend screening for osteoporosis for those aged 65 years or older.[15] A recently published Indian guideline recommended screening for osteoporosis in all women 5 years' postmenopause.[16] However, this has to be based on the magnitude of disease, resource availability, and additional risk factors for osteoporosis.

The positive correlation noted between BMI and BMD in the current study has been shown previously, but may vary widely based on association with many comorbidities.[17] The number of years since menopause had an adverse impact on the skeleton, and this may indicate the unfavorable effect of prolonged hypoestrogenic state on bone health.

Modifiable factors such as poor DCI and VDD, especially in rural India as noted in our study, may adversely impact bone health. None of our study individuals was on calcium supplementation. In a study from the neighboring state Andhra Pradesh, rural subjects had a significantly lower intake of dietary calcium as compared to urban subjects, more than two-third having either VDD or insufficiency.[18] In a study of the interaction between DCI and BMD by Kim *et al*.,[19] it was noted that the association between calcium and BMD was not consistently linear; adequate Vitamin D level seemed to compensate for the negative impact of poor calcium intake on bone. VDD has been reported in many Indian healthy and diseased cohorts ranging from 30% to 70%.[4,20] In the present study, there was a positive correlation between Vitamin D and BMD at FN implying a beneficial and protective effect of Vitamin D on bone.[21] The negative correlation between PTH and BMD in our individuals has been reported previously.[4,21,22]

In a developing country like India, highly prevalent poor DCI and VDD, that were found in this population are potentially correctible factors by either supplementation or food fortification.[23] Nonmodifiable risk factors for developing osteoporosis, including advancing age, low peak bone mass, early age of menopause, and genetic predisposition should also be considered during the assessment of osteoporosis.[24]

In addition, to being a study that looks at the bone health in a large sample of south Indian ambulatory postmenopausal women, the novelty in this study is its important findings. The

Table 5: Osteoporosis prevalence (%) in various countries

Age categories	India Present Study *n*=1565		Korea Park *et al*. *n*=4011		Australia Henry *et al*. *n*=787		Kuwait Al-Shoumer *et al*. *n*=454	
	Spine	Femoral neck	Spine	Femoral neck	Spine	Femoral neck	Spine	Femoral neck
50-59	29	9.8	13.2	5.3	6.3	3.9	16	7
60-69	45	27.2	30	16.8	18	12.9	35	13
70-79	52	43	49	43.4	31	28.8	56	16
≥80	71	71	60	74	36.5	48.8	70	18

results of this study highlight the very poor DCI and VDD in a rural population with a high prevalence of osteoporosis. These findings deliver a strong message to policymakers to implement food fortification/other public health interventions in this region to improve the DCI and Vitamin D status in this population who are at high risk for osteoporosis and fragility fractures. Limitations of this study include its cross-sectional nature, less number of subjects above 70 years, and lack of information on physical activity and osteoporotic fractures. In addition, as this study was based on participants who volunteered participation through a camp-based recruitment, they may not be representative of the community-based prevalence.

Conclusion

A significant proportion of this large cohort of south Indian healthy, rural postmenopausal women had osteoporosis at either site with advancing age. Most of them had poor DCI and VDD. Follow-up studies are needed in this cohort following optimal calcium and Vitamin D supplementation, with or without anti-resorptive medications, and the subsequent impact on incident fragility fractures.

Financial support and sponsorship

This study received funding from Fluid Research Grant, Christian Medical College, Vellore, Tamil Nadu, India.

Conflicts of interest

There are no conflicts of interest.

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