

Osteoporosis in Indians revisited

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Abstract

Osteoporosis an emerging public health problem in developed as well as developing countries, affecting both men and women. **Introduction:** To estimate the prevalence of osteoporosis and related factors, by using quantitative ultrasound (QUS).

Methodology: A cross-sectional study was done among 396 people, measuring their bone mineral density (BMD) by using QUS; after the participants were interviewed using a proforma.

Results: Out of the 396 subjects, 198 were males and 198 were females, with a male to female ratio of 1:1; among the males 9.60% had osteoporosis and 44.44% had osteopenia, on the other hand, 11.62% women had osteoporosis and 50.00% had osteopenia. Majority (72.72%) were in the age group of 45 to 54 years. Overall osteopenia was found in 187 (47.22%) and osteoporosis in 42 (10.61%); their mean (\pm SD) age was 52.91 (\pm 9.99) years, with a range of 42 to 88 years. Their mean (\pm SD) height, weight and body mass index (BMI), important indicators of the nutritional status of the population, were 2.39 (\pm 1.04) m, 63.75 (\pm 11.38) kg and 23.98 (\pm 3.94), respectively. With increasing age the incidence of osteopenia & osteoporosis were higher; although this was not found to statistically significant. Chi-square analysis showed that educational level, socio-economic status and marital status showed significant associations.

Conclusion: This study highlights the prevalence of osteoporosis in Odisha and the urgent need for measures to improve the nutritional status, dietary calcium intake and thus the bone health of this population.

Keywords: Bone Mineral Density, QUS, Osteoporosis, Calcium Intake.

Introduction

Osteoporosis is characterized by low bone mass with micro-architectural deterioration of bone tissue leading to enhanced bone fragility, thus increasing the susceptibility to fractures.⁽¹⁾

Bone loss as a consequence of ageing, can lead to osteoporosis in both men and women.⁽²⁾ However as the greatest bone loss occurs in women during perimenopause and is associated with falling estrogen levels, osteoporosis is commoner in women.⁽³⁾

It is estimated that around 200 million people in the world suffer from osteoporosis.⁽⁴⁾ It has been estimated that the number of people with osteoporosis and osteopenia in India was 50 million in 2013.⁽⁵⁾ Epidemiological studies on populations in East India are lacking.

Osteoporosis is a silent disease, reflected only in a low bone density, till a fracture occurs specially a fracture of the proximal femur which has a mortality of around 21.2% within 1 year of the event.⁽⁶⁾ Apart from morbidity and mortality osteoporosis can impose a heavy economic burden on the community. It was estimated that osteoporosis related treatment cost was 5.126 billion dollars in 2011 in South Korea.⁽⁷⁾

Many risk factors are associated with osteoporosis.⁽⁸⁾ These include non-modifiable factors like female sex, old age, small thin built, Caucasian/Asians and family history of fractures. Ethnic differences in bone mineral density (BMD) are strongly influenced by body weight. Important modifiable risk factors include calcium and vitamin D deficiency,

sedentary life style, smoking, excessive alcohol and caffeine intake.

Indians seem particularly vulnerable. Indian women attain earlier menopause than Caucasians⁽⁹⁾ hence facing longer periods of low estrogen levels increasing the risk of osteoporosis.⁽¹⁰⁾ Asian Indian ethnicity people have lower BMD compared to Caucasians and blacks.^(11,12) To make matters worse most Indian diets are calcium deficient.⁽¹³⁾ Despite abundant sunshine pigmented skin, traditional clothing, spending less time outdoors and dietary factors⁽¹⁴⁾ make many Indians deficient in Vitamin D.⁽¹⁵⁾ Poor nutritional status raises Indians susceptibility to osteoporosis.⁽¹⁶⁾

Therefore the importance of achieving and maintaining good bone health cannot be overemphasized. Adequate epidemiological data in East India will help formulate prevention and interventional strategies. While DEXA scan remains the gold standard for diagnosing osteoporosis,⁽¹⁷⁾ Quantitative ultrasonography of the Calcaneus is a proven method of diagnosis⁽¹⁸⁾ especially useful for community screening owing to reliability, lower costs and absence of radiation exposure.⁽¹⁷⁾

Aims & Objectives

To determine the prevalence and epidemiology of osteoporosis among East Indians, which will help improve awareness, prevention, and treatment of osteoporosis.

Materials & Methods

Study design: A community based cross-sectional study was conducted in selected districts of Odisha.

Study participants: All adults aged 40 years and above of either sex in the selected districts.

Recruitment of study participants: To recruit subjects, a list of all families that included people aged 40 years or older was constructed, and family codes were created. From this list, the first family was selected by randomly choosing a family code. In each family selected, all aged 40 years or older and free of bone deformities and acute illnesses were invited to participate. After selecting the first family, we used the "random walking" method to approach other families, adding subjects. The survey was carried out at the local health centres of the selected sites. To maximize participation, the local health staff visited each household to explain the study, obtained written consent from each subject, and reminded participants of the time and date of the survey.

Sampling Technique

Multi-stage stratified random sampling technique: Odisha, located in the eastern part of the country, and has a population of approximately 4.19 crores (census 2011). There are 30 districts, divided into urban wards and rural communes. A multistage sampling method was used to select subjects.

1st Stage: 30 districts in Odisha → 3 districts Puri, Nayagarh & Khordha district selected.

2nd Stage: 2 urban areas from each district selected [Puri district → 2 urban areas Puri town & Sakhigopal; Khordha district → Bhubaneswar & Khurdha; Nayagarh district → Nayagarh & Odogaon]

3rd Stage: from 6 ULBs → 2 wards each randomly selected → total 12 wards

4th Stage: from 12 wards → all adult population above 40 years of age fulfilling inclusion criteria

5th Stage: Stratified by 5yr age groups (40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and ≥85 years).

Eligible participants were screened in community based setting in the towns of Bhubaneswar, Khurda, Puri, Sakhigopal, Nayagarh, Odogaon as determined by the above sampling technique.

Data Collection: All participants completed a structured questionnaire. Background information was collected about their occupations, chronic illnesses, and reproductive history including the number of children, duration of breast feeding, menopausal status and age at menopause in case of females. Heights and weights were measured using standard procedures. A detailed history for diet (vegetarian/non-vegetarian), tobacco, alcohol and substance abuse (ganja, heroin, opium) was noted. Dietary intakes of energy, proteins and other nutrients were assessed by the 24-hours recall method, which is a well-established tool.⁽¹⁹⁾ A detailed medical and drug (especially steroids) history were recorded in a proforma

designated for the study. History of previous fractures especially those associated with osteoporosis like vertebral and radial fractures were noted. Socioeconomic status was measured by modified Kuppaswamy classification.⁽²⁰⁾

Study tool: Data was collected through in-person interviews after obtaining written informed consent using a pre-tested, structured, interviewer-administered, standardized proforma which included information on selected socio-demographic characteristics, lifestyle behaviours and anthropometric measurements. All participants completed the structured questionnaire followed by bone mineral density (BMD) assessment. The BMD was measured at the calcaneus (heel) by standardized Calcaneal QUS utilizing T-scores based on WHO criteria.⁽¹⁾ A person was classified as having osteoporosis if her T-score was ≤ -2.5 , and osteopenia if the T-score was in between -1 and -2.5 and as normal if the score was ≥ -1 .

After BMD testing, people with low BMD were advised for Vitamin D estimation, proper calcium supplementation, dietary modifications and daily physical activity.

Inclusion criteria:

1. Both men and women > 40 yrs.
2. Giving consent for the study

Exclusion criteria:

1. Pregnancy
2. Documented osteoporosis or osteopenia
3. Non ambulatory subjects
4. Known medical history of hyperparathyroidism, gastrectomy, diseases of the kidney, diabetes mellitus, rheumatoid arthritis, chronic liver disease, chronic malabsorptive syndromes, cancer, and jejunio-ileal bypass, as well as current or past treatment with glucocorticoids and/or thyroid hormone.

Sample size: Taking prevalence of osteoporosis as 35.1% from the previous study by Marwah et al,⁽²¹⁾ and taking 95% confidence and 5% absolute error, the sample size was calculated using the formula, $n = 4pq/d^2$ and found to be 364, after adding 10% non-response rate the sample size was calculated to be 396. Therefore, a total of 396 participants [33 from each ward], were included in the study who were satisfying the inclusion criteria and were willing to give consent to participate in the study.

Study Period: September 2016 to April 2017

Statistical analysis

Data was entered into Microsoft excel spread sheet, and analysed using EpiInfo statistical software [version 7.1.5.2]. The data was analysed by descriptive statistics. The degree of association of the various parameters/risk factors like age, education level, occupation, income level was found out by chi-square

test. A value of $p < 0.05$ was considered statistically significant.

Ethical consideration: The study was approved by Institutional Ethics Committee of Kalinga Institute of Medical Sciences.

Results

Out of the 396 subjects, majority (72.72%) were in the age group of 45 to 54 years. Osteopenia was found in 187 (47.22%) and osteoporosis in 42 (10.61%); 6.06% had no formal education. 78.28% were married. As per modified Kuppaswamy scale 34.85% belonged to the upper middle socio-economic status group (Table-1). Their mean (\pm SD) age was 52.91 (\pm 9.99) years, with a

range of 42 to 88 years. Their mean (\pm SD) height, weight and body mass index (BMI), important indicators of the nutritional status of the population, were 2.39 (\pm 1.04) m, 63.75 (\pm 11.38) kg and 23.98 (\pm 3.94), respectively.

Around 25% of the respondents in the 55-59 years age group had osteoporosis, while 48.44% had osteopenia. Similarly, 48.83% in 50- 54 years were having osteopenia. With increasing age the incidence of osteopenia & osteoporosis were higher; although this was not found to be statistically significant. Chi-square analysis showed that educational level, socio-economic status and marital status showed significant associations (Table 1).

Table 1: Distribution of socio-demographic characteristics of the study participants with their bone mineral density [N= 396]

Socio- Demographic Characteristics	Normal BMD [N=167]	Osteopenia [N=187]	Osteoporosis [N=42]	p value
Age Group (In Years)				
40-44 (n=20)	16	4	0	0.00
45-49 (n=159)	74	75	10	
50-54 (n=129)	56	63	10	
55-59 (n=64)	17	31	16	
60-64 (n=22)	4	12	6	
≥ 65 (n=2)	0	2	0	
Religion				
Hindu (n=392)	165	185	42	0.78
Muslim(n=4)	2	2	0	
Christian(n=0)	-	-	-	
Education				
Illiterate (n=24)	5	17	2	0.0001
Primary School Certificate(n=48)	10	29	9	
Middle School Certificate(n=28)	11	15	2	
High School Certificate(n=66)	27	30	9	
Intermediate School(n=64)	26	34	4	
Graduate(n=94)	58	24	12	
Professional degree (n=72)	30	38	4	
Socio- Economic Class				
Upper (n=50)	22	26	2	0.01
Upper middle(n=138)	68	48	22	
Lower middle (n=126)	49	64	13	
Upper lower (n=65)	23	39	3	
Lower (n=17)	5	10	2	
Marital Status				
Never Married (n=60)	30	30	0	0.01
Married (n=310)	127	147	36	
Separated (n=2)	2	0	0	
Divorced (n=18)	8	6	4	
Widowed (n=6)	0	4	2	

In the study, among the 396 participants, 198 were males and 198 were females, with a male to female ratio of 1:1 (Table 2); among the males 9.60% had

osteoporosis and 44.44% had osteopenia, on the other hand, 11.62% women had osteoporosis and 50.00% had osteopenia (Fig. 1).

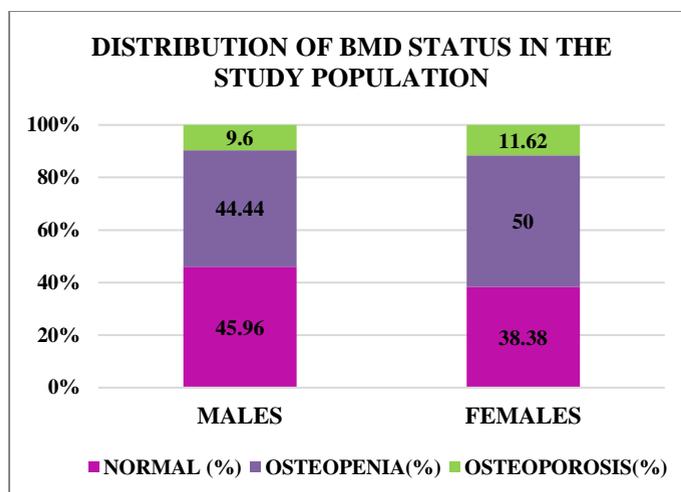


Fig. 1: Sex-wise Distribution of Bone Mineral Density Status

The mean T-SCORE of the study population was found to be (-1.36 ± 0.85) ; the mean T-SCORES of the males was (-1.03 ± 0.85) and that of the females was (-1.27 ± 0.98) .

Certain modifiable and non-modifiable risk-factors of osteoporosis were also assessed and compared between male and female groups (Table 2). Chi-square test was applied to find out the association between the

risk factors of osteoporosis and the BMD status of both the groups. A highly significant association ($p < 0.001$) was established between BMD status and family history of osteoporosis and body mass index; however dietary habits, consumption of milk and milk products daily, physical activity had no statistically significant difference between the males and females.

Table 2: Distribution of Risk Factors of Osteoporosis with Bone Mineral Density

Risk Factors	Males (n=198)			Females (n=198)		
	Normal (n=91)	Osteopenia (n=88)	Osteoporosis (n=19)	Normal (n=76)	Osteopenia (n=99)	Osteoporosis (n=23)
Non-Modifiable						
Family History						
YES (n=168)	42	33	15	20	45	13
NO (n=174)	32	43	1	41	52	5
Don't know (n=54)	17	12	3	15	2	5
Modifiable Risk Factors						
BMI Category						
Underweight (n=40)	6	4	2	19	9	0
Normal (n=218)	58	52	8	26	59	15
Overweight (n=116)	23	26	9	27	25	6
Obese (n=22)	4	6	0	4	6	2
Diet						
Vegetarian (n=35)	13	5	1	8	7	1
Non-vegetarian (n=361)	78	83	18	68	92	22
Milk And Milk Products Consumption Daily						
Yes (n= 85)	12	24	4	15	28	2
No (n=311)	79	64	15	61	71	21
Physical Activity (Daily)						
Yes (n=201)	54	45	11	33	52	6
No (n=195)	37	43	8	43	47	17

Around 66.6% of those with osteoporosis had a family history of osteoporosis, 14.28% of them did not, while 19.04% were not aware of any such ailment. On applying chi-square test to find out the association

between the risk factors of osteoporosis with their BMD status, a highly significant association ($p < 0.001$) was established between BMD status and family history of osteoporosis and body mass index. With increasing BMI

the prevalence of osteoporosis in the study population also showed an increasing trend. 5% of the underweight, 10.55% of those with normal BMI, 12.98% of those overweight and 9.09% of those obese has osteoporosis. Increasing BMI showed a negative association with bone health ($p < 0.001$).

As high as 59.02% of married people had low BMD, with 11.61% having osteoporosis. 50% of people who never married had low BMD and none of them had osteoporosis. In our study marital status and osteoporosis showed a statistically significant association ($p=0.01$). While 8.33% of the illiterate people had osteoporosis, 5.55% of those with postgraduate and above qualifications had osteoporosis. As high as 79.71% of the illiterate study population had low BMD. In our study we found that with higher level of education, the BMD status was better. Education had a strong statistically significant positive association with bone health (p value < 0.0001).

Of those who had osteoporosis, 4.76% were vegetarian, while as high as 95.24% had non-vegetarian diet. Similarly, 80.95% of those suffering from osteoporosis did not consume milk and milk products daily. Dietary habits and consumption of milk and milk products daily also showed a statistically significant ($p<0.05$) association. However physical activity was not significantly ($p=0.36$) associated with the BMD status.

Discussion

This study was conducted among the population residing in the selected districts of Odisha. Among the 396 study participants included in the study, the prevalence of osteoporosis was found to be 10.61% and osteopenia was 47.22%. This contrasts with a study in Delhi of people above the age of 50 that found Osteoporosis was present in 35.1% subjects and osteopenia in 49.5% of the overall subjects.⁽²²⁾ This may be explained by the fact that urbanization also appears to be associated with an increase in prevalence of osteoporosis due to lifestyle changes, lower physical activity, increase in indoor living, and lower sun exposure.⁽¹³⁾ Most of our subjects were from less urbanized places.

In this study, it was found that among the males 9.6% had osteoporosis and 44.4% had osteopenia. On the other hand, the females 11.62% had osteoporosis and 50.00% had osteopenia. The results were almost similar to another study by Silvanus et al⁽²²⁾ that estimated the prevalence of osteoporosis in an urban population of Mumbai to be 12.85% among women and 3.7% among men.

Our study did not show much of a difference between osteoporosis prevalence between males and females. This is in contrast to most studies like those of Marwah et al⁽²²⁾ showing a much higher prevalence in females. While osteoporosis is expected to be more prevalent among women on account of lower peak bone mass and menopause related bone mass loss,⁽²³⁾ our

findings may be explained due to limitations of sample size. This can also be attributed to better bone health and nutritional status of women in the geographical locations of our study.

In our study, 80.95% of those suffering from osteoporosis did not consume milk and milk products daily. Dietary habits and consumption of milk and milk products daily also showed a statistically significant ($p<0.05$) association with osteoporosis. The importance of milk and dairy products in bone health has been emphasised by previous studies.⁽²⁴⁾ In contrast to studies that emphasize the role of physical activity in maintaining bone health,⁽²⁵⁾ this study found that physical activity was not significantly ($p=0.36$) associated with the BMD status.

The evidence of association of BMI with BMD status is confusing. While most studies observe a positive effect of increasing BMI on BMD status.⁽²⁶⁾ Our study observed that, increasing BMI showed a highly statistically negative association with BMD status similar to the results of a cross sectional study of 2570 subjects by Lloyd et al⁽²⁷⁾ in 2016.

Our study showed a statistically significant positive association between education status of subjects and BMD status. The Louisiana Osteoporosis study⁽²⁸⁾ too reported a positive association between education and BMD status.

Conclusion

The study found the overall prevalence of osteoporosis and osteopenia was 47.22% and 10.61% respectively. This study also provides convincing evidence that BMD is significantly associated with nutrition, especially calcium rich food. Thus, lifestyle modifications are greatly necessary to achieve an optimum bone health.

There is also an increasing need of awareness in the area of bone health. Osteoporosis being a silent morbidity often goes undiagnosed until the occurrence of a fracture, thus causing a huge personal and economic burden. Thus, early screening and diagnosis by measurement of BMD and adopting preventive strategies can be implemented to improve bone health.

Limitations

This study was a cross-sectional study, and we could not measure all factors affecting the risk of osteoporosis. Moreover, using a prevalence measure to assess risk factors also has limitations because the factors associated with osteoporosis may not reflect the real cause-effect relation. Risk factors assessed by using prevalence measures can only suggest the hypothesis for a possible cause-effect relation. Thus, a prospective study is needed to confirm any association between osteoporosis and risk factors and to explain the differing patterns of osteoporosis distribution.

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Recommendation

Not much data is available in Odisha, India regarding osteoporosis. It is therefore necessary to create awareness among people of the risk of osteoporosis and formulate strategies for early diagnosis and intervention.

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