International Journal of Research in Orthopaedics
Babhulkar S et al. Int J Res Orthop. 2021 Mar;7(2):362-368
http://www.ijoro.org

Original Research Article

DOI: https://dx.doi.org/10.18203/issn.2455-4510.IntJResOrthop20210630

Prevalence of osteoporosis in India: an observation of 31238 adults

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Received: 18 December 2020
Accepted: 18 January 2021

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ABSTRACT

Background: Aim of the study was to determine the prevalence of bone loss (both osteopenia and osteoporosis) at national and regional levels in India.
Methods: In this retrospective study, data obtained from in-clinic screening camps conducted for bone loss was analysed. Participants were apparently healthy adults (aged 18 years and above) evaluated for bone mineral density (BMD) using calcaneal quantitative ultrasound (QUS) of left foot. Based on t score of BMD obtained, participants were labelled as normal (T-score <-1 SD), osteopenia (t score-1 to -2.5 SD) and osteoporosis (t score <-2.5 SD).
Results: In total, data of 31238 participants was analysed retrospectively. Mean age was 47.8±14.2 years and 47.6% were females. Among females, 38.8% were postmenopausal women (age >50 years). Overall prevalence of osteopenia and osteoporosis was 49.9 and 18.3% respectively. Across East, West, North and South India, the prevalence of osteopenia was 51.3, 47.9, 55.6 and 47.4% respectively whereas prevalence of osteoporosis was 18.4, 16.3, 16.4 and 20.7% respectively. Prevalence of osteoporosis was slightly higher in females than males (19.4 vs 17.3%). Among postmenopausal women, overall osteoporosis prevalence was 33.1% and ranged from 16.9% in North region to 21.8% South region. Prevalence of osteoporosis (37.0 vs 12.5%) was higher in elderly (≥60 years) than adults (<60 years).
Conclusions: Among adults, nearly one out of two have osteopenia and one out of five have osteoporosis. Osteoporosis prevalence was higher in the women and in the elderly. Nearly one out of three women in postmenopausal age group have osteoporosis. There is no substantial difference across the four regions of the country. Considering the significant prevalence of low BMD, there is need to increase the awareness about bone health in general population.

Keywords: Osteoporosis, Osteopenia, Bone mineral density, Postmenopausal women, Elderly, India

INTRODUCTION

World Health Organization (WHO) categorizes bone loss based on bone mineral density (BMD) as osteoporosis with BMD T-score of <-2.5 standard deviation (SD) and as osteopenia with BMD T-score of -1.0 to -2.5 SD below the average value for young healthy women.[1] Bone loss, a "silent" process affecting millions of individuals around the globe is often overlooked. Osteoporosis predisposes to fragility fractures and development of such fractures is associated with high rates of morbidity and mortality especially in elderly.[2] Globally, nearly 200 million people suffer from osteoporosis each year.[3] WHO identifies that there is relative lack of quantitative data from developing countries on incidence and prevalence of osteoporosis.[4] From India, reported prevalence of osteoporosis from various studies among women is 8 to 62%.[5] This shows wide variation in prevalence across India. Further, the risk of osteoporosis is higher in women than men and in elderly than young adults. In line with this, recent study from North India reported higher osteoporosis prevalence in women (3 and 36.4% women aged 30 to 39 years and >70 years respectively) than men (0 and 5.6% for the two age groups respectively). Additionally, prevalence of

osteopenia found to be higher in women (40.3%) than men (29.9%).[6] The differences in the two gender are largely accounted by menopausal state of females. Multiple other factors affect overall bone health. Increasing age, female sex, lack of formal education, lack of engagement in occupational activities, higher weight, androgen deprivation treatment, duration of use of dairy products, and fracture within 10 years prior to study entry.[7,8] Dietary factors also identified to either positively or negatively affect the overall bone health. Intake of vitamins such as vitamin C, B12, carotenoids improve bone health. Vitamin K also protects against osteoporotic hip fractures. Omega 3 fatty acids, dietary food and protein intake also positively impact bone health.[9] As India is a culturally diverse country with highly varied dietary patterns, there can be regional differences in occurrence of bone loss. With increasing population expectancy, number of elderly individuals is likely to increase in India. The 2011 population census reports that nearly 104 million (>60 years) (53 million females and 51 million males) elderly are present in India which represent 8.6% of total population. Further, the life expectancy of Indians at the age of 60 years is reported to be 18 years.[10] Thus, there is unmet need to address the bone health in these vulnerable population. Given the substantial presence of bone loss in Indian population with differing lifestyle habits, there can be regional differences in rates of osteopenia and osteoporosis in India. To explore the prevalence of bone loss i.e., osteopenia and osteoporosis in a nationally representative sample and to explore the national and regional differences in two genders and elderly, we performed this study.

METHODS

During routine in-clinic screening camps, a verbal consent was obtained by the physicians before subjecting participants for clinical evaluation of bone loss. The screening camps were done in between January 2018 and August 2019. Apparently healthy, adult (≥18 years) participants of either gender who were not suffering from any disorder known to affect bone health were evaluated for BMD examination. The inclusion and exclusion criteria were as below. Any participant taking drugs affecting bone health as well as pregnant and lactating females were not included in screening camps. Data obtained from these screening camps was analyzed retrospectively. The study was conducted with the ethical principles of declaration of Helsinki. Institutional ethical committee at critical care hospital and research institute, Nagpur, Maharashtra, India approved the study.

Bone mineral density assessment

It was performed using heel ultrasound of left foot in each participant. After applying sterile solution over the feet and lower leg, participants were asked to place their left foot in the groove on ultrasound machine. A trained assistant helped with assessment of BMD at all centers. After placing the foot on machine, assessment was performed automatically by the machine within 20 seconds. The obtained result of BMD was noted in participant case file. The results of heel BMD obtained with ultrasound are known to predictive of BMD-defined osteoporosis.[11,12] As a simple, non-invasive method without risk of radiation exposure, the calcaneal quantitative ultrasound (QUS) is considered as promising tool for detecting osteoporosis in routine clinical practice.[13] Further, measurement of peripheral BMD has been shown to correlate with central BMD.[14] It also predicts the risk of early postmenopausal fractures. Some authors identify that axial densitometry examination is not superior to calcaneal ultrasound evaluation.[15] Thus, QUS can be considered in routine for evaluation of osteoporosis. Based on T-score of BMD obtained, participants were labeled as normal (T-score<-1 SD), osteopenia (T-score -1 to -2.5 SD) and osteoporosis (T-score <-2.5 SD).[1]

Data of each participant such as age and gender, region of India such as North, East, West and South, and BMD was recorded. Based on the data, participants were grouped as adults (18 to 59 years) and elderly (≥60 years). All females above the age of 50 years were considered as postmenopausal women.

The main study objective of this analysis is to determine the prevalence of osteoporosis and osteopenia in apparently healthy adult population on a pan-India level. Secondary objectives include determining the regional prevalence for all four regions (zones), assessing differences in prevalence of osteopenia and osteoporosis in males and females as well as in adults and elderly on pan-India and zone levels.

Statistical analysis

Data was entered and analyzed using the Microsoft excel 2016 software. Data was presented as frequency and percentages for qualitative variables and as mean and standard deviation for quantitative variables. Chi-square test was applied to determine the statistically significant differences in qualitative variables in different groups. P value <0.05 was considered significant for all comparisons.

RESULTS

In this study, data from 31238 participants was evaluated. Table 1 describes the baseline characteristics of the participants. Mean age was 47.8±14.2 years and 23.8% were elderly. 52.4% were males and 47.6% were females. Among females, 5768 (38.8%) were in post-menopausal age. Most participants were from South India region (35%) whereas distribution in other three regions was nearly equal. Overall prevalence of osteoporosis was 18.3% and of osteopenia was 49.9% (Figure 1). Prevalence of osteoporosis was 16.3% in West region, 16.4% in North region, 18.4% in East region and 20.7% in South region. Prevalence of osteopenia varied from 47.4% in South region to 55.6% in North region (Table 2).

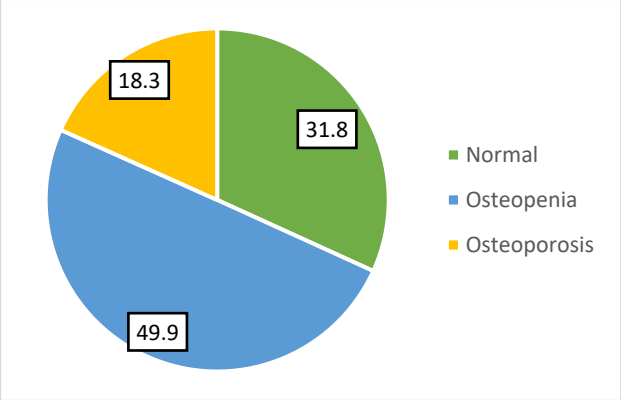

Figure 1: Overall distribution of BMD in adult Indian population.

Table 1: Demographic characteristics (n=31,238).

Characteristics	N (%)
Age (n=31238) (year)	
Mean ± SD	47.8±14.2
≤40	10750 (34.4)
41 to 59	13066 (41.8)
≥60	7422 (23.8)
Gender (n=31238)	
Male	16365 (52.4)
Female	14873 (47.6)
Postmenopausal female (age >50 y)	5768 (38.8)
Region (n=30903)	
East	6334 (20.5)
West	7160 (23.2)
North	6579 (21.3)
South	10830 (35.0)

Among males and females, prevalence of osteoporosis was 17.3% and 19.4% and of osteopenia was 50.2% and 49.6%. The distribution was statistically significant (p<0.0001). In postmenopausal women, prevalence of osteopenia and osteoporosis was 47.5 and 33.1% respectively (Figure 2). Compared to adults, elderly participants had significantly higher prevalence of osteoporosis (37.0% vs 12.5%) but osteopenia was seen in greater proportion of adults than elderly (51.6 vs 44.7%) as depicted in Figure 3. The trend persisted when data of adults and elderly was analyzed by gender. Compared to adults, osteoporosis was more common in elderly males (11.9 vs 33.68%, p<0.0001) and females (13.1% vs 41.0%, p<0.0001) (Table 3).

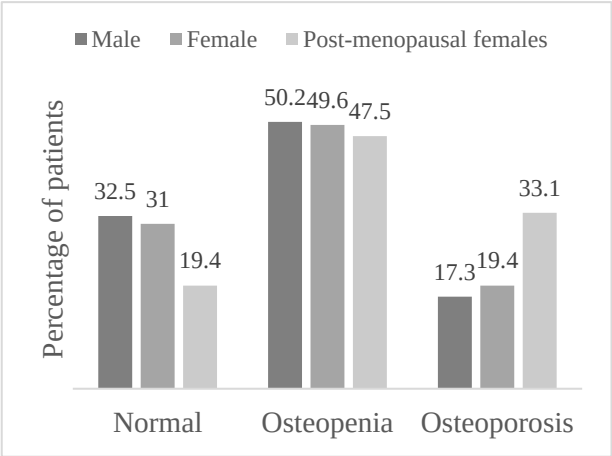

Figure 2: Distribution of BMD in two genders.

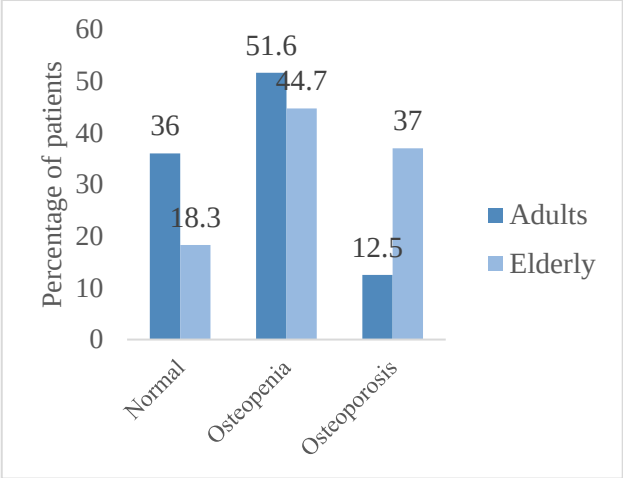

Figure 3: BMD distribution in adults and elderly.

Table 2: Overall and zone wise distribution of bone mineral density.

BMD	Total (n=31238)	East (n=6334)	West (n=7160)	North (n=6579)	South (n=10830)
Normal	9929 (31.8)	1920 (30.3)	2567 (35.9)	1844 (28.0)	3449 (31.8)
Osteopenia	15595 (49.9)	3251 (51.3)	3429 (47.9)	3657 (55.6)	5134 (47.4)
Osteoporosis	5714 (18.3)	1163 (18.4)	1164 (16.3)	1078 (16.4)	2247 (20.7)

Table 3: Gender wise bone mineral density comparison in adults and elderly.

BMD	Adult males (n=12325)	Elderly males (n=4040)	P	Adult females (n=11491)	Elderly females (n=3382)	P
Normal	4501 (36.5)	822 (20.34)		4070 (35.4)	536 (15.8)	
Osteopenia	6356 (51.6)	1857 (46.0)	<0.0001	5922 (51.5)	1460 (43.2)	<0.0001
Osteoporosis	1468 (11.9)	1361 (33.6)		1499 (13.1)	1386 (41.0)	

Table 4: Zone wise distribution of bone mineral density in adults and elderly.

BMD	East (n=6315)		West (n=7155)		North (n=6579)		South (n=10830)	
	Adults (n=5082)	Elderly (n=1252)	Adults (n=5402)	Elderly (n=1758)	Adults (n=5101)	Elderly (n=1478)	Adults (n=7980)	Elderly (n=2850)
Normal	1698 (33.4)	222 (17.7)	2246 (41.6)	321 (18.3)	1577 (30.9)	267 (18.1)	2928 (36.7)	521 (18.3)
Osteopenia	2697 (53.1)	554 (44.3)	2624 (48.6)	805 (45.8)	2928 (57.4)	729 (49.3)	3932 (49.3)	1202 (42.2)
Osteoporosis	687 (13.5)	476 (38.0)	532 (9.8)	632 (35.9)	596 (11.7)	482 (32.6)	1120 (14.0)	1129 (39.5)
P values	<0.0001		<0.0001		<0.0001		<0.0001	

Table 5: Zone wise distribution of bone mineral density in two genders.

BMD	East (n=6334)		West (n=7160)		North (n=6594)		South (n=10830)	
	Males (n=3506)	Females (n=2828)	Males (n=3685)	Females (n=3475)	Males (n=3500)	Females (n=3103)	Males (n=5530)	Females (n=5300)
Normal	1121 (32.0)	799 (28.3)	1371 (37.2)	1196 (34.4)	978 (28.1)	866 (28.0)	1786 (32.3)	1663 (31.4)
Osteopenia	1781 (50.8)	1470 (52.0)	1736 (47.1)	1693 (48.7)	1984 (56.9)	1673 (54.1)	2653 (48.0)	2481 (46.8)
Osteoporosis	604 (17.2)	559 (19.8)	578 (15.7)	586 (16.9)	524 (15.0)	554 (17.9)	1091 (19.7)	1156 (21.8)
P value	0.001		0.041		0.005		0.028	

Table 4 describes zone wise distribution of BMD in adults and elderly. Prevalence of osteopenia was higher in adults than elderly from East (53.1% vs 44.3%), North (57.4 vs 49.3%) and South (49.3 vs 42.2%) regions whereas West region (48.6 vs 45.8%) showed nearly similar proportion of adults and elderly with osteopenia. On other hand, prevalence of osteoporosis was higher in elderly from all 4 regions ranging from 32.6% in North region to 39.5% in South region. Among males, highest prevalence of osteoporosis was seen in South (19.7%) region and lowest was in North (15.0%) region. Among females, highest prevalence of osteoporosis was seen in South (21.8%) region and lowest was in West (16.9%) region. In all regions, greater proportion of females had osteoporosis than males. Among postmenopausal females, maximum prevalence of osteoporosis was seen in South region (21.8%) followed by East (19.8%), North region (17.9%) and West region (16.9%). Osteopenia on other hand was most prevalent more in North region (54.1%) and lowest prevalence was seen in South region (46.8%) (Figure 4).

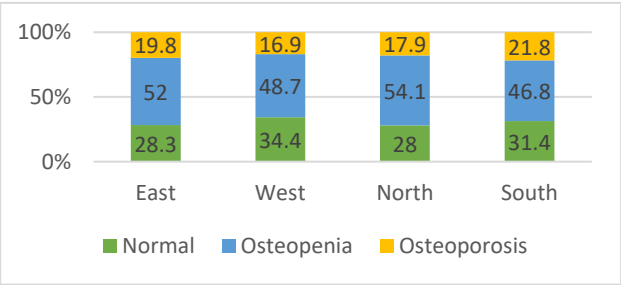

Figure 4: Zone wise distribution of BMD in postmenopausal women.

DISCUSSION

India is the second largest populated country in the world. With increasing life expectancy, there is significant increase in number of ageing populations. By 2050, projection suggests that nearly 20% of population will be over age of 60 years. With this, projections suggest that the hip fracture will increase to more than one million with male to female ratio of 1:3.[16] Loss of bone results in reduced compressive and/or torsional strength and increases the risk of fragility fractures especially in ageing population. Thus, early identification of osteopenia and osteoporosis is essential to reduce the burden of fractures. In this large observational study, the observed prevalence of osteoporosis and osteopenia was 18.3 and 49.9% respectively. Globally, osteoporosis affects more than 200 million individuals.[3] From India, Khadilkar et al in their review reported that there is wide variation in prevalence of osteoporosis and that varies from 8% to 62%. Prevalence of osteopenia was also observed to be above 50%.[5] However, the prevalence rates reflected from the studies performed in women only. We found osteoporosis in 17.3% in males and 19.4% females. A large (n=1600) study in healthy adults above 50 years from Delhi, India reported osteoporosis and osteopenia in 35.1 and 49.5% participants. Among males and females, prevalence of osteoporosis was 24.8 and 42.5% and that of osteopenia in 54.3 and 44.9% respectively.[17] These data indicate males are also affected with osteoporosis and should be evaluated for bone loss.

With aging and menopause in women, there is increased risk of fragility fractures. Early onset of menopause and

nutritional deficiencies in India women carries a greater risk of osteoporosis. In early menopause, bone loss is much accelerated (2-5% per year) which is reduced to 1% per year after 5-7 years of menopause.[18] Osteoporosis not only affects females, but also males. Low bone mass is associated with microarchitectural deterioration of bone tissue which increases bone fragility and risk of fracture. Prevalence of osteoporosis in elderly was 37% in our study and was much greater than that of adults (12.5%). Further, we observed that both elderly males (33.6%) and females (41%) had much higher prevalence of osteoporosis. Marwaha et al had similar observation with greater prevalence of osteoporosis in elderly >60 years compared to participants aged 50-60 years.[17] Consistently, osteopenia was seen in greater proportion of males than females and adults than elderly. Similar finding reported by Chitten and James with high prevalence of osteopenia in 35-55 years men and women (54 and 51%).[19] It indicates bone loss starts much earlier in Indian population which can be explained by genetic susceptibility, and nutritional deficiencies including high risk of hypovitaminosis D.[20,21] Both osteopenia and osteoporosis increase the fracture risk and therefore assessment of bone loss in all Indian adults.

In four regions of India, observed prevalence of osteoporosis and osteopenia was South region (20.7%) had highest prevalence of osteoporosis and osteopenia was highest in North (55.6%). Regional distribution also showed trends as seen in overall population. From South India, Shetty et al reported osteoporosis in 20% and osteopenia in 58% males above 50 years of age.[22] Paul et al reported osteoporosis prevalence of 50% in South Indian women aged 50 years which is higher compared to our observation of 21.8%.[21]

A study from North India by Agrawal and Sharma observed osteoporosis in 8.5% and osteopenia in 42% adult males above 50 years of age.[23] We observed highest prevalence of osteopenia in North Indian males (56.9%). In young females from North India, osteoporosis was reported in 18% by Acharya et al [24] which is similar to our finding of 19.7% osteoporosis in females of this region.

From Western region, Selvanus et al reported osteoporosis in 12.85% and 3.7% females and males whereas osteopenia was reported in 41.4% and 33.33% females and males.[25] However, greater proportion of males in our study had osteoporosis (15.7%). Near similar observation were seen in study from Kadam et al reporting osteoporosis in 14.5% males and 18% females and osteopenia in 56% males and 44.8% females.[26]

In East region, osteoporosis and osteopenia prevalence was 18.4 and 51.3% with nearly similar rate in males and females. Borgohain et al observed osteoporosis in 29.4% and osteopenia in 47.9% of adults >18 years in this region.[27] These data indicate in Eastern region, osteoporosis is prevalent condition.

Bone loss is eminent in postmenopausal period in all females. We observed 47.5% women were osteopenic and 33.1% had osteoporosis. This indicates 1 out of 2 women and 1 out of 3 women in postmenopausal period has osteopenia and osteoporosis. A metanalysis from Thulkar et al reported pooled prevalence for the osteoporosis in the Asian postmenopausal women to be 41%.[28] As various factors determine the development of osteoporosis, there could be subtle differences in prevalence across the nation. We found that South Indian women (21.8%) had slightly higher prevalence of osteoporosis compared to West (16.9%), North (17.9%) and East (19.8%) region. In different studies involving postmenopausal women, reported osteoporosis prevalence was highly variable and ranged from 44.7 to 50% in South India, and 26.4 to 53% in North India.[21,22,29,30] However, it should be emphasized that most of these studies were small sample which may show higher prevalence than actual.

The main strength of our study is that it is first of a kind study reporting data on osteoporosis and osteopenia on national level and in each geographical zone. The data was based on the calcaneal ultrasound derived estimations. Some experts suggest peripheral estimation of bone loss may not be appropriate as DEXA scan of axial skeleton. However, it is identified as a simple, non-invasive method for detecting osteoporosis in routine clinical practice. Also, measurement of peripheral BMD correlates with central BMD. Nonetheless, study provides substantial evidence on presence of osteoporosis and osteopenia on a countrywide level. Our observations are limited by lack of detailed data on risk factors that may predispose to osteoporosis, lack of data on fragility fractures that may have occurred in any of the participants. Further, data on vitamin D levels and daily intake of calcium and types of food would have provided more insights into epidemiological differences in four zones.

CONCLUSION

Our analysis identifies that osteoporosis affects 1 out of 5 adults and osteopenia is seen in 1 out of 2 adults in India. This is ubiquitous in India with no major differences in all four regions. Though osteoporosis is more common in women especially postmenopausal and in elderly, osteopenia is common in males and younger adults. Two out of five elderly women and one out of three elderly men have osteoporosis. South Indian females have slightly greater prevalence of osteoporosis compared to West Indian women. Given the general lack of awareness in India about bone health and osteoporosis, we identify need of increased awareness to identify a greater number of individuals with bone loss. A greater prevalence of osteopenia in our study suggests that these population are at greatest risk of developing osteoporosis in future and therefore need to be managed adequately to reduce fractures risk. We identify need of such pan India studies to further substantiate our observations to assist physicians and policy makers for taking appropriate steps to curb bone loss in susceptible population.

ACKNOWLEDGEMENTS

Authors would like to thank all the participants for their consent to BMD evaluation. We extend our thanks to all the physicians and "Bandhan" team provided participant data and ensured appropriate BMD evaluations. We also thank Dr. Vijay M. Katekhaye (Quest MedPharma Consultants, Nagpur, India) for his assistance in drafting, reviewing, and editing the manuscript. The manuscript development was funded by Integrace Helath Pvt. Ltd., Mumbai, India.

Funding: Funding sources by Integrace Health Pvt Ltd., Mumbai, India.
Conflict of interest: Dr Shobhit Seth is a salaried employee of Integrace health Pvt Ltd., Mumbai, India.
Ethical approval: The study was approved by the institutional ethics committee

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Cite this article as: Babhulkar S, Seth S. Prevalence of osteoporosis in India: an observation of 31238 adults. Int J Res Orthop 2021;7:362-8.