

# Prevalence and related risk factors of osteoporosis in peri- and postmenopausal Indian women

Neelam Aggarwal, Ainharan Raveendran, Niranjana Khandelwal<sup>1</sup>, Ramesh Kumar Sen<sup>2</sup>, J. S. Thakur<sup>3</sup>, Lakhbir Kaur Dhaliwal, Veenu Singla<sup>1</sup>, Sakthivel Rajan Rajaram Manoharan<sup>2</sup>

Departments of Obstetrics and Gynaecology, <sup>1</sup>Radiodiagnosis and Imaging, <sup>2</sup>Orthopaedics Surgery, and <sup>3</sup>Community Medicine, School of Public Health, Postgraduate Institute of Medical Education and Research, Chandigarh, India

## ABSTRACT

**Aim:** We undertook this study involving 200 peri- and postmenopausal women to determine the prevalence of osteoporosis, and in turn increase the awareness, education, prevention, and treatment of osteoporosis.

**Setting and Design:** Postgraduate Institute of Medical Education and Research, UT Chandigarh, India, and a clinical study.

**Materials and Methods:** A detailed medical, obstetrical, menstrual, and drug history was recorded in a proforma designated for the study. Height and weight was measured, weight-bearing exercise was assessed, and sunlight exposure per day for each woman was recorded. Food intake was estimated by using the 24-hour dietary recall method, and calcium and vitamin D consumption pattern was assessed. Bone mineral density (BMD) at postero-anterior lumbar spine and dual femurs was assessed by densitometer. Women were classified according to the WHO criteria.

**Statistical Analysis Used:** Student's *t*-test, multiple logistic regression analysis.

**Results:** The prevalence of low BMD was found in more than half of this population (53%). The mean age in group I (normal BMD) was found to be 50.56 ± 5.74 years as compared to 52.50 ± 5.94 in group II with low BMD (*P*=0.02). The two groups were similar with respect to parity, education, socioeconomic status, family history of osteoporosis, hormone replacement therapy, and thyroid disorders. 46.8% of the women in group I and 33% of the women in group II had low physical activity and there was no statistically significant difference in sunlight exposure between the groups. Parity or the number of children and type of menopause was not seen to have much association with low BMD in our study. Lack of exercise and low calcium diet were significantly associated with low BMD. Multiple logistic regression analysis showed that age, exercise, menopause, and low calcium diet acted as significant predictors of low bone density.

**Conclusion:** The findings from the study suggest the need for large community-based studies so that high-risk population can be picked up and early interventions and other life style changes can be instituted if there is delay in implementing national or international health strategies to tackle this increasing global health problem. Strategies to identify and manage low BMD in the primary care setting need to be established and implemented.

**Key Words:** Bone mineral density, calcium, dual-energy X-ray absorptiometry scan, osteoporosis and menopause

## INTRODUCTION

Osteoporosis is a major global public health problem associated with significant morbidity, mortality, and socioeconomic burden.<sup>[1]</sup> It is defined as a skeletal disorder characterized by low bone strength, leading to an increased risk of fragility fractures. The greatest bone loss occurs in women during perimenopause and is associated with estrogen insufficiency, a condition of menopause.

**Address for Correspondence:** Dr. Ainharan Raveendran, Department of Obstetrics and Gynaecology, New Cross Hospital, The Royal Wolverhampton NHS Trust, Wolverhampton, WV11 1SJ, UK. E-mail: rainharan@yahoo.co.in

According to National Health and Nutrition Examination survey (NHANES III), an estimated 14 million American women over age 50 years are affected by low density at the hip. The prevalence of osteoporosis increases with age for all sites, and by World Health Organization (WHO) definition, up to

### Access this article online

Quick Response Code:



**Website:**  
www.jmidlifehealth.org

**DOI:**  
10.4103/0976-7800.92537

70% of women over the age 80 years have osteoporosis.<sup>[2]</sup> Indian subcontinent is situated between 8.4° and 37.6°N latitude and majority of the population living here experience perennial sunlight throughout the year and vitamin D through this adequate sun exposure. However, darker skin pigmentation, recent modernization of India resulting in working indoor, and reduced physical activity have resulted in limited sun exposure. The women from Indian subcontinent who have migrated to western countries are at increased risk of accelerated age-related bone loss when compared to their counterparts living in the same geographic region due to their darker skin, conservative dressing such as “Burqa,” “Sari,” and “Salwar kameez,” and their genetic pattern.<sup>[3]</sup> This silently progressing metabolic bone disease is widely prevalent in India and osteoporotic fractures are a common cause of morbidity and mortality in adult Indian men and women. Expert groups peg the number of osteoporosis patients in India at approximately 26 million (2003 figures), with the numbers projected to increase to 36 million by 2013.<sup>[4]</sup> Osteoporosis has numerous medical implications and a huge economic impact. So it is of utmost importance that we take immediate steps to create awareness and treatment of this disease.

Osteoporosis is a condition that can be prevented and treated if diagnosed early and accurately. Unfortunately, it is often undiagnosed until a fracture occurs. Therefore, the number of people who are screened for this disease must be increased. Measuring bone mineral density (BMD) is the most important tool in the diagnosis of osteoporosis. The gold standard for measuring BMD is the dual-energy X-ray absorptiometry (DEXA) densitometer, a specialized X-ray device that precisely quantifies BMD at the spine, femur, and other skeletal sites. DEXA scans are noninvasive and comfortable for the patient, with very low radiation requiring only 10 minutes for the entire examination. With the onset of menopause, rapid bone loss occurs which is believed to average approximately 2–3% over the following 5–10 years, being greatest in the early postmenopausal years. Thus, for the purposes of prevention and control of osteoporosis, there is a great interest in conducting epidemiologic surveys of the prevalence of osteoporosis and related risk factors in communities. Hence, we undertook this study involving 200 peri- and postmenopausal women from the union territory of Chandigarh, India, to determine the prevalence of osteoporosis and in turn to increase awareness, education, prevention, and treatment of osteoporosis, and to evaluate the result of intervention done for treatment/progress of the disease.

## MATERIALS AND METHODS

A total of 200 women aged 45 years and above belonging to Chandigarh city, India, were recruited in the study after informed consent was obtained from them and they participated in the study on a voluntary basis. Exclusion criteria included pregnancy, documented osteoporosis or osteopenia, nonambulatory women, and women not willing for continued follow-up.

A detailed medical, obstetrical, menstrual, and drug history was recorded in a proforma designated for the study. Particular focus was laid upon the medical conditions like hyperparathyroidism, renal diseases, diabetes mellitus, rheumatoid arthritis, chronic liver disease, chronic malabsorption syndrome, current or past treatment with glucocorticosteroids, thyroid hormones, and use of oral contraceptive pills and hormone replacement therapy. Information on past fracture history, family history of fracture and osteoporosis, socioeconomic status, occupation, educational level, and weight-bearing exercises was collected and recorded. Weight-bearing exercise was assessed by inquiring about regular weight-bearing exercise for the past 12 months, and the number of sessions of weight-bearing exercise of at least 30 minutes was noted. Height and weight was measured by a trained investigator, with the women in light gown and without footwear. Body mass index (BMI) was calculated using the formula: Weight (kg)/height (cm)<sup>2</sup>. Data regarding sunlight exposure per day for each woman were recorded using the “rules of nines” by using Barger-Lux–Heaney index (sun index=hours of sun exposure per week×fraction of body surface area exposed to sunlight); this was further categorized as high, medium and low sun exposure.<sup>[5]</sup> Food intake was estimated by using the 24-hour dietary recall method, and nutrients of each meal were assessed by applying the Indian database of nutritive value of each cooked food.<sup>[6]</sup> Calcium and vitamin D consumption pattern was assessed using a short food frequency questionnaire.

BMD at postero-anterior lumbar spine (L2–L4) and dual femurs (total hip, trochanter, wards, femoral neck) was assessed by Lunar DPX-PRO total body pencil beam densitometer (GE Healthcare, Waukesha, Winconsin, USA) using a medium mode scan. Women were considered at moderate risk if T score was between less than –1 and –2.5 and at high risk if T score was less than –2.5, according to the WHO classification. After testing, the patients were informed about the results of their investigations and counseled regarding risk of osteoporosis. Education regarding the screening results and standard information on dietary recommendations

and lifestyle modification were provided based on National Osteoporosis Foundation guidelines.<sup>[7]</sup> Women found to have osteopenia and osteoporosis were treated by the orthopedic surgeons.

### Statistical analysis

Data were calculated as percentage and mean (standard deviation). Student's *t*-test was applied to examine the differences in prevalence of osteoporosis. Multiple logistic regression analysis was used for associations between osteoporosis and data presented as odds ratio and 95% confidence intervals. Associations were considered statistically significant at  $P < 0.05$  level. All statistical analyses were performed by using SPSS version 15 statistical package (Chicago, IL, USA).

## RESULTS

Out of 200 women studied, 106 were found to have low BMD (osteopenia and osteoporosis). These were grouped as group II in the analysis. Women with normal BMD formed group I. The prevalence of low BMD was found in more than half of this population (53%).

The mean age in group I was found to be  $50.56 \pm 5.74$  years as compared to  $52.50 \pm 5.94$  years in group II with low BMD, which was statistically significant ( $P=0.02$ ). The average age at menopause was  $50.12 \pm 4.60$  years in group I and  $51.23 \pm 4.82$  years in group II. The average period since menopause was  $5.6 \pm 4.1$  years in group I and  $5.06 \pm 3.8$  years in group II. The two groups were similar with respect to parity, education, and socioeconomic status, family history of osteoporosis, hormone replacement therapy, and thyroid disorders. None had previous history of bone fractures. Mean age at menarche was  $14.3 \pm 1.6$  years and  $14.5 \pm 1.2$  years in group I and group II, respectively [Table 1]. 46.8% of women in group I and 33% of women in group II had low physical activity and there was no statistically significant difference in sunlight exposure between the groups.

The mean calorie and protein intake were  $1612 \pm 368$  kcal and  $38.01 \pm 14.36$  g, respectively, in group I and  $1598 \pm 402$  kcal and  $36.48 \pm 12.36$  g, respectively, in group II. Twenty-three percent of the women in group I and 22.3% of the women in group II had their total calorie intake below the recommended dietary intakes (RDIs), while 16.4% of the women in group I and 18.4% of the women in group II had their total protein intake below the recommended protein intakes. The mean calcium intake for group I and group II was  $520 \pm 233$  mg/day and  $514 \pm 186$  mg/day, respectively.

Nineteen percent of the women in group I and 37.7% of the women in group II had calcium intake below the RDIs. Osteoporosis and osteopenia of lumbar spine, femoral neck, and total spine (T score less than  $-2.5$  and T score between  $-1$  and  $-2.5$ ) was seen in 53% ( $n=106$ ) of the affected population. Prevalence of osteoporosis was seen to be high with increasing age and low BMD. Parity or the number of children and type of menopause was not seen to have much association with low BMD in our study. Lack of exercise and low calcium diet were significantly associated with low BMD. Interestingly, more number of patients in the premenopausal age group were found to be having low BMD than the postmenopausal women in this population. Multiple logistic regression analysis showed that age, exercise, menopause, and low calcium diet acted as significant predictors of low bone density [Table 2].

## DISCUSSION

There has been a great interest in conducting epidemiologic surveys of the prevalence of osteoporosis and related risk factors in communities.<sup>[8]</sup> In India, the precise figures on the prevalence of osteoporosis are not available at present. However, it is estimated that more than 61 million Indians have osteoporosis; of these, 80% patients are females.<sup>[9,10]</sup> An age-dependent

**Table 1: Baseline demographic characteristics and risk factors of the study population**

Variables	Group I (%)	Group II (%)	P value
Mean age (years)	$50.56 \pm 5.74$	$52.50 \pm 5.94$	0.02
Age at menarche (years)	$14.41 \pm 1.20$	$14.32 \pm 1.67$	0.57
Age at menopause (years)	$50.12 \pm 4.60$	$51.23 \pm 4.82$	0.02
BMI			
<25	15 (14.1)	33 (31.1)	0.005
>25	79 (85.9)	73 (68.9)	
Exercise 30 minutes/3 times a week	44 (46.8)	35 (33)	0.046
Low calcium diet	18 (19.1)	40 (37.7)	0.004
Family history of osteoporosis	8 (8.5)	8 (7.5)	0.802
Postmenopause	44 (46.8)	35 (33)	0.046
Hormone replacement therapy	4 (4.3)	9 (8.5)	0.225
Thyroid disorders	11 (11.7)	7 (6.6)	0.209
Steroid therapy	-	2 (1.9)	0.280

BMI = Body mass index

**Table 2: Multiple logistic regression analysis of risk factors**

Risk factors	Odds ratio	95% confidence interval	P value
Age	1.733	0.893, 3.361	0.020
Exercise	0.528	0.282, 0.901	0.046
Low calcium	2.308	1.168, 4.564	0.004
Postmenopause	2.391	1.207, 4.361	0.046

decline in BMD was seen in both women and men over the age of 50 years in a study to establish the normative database for BMD in Indian population using digital X-ray radiogrammetry.<sup>[11]</sup> A large single-center study from Jaipur, India, has shown that the mean Indian BMD is about 2SD lower than the western BMD.<sup>[12]</sup>

Ours was a cross-sectional study to assess the prevalence of osteoporosis in a selected population of the city. Almost half of the women in peri- and postmenopausal age group were found to have low BMD. Other high-risk factors associated with low BMD were found to be low BMI, low dietary calcium intake, lack of exercise, and increasing age. Indian Council of Medical Research (ICMR) recommendation for calcium and vitamin D for various populations in India is much lower when compared to the RDI of developed nations.<sup>[2]</sup> One of the important determinants of bone health is BMI which is again significantly lower in Indian women when compared to their western counterparts. Literature review reveals extensive studies of factors affecting osteoporosis. Increasing age, especially when women become postmenopausal, low education level, low socioeconomic status, frequent childbirth, and poor dietary intake have been associated with higher prevalence of osteoporosis. With 19% of the women in group I and 37.7% of the women in group II having calcium intake much lower than the RDI, the effect on their bone health is dismal. Even in the UK, there is no accepted policy for population screening to identify individuals with osteoporosis. Patients are identified opportunistically using a case-finding strategy on the finding of a previous fragility fracture or the presence of significant clinical risk factors. Some of the risk factors act independently of BMD to increase fracture risk, whereas others increase fracture risk through their association with low BMD.<sup>[13]</sup>

In large community-based studies, the prevalence of osteoporosis was comparatively lower in western countries when compared to Asian population. In pre-menopausal Dutch women, the prevalence of osteopenia was 27.3%, and 4.1% of the women were osteoporotic; and in Canadian women, the prevalence of osteoporosis was 20%.<sup>[14,15]</sup> In Vietnamese adult women, the prevalence of osteoporosis was found to be relatively higher compared with that in nearby countries. High osteoporosis in the age group 50–70 years was comparable to Japanese women and this was postulated to be due to pre-World War exposure and poor nutrition at that time.<sup>[16]</sup> In this study, the prevalence was thought to be less among rural premenopausal women as compared to urban due to high outdoor physical activity in this population.

Results from the National Osteoporosis Risk Assessment (NORA) reported that osteoporosis was associated with a fracture rate approximately four times that of normal BMD and osteopenia was associated with a 1.8-fold higher rate. The same study affirms the immediacy of risk posed by the finding of low BMD; the risk of fracture is not a decade or more in the future, but rather exists at the time of diagnosis.<sup>[17]</sup> One intriguing observation has emerged in our study population that significantly less women were postmenopausal among those having low BMD, but then it was a small study involving only 200 women. Of major interest is the finding that almost every alternate woman in the peri- and postmenopausal group was found to have low BMD. Similar prevalence of osteoporosis after the age of 50 years has been seen in previous studies by Babu and Vestergaard *et al.*<sup>[18,19]</sup> Prevalence of osteoporosis in healthy ambulatory postmenopausal South Indian women was found to be 48%, and a significant positive correlation between BMI and BMD at the lumbar spine and femoral neck was established in this study ( $r=0.4$ ;  $P=0.0001$ ).<sup>[20]</sup> In our study also, there was positive correlation between low BMI and low BMD. Many of the published data from India have shown lower BMD among young Indian women as compared to those established by the NHANES III reference database in women aged 20–29 years.<sup>[12,21,22]</sup> There is a suggestion that lower BMD values in Asians may be a size related artifact and there may be a need among the Indian women to measure bone mineral apparent density (BMAD), which is an estimation of volumetric density.<sup>[23]</sup>

The prevalence of osteoporosis in our study was found to be high (53%) in peri- and postmenopausal women. There was a significant positive correlation between increasing age, low BMI, low calcium intake, lack of exercise, and low BMD. Thus, high prevalence of osteoporosis in peri- and postmenopausal women is a major health concern. Although no symptoms occur prior to fracture, BMD and other risk factors can be used to identify high-risk patients, and because effective interventions exist, many of these fractures are now preventable. The launch of the WHO technical report, assessment of osteoporosis at primary health care level, and the related web-based FRAX tool are the major milestones toward helping health professionals worldwide to improve identification of patients at high risk of fractures.<sup>[24]</sup> A risk assessment tool for osteoporosis developed by Sharma and Khandelwal can be effective in a resource-poor nation like India, where they used a combination of questionnaire and ultrasonic measurement of BMD. Although DEXA scan is

considered as a gold standard for BMD assessment, most of the Indian women cannot afford it due to the cost involved.<sup>[25]</sup>

We seek to identify a large problem for aging Indian women and as a consequence a challenge for public health planners. It is therefore necessary to create awareness among women from Indian subcontinent, irrespective of their geographic location, about the risk of osteoporosis and educate those regarding preventive measures to avoid future fractures secondary to osteoporosis. There is also a need for large community-based studies so that high-risk population can be picked up and early interventions like adequate calcium intake, vitamin D supplementation, and other life style changes can be instituted if there is delay in implementing national or international health strategies to tackle this increasing global health problem.

## REFERENCES

- Delmas PD, Fraser M. Strong bones in later life: Luxury or necessity? *Bull World Health Organ* 1999;77:416-22.
- National Institute of Nutrition. Dietary guidelines for Indians – a manual. Hyderabad, India: Indian Council of Medical Research; 1998.
- Mitra S, Desai M, Ikram M. Association of estrogen receptor gene polymorphisms with bone mineral density in postmenopausal Indian women. *Mol Genet Metab* 2006;87:80-7.
- Gupta A. Osteoporosis in India the nutritional hypothesis. *Natl Med J Ind* 1996;9:268-74.
- Barger-Lux MJ, Heaney R. Effect of above average summer exposure on serum 25-hydroxyvitamin D and calcium absorption. *J Clin Endocrinol Metab* 2002;87:4952-6.
- Chiplonkar SA, Agte VV. Extent of error in estimating nutrient intakes from food tables versus laboratory estimates of cooked foods. *Asia Pac J Clin Nutr* 2007;16:227-39.
- National Osteoporosis Foundation. Physician's guide to prevention and treatment of postmenopausal osteoporosis. Washington DC, USA: National Osteoporosis Foundation; 2003.
- Inanici-Ersöz F, Gökçe-Kutsal Y, Oncel S, Eryavuz M, Peker O, Ok S. A multicenter case control study of risk factors for low tibial speed of sound among residents of urban areas in Turkey. *Rheumatol Int* 2002;22:20-6.
- Joshi VR, Mangat G, Balakrishnan C, Mittal G. Osteoporosis—approach in Indian scenario. *J Assoc Physicians India* 1998;46:965-7.
- Rao H, Rao N, Sharma LR. A clinical study of bone mineral density using heel ultra-densitometer in Southern Maharashtra. *Indian J Orthop* 2003;37:9.
- Pande KC, Veeraji E, Pande SK. Normative reference database for bone mineral density in Indian men and women using digital X-ray radiogrammetry. *J Indian Med Assoc* 2006;104:288-91.
- Patni R. Normal BMD values for Indian females aged 20-80 years. *J MidLife Health* 2010;1:70-3.
- Compston J, Cooper A, Cooper C, Francis R, Kanis JA, Marshal D, *et al.* Guideline for the diagnosis and management of osteoporosis in postmenopausal women and men from age of 50 years in the UK. on behalf of the National Osteoporosis Guideline Group (NOGG), Sheffield, UK. 2010.
- Smeets-Goevaers CG, Lesusink GL, Papapoulos SE, Maartens LW, Keyzer JJ, Weerdenburg JP, *et al.* The prevalence of low bone mineral density in Dutch perimenopausal women: The Eindhoven perimenopausal osteoporosis study. *Osteoporos Int* 1998;8:404-9.
- Tenenhouse A, Joseph L, Kreiger N, Poliquin S, Murray TM, Blondeau L, *et al.* Estimation of the prevalence of low bone density in Canadian women and men using a population specific DXA reference standard: The Canadian multicentre osteoporosis study (CaMos). *Osteoporos Int* 2000;11:897-904.
- Vu TT, Nguyen CK, Nguyen TL, Le BM, Nguyen Trung Le D, Bui TN, *et al.* Determining the prevalence of osteoporosis and related factors using quantitative ultrasound in Vietnamese adult women. *Am J Epidemiol* 2005;161:824-30.
- Siris ES, Miller PD, Barrett-Connor E, Faulkner KG, Wehren LE, Abbott TA, *et al.* Identification and fracture outcomes of undiagnosed low bone mineral density in postmenopausal women: Results from the National osteoporosis risk assessment. *JAMA* 2001;286:2815-22.
- Babu AS, Ikbal FM, Noone MS, Joseph AN, Samuel P. Osteoporosis and osteopenia in India: A few more observations. *Indian J Med Sci* 2009;63:76-7.
- Vestergaard P, Rejnmark L, Mosekilde L. Osteoporosis is markedly underdiagnosed: A nationwide study from Denmark. *Osteoporos Int* 2005;16:134-41.
- Paul TV, Thomas N, Seshadri MS, Oommen R, Jose A, Mahendri NV. Prevalence of osteoporosis in ambulatory postmenopausal women from a semiurban region in Southern India: Relationship to calcium nutrition and vitamin D status. *Endocr Pract* 2008;14:665-71.
- Nangia S, Arya V, Gujral RB, Mithal A. Spine bone mineral density in normal Indian females. Presented at 27<sup>th</sup> Annual meeting of the Endocrine Society of India, Lucknow, 1997.
- Population based reference standards of peak bone mineral density of Indian males and females – an ICMR multi-centre task force study. Published by Director General, New Delhi: ICMR; 2010. p. 1-24.
- Vaidya R, Shah R. Bone mineral density and reference standards for Indian women. *J MidLife Health* 2010;1:55.
- Kanis JA. On behalf of the world health organisation scientific group. Assessment of osteoporosis at the primary health care level. WHO Collaborating Centre for Metabolic Bone Diseases. England, UK: University of Sheffield; 2008.
- Sharma S, Khandelwal S. Effective risk assessment tools for osteoporosis in the Indian menopausal female. *J MidLife Health* 2010;1:79-85.

**How to cite this article:** Aggarwal N, Raveendran A, Khandelwal N, Sen RK, Thakur JS, Dhaliwal LK, *et al.* Prevalence and related risk factors of osteoporosis in peri- and postmenopausal Indian women. *J Mid-life Health* 2011;2:81-5.

**Source of Support:** Nil, **Conflict of Interest:** None declared.