ORIGINAL RESEARCH

Prevalence of Osteoporosis and Associated Risk Factors among Postmenopausal Women

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ABSTRACT
Background: Osteoporosis is a degenerative, debilitating metabolic bone disease that is increasingly prevalent in postmenopausal women. In recent years, osteoporosis has become a global public health concern because of its negative effects on quality of life and its proven link with increased mortality and a significant financial burden to society. As a bone disease that develops when bone mineral density and bone mass decrease, it leads to weak and brittle bones that are more vulnerable to fracture. Prevalence statistics of postmenopausal osteoporosis and knowledge regarding its independent predictors are lacking.**Aim and objectives:** This study aims to investigate the prevalence of osteoporosis and associated risk factors among postmenopausal women.**Materials and Methods:** The present study was a hospital-based prospective cross-sectional study. This study was carried out among postmenopausal women who attended the orthopaedics/gynaecology outpatient department of Sri Krishna Medical College & Hospital, Muzaffarpur, Bihar, Indiafrom January 2019 to July 2019, and 690 women ranging in age between 50 and 80 years who had confirmed menopause were enrolled for the study. Finally, 539 women were recommended for bone mineral density testing using dual energy X-ray absorptiometry. To analyse the differences between the groups, a chi-square and Student's t-test were used for the categorical and continuous variables, respectively. $P < 0.05$ was considered to show significant associations.**Results:** In present study, 60% of subjects belonged to the 60-year age group. 40% of subjects were having 5 or more children. 20% of subjects were currently smoking or chewing tobacco. Age of menopause among 42% of subjects was after 50 years of age, and duration of menopause at the time of enrolment in the study was more than 10 years in 50% of subjects. The prevalence of osteoporosis increased with the increase in the parity. Subjects with poor socioeconomic condition, family history of symptoms related to osteoporosis and fragility fracture, and self-history of fragility fracture had a higher prevalence of osteoporosis ($P < 0.05$).**Conclusions:** The prevalence of osteoporosis is high among postmenopausal women, but the awareness is limited. This study highlights the need for screening all women after the age of 40 years. In this study, the overall prevalence of osteoporotic fractures among postmenopausal females was 80% (osteoporosis: 38% and osteopenia: 42%). The gold standard method recommended by the WHO in the diagnosis of osteoporosis is DXA. By this method, osteoporosis is defined by a BMD lower than 3.5 SDs of the reference BMD. Health education is necessary for preventing modifiable risk factors and reducing the complications of this disease.
Keywords: bone mineral density, fracture, osteoporosis, postmenopausal, Z-score

INTRODUCTION
In recent years, osteoporosis has become a global public health concern because of its negative effects on quality of life and its proven link with increased mortality and a significant financial burden to society.Osteoporosis is a now well-

known systematic bone disease characterised by low bone mass and deterioration of the microarchitecture of the bone, leading to bone fragility and eventually fractures. Osteoporosis is characterised by low bone mass and destruction of bone tissue structure, leading to increased bone fragility and susceptibility to fractured bones.[1,2] Osteoporosis is one of the major health problems in any country because of its association with fractures. T-score and Z-score indices are used to quantify bone density. The World Health Organisation (WHO) defines osteoporosis as a bone mineral density (BMD) that lies 2.5 standard deviations (SDs) or more below the mean maximum BMD.[3,4] T-score indicates changes in the SD of a person's bone density relative to the maximum BMD in healthy and young individuals, and Z-score also shows changes in the SD of a person's bone density relative to people of similar age, sex, and race. Accordingly, osteoporosis is defined as a T-score of 2.5 and osteopenia as a T-score between 1 and 2.5. Age, sex, race, genetics, low calcium intake, and activity have an effect on bone mass.[5]

Menopause is one of the most important causes of osteoporosis. Postmenopausal women lose 3%–5% of their bone mass annually. These women lose part of their bone mass and are exposed to osteoporosis for up to 7 years after menopause. The reason for bone loss after menopause is the reduction in oestrogen production by the ovaries. Menopausal osteoporosis is important because women spend one-third of their lives under conditions of reduced bone mass and increased risk of fractures, and the rate of bone loss in the first few years of menopause is high.[6,7] Bone loss in postmenopaused women occurs in two phases. The initial short phase lasts 3–5 years and trabecular bone loss occurs rapidly (menopause-related bone loss), and in the long-term phase, men and women gradually lose their cortical and trabecular bones for over 10–20 years (age-related bone loss).[8] Fracture, disability, and chronic pain are the most common clinical consequences of osteoporosis. Pelvic, vertebrae, and distal radius fractures are the most common osteoporotic fractures. These fractures not only cause morbidity but also increase the chances of mortality, with mortality following hip fracture in the 1st year being 20%. Also, the disability-adjusted life year caused by osteoporosis in India was 36,026 years.[9,10]

Prevalence statistics of postmenopausal osteoporosis and knowledge regarding its independent predictors are lacking, especially in India, where every third woman and every eighth man is suffering from it.[9] Investigation of common risk factors for calculating the independent risk predictors for osteoporosis is an important strategy, which can be useful in formulating an effective approach for managing osteoporosis and its imperative consequences. There is no compelling report on the prevalence and predictors for osteoporosis or osteopenia in the population of the Mewat region, which has been analysed in the present study.

AIM AND OBJECTIVES
This study aims to investigate the prevalence of osteoporosis and associated risk factors among postmenopausal women.

MATERIALS AND METHODS
The present prospective cross-sectional study was carried out on postmenopausal women who attended orthopaedics/gynaecology at Sri Krishna Medical College, Muzaffarpur, Bihar, India from January 2019 to July 2019, and 690 women ranging in age between 50 and 80 years who had confirmed menopause (one or more complete years of cessation of the menstrual cycle) were enrolled for the study. All those women who were not consenting, having other musculoskeletal disorders, cardiovascular disorders, cerebrovascular pathology, sarcopenia, diabetes, liver disorders, family history of osteoporotic fractures, thyroid dysfunction, all lupus, chronic kidney disease, taking hormone therapy or any medication affecting blood pressure or lipoprotein metabolism, taking psychotropics, psychoactives, psychedelics, or multivitamins/antioxidants were excluded.

Finally, 539 women were recommended for BMD testing. These women were tested with dual-energy X-ray absorptiometry (DXA) at the femoral neck (hip) and lumbar region (L1–L4 vertebrae). On the basis of T-scores calculated according to WHO guidelines, the subjects were categorised as women with osteoporosis ($n = 202$), women with osteopenia ($n = 241$), and women with normal bone mass ($n = 96$). All the postmenopausal women gave their written consent before participation in the study. The study protocol was approved by the Institutional Ethical Review Committee.[11]

BMD of the women in the supine position was measured with a DXA. On the basis of T-scores obtained according to WHO guidelines, women were characterised as osteoporotic when the T-

score was 3.5 SD, osteopenic when the T-score was observed between 1.1 and 2.5 SD, and normal (without bone loss) when the T-score was <1 SD from the optimal peak bone density of healthy young adults of the same sex. The DXA system was calibrated every day before using it with the Phantoms supplied by the manufacturer. The coefficient of variation was observed to be <4% for the measurements of BMD at the hip and spine.[11]

A structured pro forma was used to obtain demographic and maternal characteristics (age group, education, marital status, abortion, ever breast feed, and smoking/tobacco intake); menstrual characteristics (age at menarche in years, years of menstruation, age at menopause, and duration of menopause); self and family history related to osteoporosis (family history of symptoms related to osteoporosis, family history of fragility fracture, and self-history of fragility fracture); and clinical and laboratory profile (body mass index [BMI] [kg/m^2], physical activity, immobilization, diabetic, hypertensive, calcium intake [mg/day], use of statin, use of Vitamin D3, and Vitamin D3 level [ng/mL]).

BMI was calculated by measuring the weight and height of the subject according to the equation weight in kilogrammes/height in meters squared. Active and sedentary lifestyle was based on whether the subject was doing a minimum of 30 minutes of brisk walking or aerobic exercise every day or not. Systolic blood pressure and diastolic blood pressure were measured by taking an average of the three blood pressure readings using a sphygmomanometer, taken after a 3-minute interval each with the subject in resting position. Immobilisation was defined as "being confined to bed for a continuous period >2 months. Serum vitamin D3 concentrations were determined using radioimmunoassay (BIOSOURCE Europe S. A., Nivelles, Belgium) and were classified as follows: vitamin D deficiency (>20 ng/mL), vitamin D insufficiency (20–29 ng/mL), and vitamin D sufficient (≥30 ng/mL).

Statistical analysis
Data are shown as numbers, percentages, or mean standard deviation. To analyse the differences between the groups, a chi-square and Student's *t*-test were used for categorical and continuous variables, respectively. $P < 0.05$ was considered to show significant associations.

RESULTS
In our study, 54.7% of subjects belonged to the <60-year-old age group. Half of the subjects (51.9%) were illiterate. 90.4% of subjects were married, and 37.7% of subjects were having 6 or more children. Around one tenth of subjects (11.3%) had a history of >2 abortions. 79.2% of subjects gave a history of ever breastfeeding. 14.5% of subjects were currently smoking or chewing tobacco [Table 1].

Table 1: Demographic and maternal characteristics of the study subjects (*n*=539)

Characteristics	Variables	Number of participant(n=539)	Percentage
Age group (years)	<60	295	54.7
	≥60	244	45.3
Education	Illiterate	280	51.9
	Primary school/middle school	148	27.5
	High school or above	111	20.6
Marital status	Single	09	1.7
	Married	487	90.4
	Divorced or widowed	43	8.0
Parity	2 or less children	104	19.3
	3-5 children	232	43.0
	6 or more children	203	37.7
Abortion	Nil	369	68.5
	1-2	109	20.2
	>2	61	11.3
Ever breast feed	Yes	427	79.2
	No	112	20.8
Smoking/tobacco intake	Never smoke/chewed tobacco	461	85.5
	Current smoker/tobacco chewer	78	14.5

Figure 1: Age (in years) wise distribution of the participants
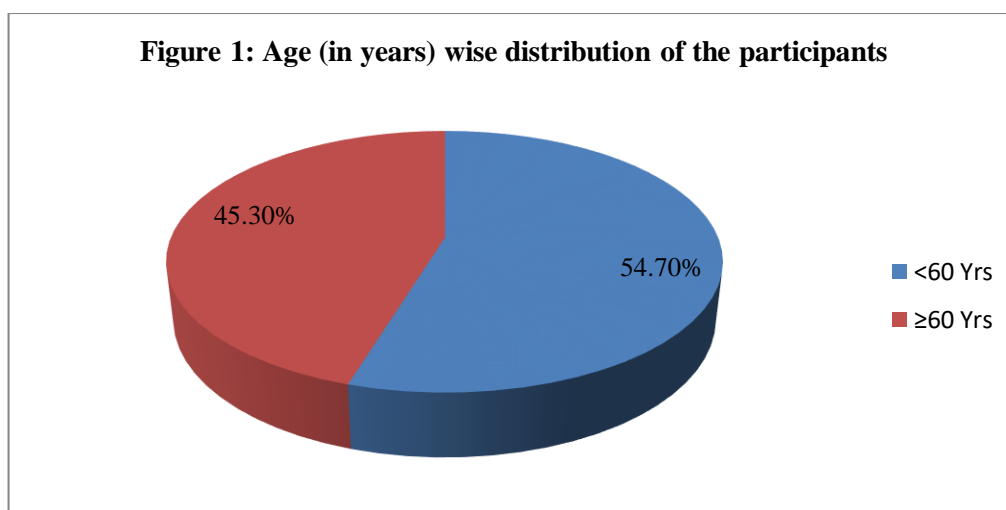
The mean age at menarche was 13.17 <0x7E> 1.85 years for the study subjects. The mean menstrual years were 37.21 <0x7E> 3.76 years among subjects. Age of menopause among 38.0% of subjects was after 50 years of age, and duration of menopause at the time of enrolment in the study was more than 10 years in 48.8% of subjects [Table 2].

Table 2: Menstrual characteristics of the study subjects (*n*=539)

Characteristics	Variables	Number of participants (n=539)	Percentage
Age at menopause (years)	≤50	334	62.0
	>50	205	38.0
Duration of menopause (years)	≤5	142	26.3
	6-10	134	24.9
	>10	263	48.8
Age at menarche (years), mean±SD		13.17±1.85	
Years of menstruation (years), mean±SD		37.21±3.76	

61.0% of subjects had a BMI falling into the obese category, and intake of statins was reported in 67.9% of subjects. 49.2% of subjects were diabetics, and 64.2% of subjects were hypertensives. Family history of symptoms related to osteoporosis and fragility fracture was reported in 31.5% and 24.3% of subjects, respectively.

Table 3: Clinical characteristics and family history of the study subjects (*n = 539*)

Characteristics	Variables	Number Of Participants (n=539)	Percentage
BMI (kg/m^2)	Normal	47	8.7
	Overweight	163	30.2
	Obese	329	61.0
Physical activity	Yes	89	16.5
	No	450	83.5
Immobilization	Yes	27	5.0
	No	512	95.0
Diabetic	Yes	265	49.2
	No	274	50.8
Hypertensive	Yes	346	64.2
	No	193	35.8
Calcium intake (mg/day)	<600	166	30.8
	600-1000	238	44.2
	>1000	135	25.0
Use of statin	Yes	366	67.9
	No	173	32.1

Use of Vitamin D3	Yes	481	89.2
	No	58	10.8
Vitamin D3 level (ng/mL)	Normal	322	59.7
	Insufficiency	102	18.9
	Deficiency	115	21.3
Family history of symptoms related to osteoporosis	Yes	170	31.5
	No	369	68.5
Family history of fragility fracture	Yes	131	24.3
	No	408	75.7
Self-history of fragility fracture	Yes	102	18.9
	No	437	81.1

BMI: Body mass index

The DXA at the femoral neck (hip) and lumbar region (L1–L4 vertebrae) showed osteoporosis among 37.5% of subjects, and osteopenia was observed in 44.7% of subjects. Only 17.8% of subjects were having normal BMD [Table 4].

Table 4: Prevalence of osteoporosis and osteopenia among study subjects (*n*=539)

Prevalence	Lumbar spine, *n* (%)	Left femoral neck, *n* (%)	Overall, *n* (%)
Osteoporosis	175 (32.5)	77 (14.3)	202 (37.5)
Osteopenia	223 (41.4)	302 (56.0)	241 (44.7)
Normal	141 (26.1)	160 (29.7)	96 (17.8)

The subjects with higher age at menarche (13.98 ± 1.78); lesser years of menstruation (36.02 ± 3.92); and more duration of menopause showed a higher prevalence of osteoporosis ($P< 0.05$). Furthermore, subjects with family history of symptoms related to osteoporosis and fragility fracture and self-history of fragility fracture had a higher prevalence of osteoporosis ($P < 0.05$).

DISCUSSION

Osteoporosis is the most common bone metabolic disease and the fourth major enemy of humans after cancer, cardiovascular disease, and stroke, which increases with age. Osteoporosis occurs when the processes of bone resorption and bone formation lose their balance. The gold standard method recommended by the WHO in the diagnosis of osteoporosis is DXA. By this method, osteoporosis is defined by a BMD lower than 2.5 SDs of the reference BMD of Caucasian women aged 20–29 years. This simplified definition of osteoporosis eases the physicians, orthopaedician, gynaecologists, endocrinologists, biostaticians, and community health workers in diagnosing and initiating treatment for osteoporotic patients.

Vitamin D deficiency is a very common endocrine and medical problem throughout the world. It has been predicted that one billion people throughout the world are vitamin D deficient.[12] The prevalence of vitamin D deficiency in the countries where food is enriched by vitamin D is 1.6%–14.8%.[13]

In other European nations, the percentage of young adults who are middle-aged and elderly was 59.6%; in Boston it was 24.1%; and in Tunisia it was 47.6%. [14,15,16]

The Indian Council of Medical Research recommendation for calcium and vitamin D for Indians is much lower when compared to the RDI of developed nations.[22,23] Vitamin D sufficiency through sun exposure is untenable for most Indians, especially for those living in slums where congestion is the big issue. Vitamin D (relatively) rich dietary sources are unaffordable and mostly limited to people in low socioeconomic strata. Most women living in slums are vegetarians, as they cannot afford a nonvegetarian diet. Vitamin D supplements are unaffordable and not feasible and beyond their reach. Fortification of widely consumed staple foods with Vitamin D is the only viable option towards attaining Vitamin D sufficiency in slums.

In India, many studies have been done, but 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% of patients are females.[17,18,19]

In a study done by Pande *et al.*[20], an age-dependent decline in BMD was seen in both

women and men over the age of 50 years. A large single-centre study by Patni R[21] in 2010 in Jaipur, India, was done to establish a normative database for BMD in the Indian population using dual energy X-ray absorptiometry. This study showed that the mean Indian BMD is about 2 SDs lower than the western BMD.

Many studies in the literature showed that the most important determinants of bone health are BMI, which is again significantly lower in Indian women, especially in lower socioeconomic status and even in the affluent category as compared to developed countries. Osteoporosis is extensively studied in the literature, and many factors affect its development. Increasing age, especially when women become postmenopausal, low education level, frequent childbirth, low socioeconomic status, low education, and poor dietary intake have been associated with a higher prevalence of osteoporosis. In developed countries also, there is still no formally accepted policy for population screening to identify individuals with osteoporosis. Patients are being detected using a case-to-case finding strategy based on a previous fragility fracture of the distal radius or hip 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.[24]

The prevalence of osteoporosis in our study was found to be very high in postmenopausal women. Thus, the high prevalence of osteoporosis in peri- and postmenopausal women is a major health concern in low economic strata. Self-history of fragility fracture was given by 18.9% of subjects. In these populations, BMD and other risk factors can be used to identify high-risk patients, and because effective interventions exist, many of these fractures can be preventable. The implementation of the WHO technical report, assessment of osteoporosis at the primary health care level, and the related web-based FRAX tool are the major milestones towards helping health professionals worldwide to improve identification of patients at high risk of fractures.[25]

A risk assessment tool for osteoporosis developed by Sharma et al.[26] can be effective in a resource-poor and developing country like India, where they used a combination of a questionnaire and ultrasonic measurement of BMD. In a recent study done by Nikose et al.[27,] in 2015, a total of 3532 female patients were screened. In their study, it was noted that a significant study population had a lower BMD score, which suggests osteoporosis, and had a statistically significant correlation with their socioeconomic status, literacy rate, and emotional family backup. [27] Although DEXA scan is considered a gold standard for BMD assessment, most of the Indian population is not covered under any kind of health insurance, and so they cannot afford it due to the cost involved.

Although many studies have been published region-wise in India that recommend regular screening of this silent epidemic, it is still not effective on the ground as many women do not know the entity due to poor literacy rates and poor family support. In our study, it was observed that the women eat whatever is left at the end after feeding their husbands, children, and in-laws if living together. This practice was deeply embedded in her mind that, in spite of repeated advice and counselling, it was very difficult to change.

The limitation of the study was its short duration.

CONCLUSION

The prevalence of osteoporosis is high among postmenopausal women, but the awareness is limited. This study highlights the need for screening all women after the age of 40 years. In this study, the overall prevalence of osteoporotic fractures among postmenopausal females was 80% (osteoporosis: 38% and osteopenia: 42%). The gold standard method recommended by the WHO in the diagnosis of osteoporosis is DXA. By this method, osteoporosis is defined by a BMD lower than 3.5 SDs of the reference BMD. Health education is necessary for preventing modifiable risk factors and reducing the complications of this disease.

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