

Study on Prevalence of Osteoporosis in Females in a Tertiary care Centre

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Abstract

Background: Osteoporosis tremendously increases the risk of fragility fracture among elderly women and a significant proportion of elderly women with fractures die within a year of the accident.

AIM: Present study aimed to determine the prevalence and determinants of osteoporosis among women aged above 30 years in a tertiary care centre.

Material and Methods: A single centre, hospital-based, cross-sectional study was conducted involving a total of 246 women aged more than 30 years. The data on age, socioeconomic status, and menstrual history were collected. The bone mineral density of the participants was measured using a Quantitative Ultrasound Densitometer.

Results: The overall prevalence of osteoporosis among women was 16.3%: the prevalence of osteoporosis among women aged >60 years, 51-60 years, and 41-50 years was 63%, 27%, and 4.1%, respectively. The prevalence of osteoporosis was highest among menopausal women (63.4%), followed by premenopausal women (34%), and was lowest among women with a normal menstrual cycle (2.4%). The age >50 years, being menopausal, belonging to low socioeconomic status, and residing in urban areas were associated with higher odds of osteoporosis.

Conclusion: The prevalence of osteoporosis increased, and the bone mineral density decreased with age. The perimenopausal period act as a watershed moment for the development of osteoporosis.

Keywords: Osteoporosis, Women, Prevalence, Determinants.

Introduction

Osteoporosis is a common disease all over the world. The incidence of osteoporotic fractures has made it one of the leading causes of death among elderly women[1], approximately 20% of elderly women die within a year of a fracture[2]. Because the risk of osteoporotic fractures is higher in older women than in older men, all menopausal women should be screened for signs of osteoporosis[3]. Osteoporosis has been operationally defined based on bone mineral density (BMD) assessment. According to the WHO criteria, osteoporosis is defined as a BMD that lies 2.5 standard deviations or more below the average value for young, healthy women (a T-score of < -2.5 SD)[4]. Osteoporosis is classified as primary and secondary. Primary osteoporosis is seen in post-menopausal women and men over 70 years of age due to ageing[5]. Secondary osteoporosis is caused by diseases, treatments, or idiopathic[5].

Various methods are used to measure osteoporosis. The gold standard method to diagnose osteoporosis is bone mineral density (BMD) measurement by dual-energy X-ray absorptiometry (DXA) at various skeletal sites[6]. Another way to diagnose osteoporosis is the speed of sound (SOS) in the tibia, which can be measured by ultrasound imaging[7]. Risk factors for osteoporosis are divided into two categories: modifiable and non-modifiable [6], [8]. Weight, smoking, alcohol consumption, physical inactivity, dietary calcium deficiency, and long-term glucocorticoid use are among the risk factors for the modifiable osteoporosis group[6], [8]. Gender, age, race, and genetic characteristics are among the risk factors for the non-modifiable risk factors for osteoporosis[6], [8]. Although, osteoporosis

is a problem for both sexes, however, the research on osteoporosis has focused on women because women are more likely than men to develop osteoporosis and subsequent fractures[9]. Premature menopause and loss of ovarian function before menopause are additional risk factors for osteoporosis among women[6], [8], [10]. Research has shown that an adult woman can be divided into three groups: premenopausal (before menopause), the onset of menopause, and women with over five-ten years of menopause[6]. Bone fractures due to osteoporosis are more common in post-menopausal women than in premenopausal women or around the onset of menopause[1], [11]. So far, many studies have been conducted on the prevalence of osteoporosis in different parts of India [11]– [16]. However, many of these studies either included both men and women or exclusively focused on post-menopausal women[11]– [16]. A study of 773 Indian men and women between the ages of 30 and 90 showed that the prevalence of osteoporosis was 24.7%. The prevalence in women was reported to be 15%; 10.3% was related to post-menopausal women, and 4.7% to premenopausal women[16]. The prevalence of osteoporosis in a sample of 524 Indian people between the ages of 20 and 85 was reported to be 6.9%, 11.1% of which were women, and 3.9% were men[11]. With increasing life expectancy and longevity, the prevalence of osteoporosis and related fractures is increasing[6], [8]. Therefore, it is important to have consistent information on the prevalence of osteoporosis in different parts of India. Determining the prevalence and incidence of osteoporotic fractures is the first step in adopting the necessary strategies to reduce the burden of this challenge and concerns. Hence, we conducted this study intending to determine the

prevalence of osteoporosis among women aged more than 30 years.

Methods and materials

Study Design: A single centre, hospital-based, cross-sectional, observational study.

Study Setting: Department of Obstetrics & Gynaecology, LN Medical College, and affiliated JK Hospital, Bhopal, Madhya Pradesh. It is a tertiary care institute. The study was approved by the Institute's ethical committee on Human Research.

Study Duration: From December 2020 ending when the appropriate sample size was reached.

Study Outcomes: (i) Prevalence of Osteoporosis (ii) Bone mineral density.

End Point of Study: (i) A participant decided to withdraw from the study, (iii) After the completion of data collection.

Participants' recruitment: The participants were recruited into the study after verifying that they fulfilled the following criteria:

Inclusion

- Non-pregnant women aged >30 years of age.
- Patients agree to provide written informed consent.

Exclusion Criteria

- Patients on chronic medications known to affect bone metabolism viz. Oestrogen, diuretics, systematic glucocorticoid, and immunosuppressants.
- Women having any of the following diseases: Chronic liver disease, Chronic kidney disease, Hypo or hyperthyroidism, or Previous GI surgery.
- Having a history of osteoporotic fractures or inflammatory arthritis
- A patient who refused to take part in the study.

Sample Size: The smallest required sample size for the study was estimated following the recommendation of

Charan et al (2012) for a cross-sectional survey [17]. Using the prescribed formula, the minimum sample size was calculated as 246.

Sampling Methodology: A systematic-random sampling methodology to recruit participants for the study [18]. Every fourth woman (either patient or their attendant) coming to the registration counter of the OPD was approached for enrollment into the study. The prospective participants were approached and explained in detail the study procedure and participants' roles (and implications).

Informed Consent: A bilingual (Hindi, & English) consent form was drafted following the prescribed guidelines for research on human participants. The consent form was given to all the participants to read. Thereafter, the contents of the consent form were explained to all the prospective participants. The participants were informed and explained that they have the right to withdraw from the study at any point in time. Thereafter, willing participants were asked to sign the consent form.

Data Collection: The data were collected in a paper-based questionnaire. The questionnaire had 3 parts as follows: (i) Demographic details (ii) Menstrual history (iii) Laboratory and Radiological Investigations.

Source of Data: There were two sources of data. The first source was the questionnaire-based interview with the participant and the second source was the laboratory and radiological reports of the participants.

Measurement of Bone Mineral Density: The bone mineral density of the participants was measured using a Quantitative Ultrasound Densitometer. A standard methodology was adopted for measuring the BMD[19].

Statistical Analysis Plan: The primary outcome was the prevalence of osteoporosis among the study participants.

The secondary outcome was to identify the determinants of osteoporosis. We employed a multi-variable logistics regression model to identify the determinants of osteoporosis. The primary independent variable for logistic regression was the age of the participant. The coded data were imported into Stata 16.1 version for analysis. For the continuous data, the authors calculated the mean, median, mode, standard deviation, and inter-quartile range. For discrete data, we calculated and reported frequency, proportion, and percentage. We followed the scientific convention for detecting a significant difference between two groups of P -value < 0.05 [20].

Results

To recruit participants for the present study we approached a total of 289 women: 27 (9.3%) women were excluded, 16 (5.5%) women refused to participate in the study, and the remaining 258 (89.3%) women were enrolled in the present study.

Table 1: Osteoporosis and Mean Bone Mineral Density among study participants (n=246)

Age group	Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)	Mean BMD
30-40	36 (41.9)	48 (55.8)	1 (1.1)	-0.26
41-50	14 (18.9)	54 (73.0)	3 (4.1)	-1.89
51-60	4 (8.3)	32 (66.7)	13(27.1)	-2.10
≥60	2 (5.3)	12 (31.6)	24 (63.2)	-2.76
Total	56 (22.7)	149(60.5)	41 (16.3%)	-1.35

Overall, the prevalence of Osteoporosis among the study participants was 16.3% and the prevalence of osteopenia was 60.5% among study participants. The mean BMD among participants was -1.35. Table 1 shows the age-group-wise distribution of the prevalence of osteoporosis and osteopenia among study participants. As can be seen from Table 1, as the age of the participants increased the

prevalence of both osteopenia and osteoporosis increased, and the mean bone mineral density decreased.

Table 2: Prevalence of Osteoporosis concerning Menstrual Status of participants (n=246).

Menstrual Status	Normal n (%)	Osteopenia n (%)	Osteoporosis n (%)	Mean BMD n (%)
Normal Menstruation	40 (71.4)	52(34.9)	1(2.4)	-0.69
Peri-Menopausal	14 (25.0)	73(49.0)	14(34.1)	-2.23
Menopause	2 (3.6)	24(16.1)	26(63.4)	-2.91
Total	56 (22.7)	149(60.5)	41 (16.3%)	-1.35

Table 2 shows the prevalence of osteopenia and osteoporosis among the participants by their menstrual status. The prevalence of osteoporosis was highest among menopausal women (63.4%) and lowest among women with a normal menstrual cycle (2.4%). Furthermore, all women who had their menopause >10 years ago had osteoporosis (data not shown in table).

Table 3: Distribution of socio-demographic variables among study participants (n=246)

Variable	Osteoporosis		P-value
	Yes (n, %)	No (n, %)	
Religion			
Hindu	22 (53.7)	123 (60.0)	0.073
Muslim	14 (34.1)	68 (33.2)	
Other	5 (12.2)	14 (6.8)	
Residence			
Urban	32 (78.0)	143 (69.8)	0.029
Rural	9 (22.0)	62 (30.2)	
Socioeconomic Status			
Upper	7 (17.1)	36 (17.6)	0.025
Upper Middle	9 (22.0)	43 (21.0)	
Lower Middle	11 (26.8)	51 (24.9)	
Lower	14 (34.1)	75 (36.6)	

Table 3 illustrates the distribution of socio-demographic variables among study participants. The prevalence of osteoporosis was higher among women living in urban areas and those belonging to lower socioeconomic classes ($p < 0.05$).

Table 4: Determinants of Osteoporosis among study participants (n=246)

Variable	Osteoporosis		P-value
	AOR	CI	
Age Group			
>60	54.3	19.4-116.8	<0.0001
51-60	29.3	7.8-53.2	0.0012
41-50	3.7059	0.37 - 23.43	0.2613
30-40	1	-	-
Menstruation Status			
Menopause	46.8	22.1-76.9	0.0003
Peri-Menopausal	31.4	9.4-59.2	0.0093
Normal Menstruation	1	-	-
Religion			
Hindu	0.72	0.19 - 1.53	0.2251
Muslim	0.57	0.17 - 1.86	0.3570
Other	1	-	-
Residence			
Urban	3.46	1.23-5.34	0.031
Rural	1	-	
Socioeconomic Status			
Lower	1.93	1.12-2.67	0.025
Lower Middle	1.59	0.81-1.70	0.085
Upper Middle	1.09	0.60-1.41	0.074
Upper	1	-	-
AOR- Adjusted Odds Ratio, CI- Confidence Interval			

Table 4 shows the results of the multi-variable logistics regression analysis. Women older than 60 years of age

had more than 50 times higher odds of having osteoporosis in comparison to women aged between 30- and 40 years of age. In comparison women aged between 50-and 60 years of age had about 29 times higher odds of having osteoporosis in comparison to women aged 30-40 years. Further, menopausal women and pre-menopausal women had more than 45 times and 30 times higher odds of having osteoporosis in comparison to women with a normal menstrual cycle. Also, women residing in urban areas had about 3 times higher odds of having osteoporosis.

Discussion

Osteoporosis is defined as a progressive systemic skeletal disease characterized by low bone mass and micro-architectural deterioration of bone tissue with a consequent increase in bone fragility and vulnerability to the fracture[6]. As mentioned earlier, several studies have measured the prevalence of osteoporosis in different age and gender groups in different parts of India. In our study, the overall prevalence of osteoporosis among women aged more than 30 years was 16.3%. Furthermore, the prevalence of osteoporosis among women aged >60 years, 51-60 years, and 41-50 years was 63%, 27%, and 4%, respectively. A study by RK Marwaha et al. reported that osteoporosis was present in 42.5 % of female subjects and osteopenia in 44.9% of the population more than 50 years of age[21]. Another study by Nikose S et al. reported that the prevalence of osteoporosis was 32.13% and osteopenia was 35.78% of females in age between 20 and 76 years when measured by calcaneus ultrasound[12]. Agrawal T et al. conducted a study in Pune, India and they reported that the prevalence of osteoporosis was 13.3% and osteopenia was 48.1%[14]. They further reported that the highest prevalence of osteoporosis was seen among

women aged 55-64 years and 45- 54 years. Similar to our findings, more than 80% of the population above 50 years of age had osteoporosis[14]. Also similar to our study, Agarwal T et al., observed a statistically significant relationship between age group and the prevalence of osteopenia and osteoporosis[14]. A study on Iranian women above 45 years reported that the prevalence of osteoporosis was 50.7% [22]. Another study conducted by Ejaz et al. reported that the prevalence of osteoporosis in Pakistani postmenopausal women was 49.3% [23].

In the present study, the prevalence of osteoporosis was highest among menopausal women (63.4%), followed by premenopausal women (34%), and lowest among women with a normal menstrual cycle. Kadam et al. reported that the prevalence of osteoporosis was 18.4% in postmenopausal women <5 years since menopause and 37.3% in postmenopausal women more than 5 years since menopause[13]. A different study conducted by Kadam et al. reported that the prevalence of osteoporosis was 7.6% in premenopausal and 25.8% among postmenopausal women, respectively[24]. The mean BMD among study participants in our study was -1.35. Furthermore, the BMD among women aged >60 years, 51-60 years, and 41-50 years of age were -2.76, -2.10, and -1.89, respectively. Like our findings, Kadam et al. reported that the postmenopausal women had significantly lower BMD compared to premenopausal women ($P < 0.05$)[13]. Like our study, Agarwal et al. also reported a negative correlation between the age of the women and BMD[14].

As mentioned earlier, there are two types of risk factors for osteoporosis: modifiable and non-modifiable[6], [8]. Literature suggests a significant positive association between increasing age, nutritional intake,

socioeconomic status, lack of exercise, and osteoporosis. In our study, the strongest determinants (risk factors) associated with osteoporosis were women's age and menstrual status. In our study, postmenopausal women had more than 45 times higher odds of having osteoporosis in comparison to women with a normal menstrual cycle. Further, age-wise, women older than 60 years had more than 50 times higher odds of having osteoporosis in comparison to women aged between 30- and 40 years. Kadam et al. also reported that old age is the greatest risk factor for osteoporosis. They reported an 8.5 times higher prevalence rate in women over 70[13]. Several other studies have reported similar findings[12], [15], [24], [25].

Prevention of loss of BMD with age requires two important inputs: nutrition and physical activity[8], [10]. In our study, women belonging to lower socioeconomic status had higher odds of having osteoporosis in comparison to women belonging to upper socioeconomic class. Women belonging to higher socioeconomic classes have better access to a good nutritional diet including calcium and vitamin D supplements. Poor economic status (and low educational background) is often associated with a lack of awareness about nutrition and exercise. This is a possible reason for the high prevalence of osteoporosis in females belonging to low socioeconomic status as observed in our study. Nikose et al. also reported that the presence of osteoporosis was about 1.6 times higher in the low household income group compared to the highest household income group[12]. Navarro et al. reported that postmenopausal women with poor socioeconomic status had lower BMD values and a higher risk of total and vertebral fractures than their counterparts with better socioeconomic status[26]. Lyles et al. observed a higher

risk of osteoporosis in low-income [OR 1.90 (95% CI: 1.07–3.37)] and food-insecure [3.48 (1.43–8.48)] populations. Lastly, in our study, women living in urban areas had more than 3 times higher odds of having osteoporosis in comparison to women residing in rural areas. In our opinion, women living in rural areas of India have greater physical activity in their daily life in comparison to their urban counterparts. This may probably explain our study findings.

Conclusion

The prevalence of osteoporosis increased, and the mean bone mineral density decreased with age. Old age, being menopausal, low socioeconomic level, and residing in urban areas were some of the factors associated with a higher risk of developing osteoporosis. For women of lower socio-economic strata govt schemes should be initiated to start calcium and Vitamin D supplementation as malnourishment seems to be a contributing factor to their increased risk of osteoporosis. For urban population-lifestyle changes can be encouraged.

We can conclude that the perimenopausal period act as a watershed moment for the development of osteoporosis. The perimenopausal age group has been identified as the target cohort for beginning calcium supplements for early osteoporosis prevention. Rather than treating osteoporosis, we can prevent it by beginning supplementing during the perimenopausal period. Based on previous studies and our findings, we recommend the regular screening of women aged more than 45 years for osteoporosis. In future research, it is necessary to study disparities in the prevalence of osteoporosis using a longitudinal design, such as through large-scale prospective cohort studies.

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