Original Article

A cross sectional study of determinants of bone mineral density among postmenopausal women with special reference to anthropometric and lifestyle factors in an urban slum of Mumbai

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Abstract

Background and Aim: Osteoporosis significantly compromises the quality of life of postmenopausal women. There are DALY (Disability-Adjusted Life Years) losses for postmenopausal women who suffer from osteoporosis. Therefore, this study was taken up with the objective to determine prevalence of osteopenia and osteoporosis among postmenopausal women and to study the association of their anthropometric parameters and lifestyle factors with their bone mineral density (BMD). To study the determinants of BMD among postmenopausal women with special reference to anthropometric and lifestyle factors in an urban slum. **Materials and Methods:** A community-based, cross-sectional study was conducted in an urban slum of Mumbai. The study was conducted among 148 postmenopausal women. BMD of the study group was measured using portable, noninvasive Calcaneum Ultrasound Bone Densitometer, and T-score reading was noted. Lifestyle factors and dietary habits were assessed through a prestructured, validated questionnaire. Body mass index (BMI) was calculated with a standard procedure. No trial was conducted in the study. Statistical Package for Social Sciences (version 20) was used for statistical analysis. **Results:** The prevalence of osteopenia among study participants was found to be 43.9% and that of osteoporosis was 12.8%. Their BMI was in the range of 16.44–39.18 kg/m^2. Walking, stretching exercises, and yoga were the form of exercise being practiced by 29.1% of postmenopausal women. **Conclusions:** BMD was significantly associated with age, socioeconomic status, BMI, exercise, walking, and consumption of fruits. Negative correlation was found between duration since menopause and BMD T-score reading, which implied that duration since menopause had an inverse relationship with BMD.

Keywords: Bone density, BMI, lifestyle, osteoporosis, postmenopausal

Introduction

In India, the cohort of postmenopausal women is increasing.[1] The hormonal changes during menopause increase the rate of bone reabsorption, thereby increasing the risk of osteoporosis.[1]

According to the World Health Organization (WHO), osteoporosis is second only to cardiovascular disease as a global health-care problem. In India, one in three urban women over the age of 45 years has osteoporosis.[2] Osteoporosis is a systemic disease that causes microarchitectural degradation,

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resulting in decreased bone strength.[3] Because of its morbid consequences resulting in fracture, prevention of osteoporosis is considered essential.[4] Bone mineral density (BMD) has been widely accepted as a measure for diagnosis of osteoporosis and osteopenia.[4] Osteoporosis can be diagnosed with modalities such as dual-energy X-ray absorptiometry, quantitative computed tomography, and quantitative calcaneal ultrasonography.[5] Deteriorating effects of risk factors of osteoporosis can be reduced through modifying lifestyle, doing regular exercise, and eating a balanced diet.[5]

This study will help pave the way to identify the individuals at risk at an early stage to prevent progression to osteoporosis. The study stresses on the importance of preventive approach in the form of BMD screening of postmenopausal women, adapting lifestyle changes and incorporating calcium-rich nutrients in the diet, which eventually will boost the bone health of postmenopausal women.

Objectives

1. To determine the sociodemographic profile of postmenopausal women
2. To study the prevalence of osteopenia and osteoporosis among the study group participants
3. To study association of lifestyle factors with BMD

Subjects and Methods

This is community-based, cross-sectional, descriptive study that was carried out in 2018 in an urban health center affiliated to Topiwala National Medical College, Mumbai, which caters to a population of about 92,596 (2011 census). One hundred and forty-eight postmenopausal women, belonging to the age group 40–70 years, who had attained natural menopause were included in the study. Women who had surgical menopause (hysterectomy) and those on estrogen drugs or hormonal replacement therapy were excluded from the study.

Sample size – It was calculated using 10% admissible error, 95% confidence interval, and taking the prevalence of low BMD as 73% among postmenopausal females as per a study conducted in an urban area of Hyderabad by Bala *et al.*[6] The sample size calculated was $N = 148$.

Study tools and data collection– For data collection, the houses were selected using simple random table. Postmenopausal female living in the house, if fitted into the inclusion criteria, was selected. If more than one eligible participant was found in the house, only one was selected using lottery method. The study participants were explained about the purpose of the study and their consent was taken. Also, their contact number was taken.

The selected participants were called on the screening day (second and fourth Wednesdays of the month) at the community hall of the study area. On the decided screening day, the selected participants were given consent form in the language they understood. For every participant, details regarding sociodemographic profile and lifestyle factors were collected using a predesigned questionnaire. Anthropometric measurements which included height and weight were taken with the standard procedure.

BMD was measured using noninvasive, Japanese model CM-200 light (Calcaneum Ultrasound Bone Densitometer) hired on rent from a private pharmacist. Expense was borne by the investigator. It is a portable machine weighing approximately 9 kg with dimensions W495 mm × D310 mm × H200 mm. BMD was assessed at the heel region. Measurement time was 3–10 s.

The participants were asked to remove footwear, and the heel area was cleaned of any dirt. A small amount of ultrasound gel was applied on both sides of the heel area of one foot (right foot). The heel was then placed in contact with the transducer of the BMD machine, and BMD T-score reading was taken. The participants were then categorized as per the T-score reading as normal, osteopenia, and osteoporosis.

This study is purely a descriptive study, and no trial was conducted in the study.

The categories for diagnosis of osteoporosis according to WHO

BMD T-score reading	Diagnosis
T score -1 and above	Normal
T score between -1 and -2.5	Osteopenia
T score -2.5 and below	Osteoporosis

Data analysis

Data was entered in MS Excel and analyzed using Statistical Package for the Social Sciences version 24. Percentages were calculated, and Chi-square test was applied wherever necessary.

Ethical consideration

Ethical clearance was obtained from the Institutional Ethics Committee of Topiwala National Medical College and Hospital, Mumbai (ECARP/2016/190). Consent was taken from all the participants of the study. In the form, the participants gave their consent and agreed to use the study data and findings for research publication purpose. The patients understand that their identity will be kept confidential all throughout the process.

Results

A total of 148 postmenopausal women participated in the study. Table 1 shows the sociodemographic details of the participants. A majority, that is, 45.9% (68), of women belonged to the age group of 51–60 years. The mean age of the participants in the study was 45 years ± 3.9 (standard deviation [SD] =3.9). Majority of them, that is, 60.8% (90), were married and majorly belonged to nuclear family (71.6%, 106). Of all the participants, 27% (40) belonged to socioeconomic class III as per the modified B. G.

Prasad scale (2016). Almost one-fifth of the participants were illiterate. Most of them, that is, 73.6% (109), were homemakers.

Figure 1 shows the prevalence of osteopenia and osteoporosis in postmenopausal study participants. It was found that 43.9% of women had osteopenia and 12.8% had osteoporosis.

Table 1: Distribution of study participants according to sociodemographic details (*n*=148)

Sociodemographic factors	*n* (%)
Age (years)	
42	5 (3.4%)
43–50	59 (39.9%)
51–60	68 (45.9%)
61–69	12 (8.1%)
70	4 (2.7%)
Socioeconomic status as per the modified B. G. Prasad scale 2016	
Class I	15 (10.1%)
Class II	32 (21.6%)
Class III	40 (27%)
Class IV	33 (22.3%)
Class V	28 (18.9%)
Education	
Illiterate	43 (29.1%)
Primary school	25 (16.9%)
Middle school	37 (25%)
Secondary school	26 (17.6%)
Higher secondary school	8 (5.4%)
Intermediate/post-high school diploma	4 (2.7%)
Undergraduate	5 (3.4%)
Working status	
Homemaker	109 (73.6%)
Unskilled worker	19 (12.8%)
Semi-skilled worker	12 (8.1%)
Skilled worker	8 (5.4%)
Marital status	
Married	90 (60.8%)
Widow	52 (35.1%)
Separated	5 (3.4%)
Divorcee	1 (0.7%)
Types of family	
Nuclear	106 (71.6%)
Joint	34 (23%)
Three generation	8 (5.4%)

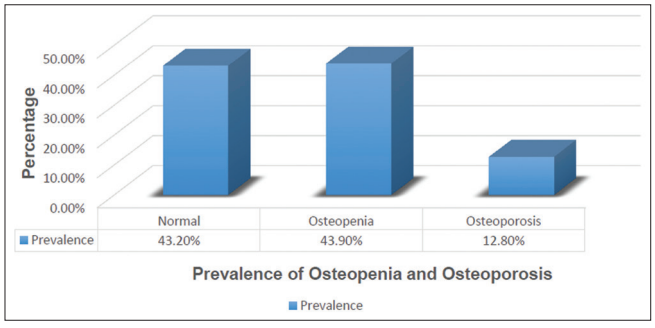

Figure 1: Prevalence of osteopenia and osteoporosis among the postmenopausal women

Table 2 shows the frequency distribution table of lifestyle factors of the study participants.

It was found that 43.9% (65) of the study participants were always doing heavy household work such as washing floors and windows and fetching buckets of water. Only 29.1% (43) did exercise regularly. The exercise include walking, stretching exercises, and yoga.

From the study, it was found that 20.9% (31) of participants consumed milk on a daily basis. Most of the participants, that is, 48.6% (72), consumed eggs less than 3 days a week and about 52.7% (78) of them consumed fish for less than 3 days a week. Moreover, 12.8% (19) of them consumed fruits on a daily basis. About 7.4% (11) of women had history of tobacco chewing, and most of the participants, that is, 88.51% (131), complained of backache and joints pain.

Table 3 shows the relationship between some key determinants and BMD of the study participants. It was found from the study that 14.86% (22) of women who belonged to the age group 59–70 years suffered from osteopenia. Among the participants who belonged to socioeconomic class I–III of B. G. Prasad, about 24.32% (36) had osteopenia and 4.72% (seven) suffered from osteoporosis. In addition, 16.21% (24) of women who had hypertension had osteopenia and about 7.43% (11) had osteoporosis. Among those women who were obese, 7.3% (11) had osteopenia and 5.4% (eight) had osteoporosis. Eggs and fish were majorly consumed less than three times a week by the study participants. Among egg eaters, 31.75% (47) had osteopenia and 8.10% (12) had osteoporosis. Among fish eaters, 30.40% (45) had osteopenia and 6.08% (nine) had osteoporosis.

Table 4 shows the correlation between duration since menopause and T-score reading. Pearson's correlation coefficient found was −0.419

Figure 2 shows the correlation between duration since menopause and T-score reading. It is evident from the figure

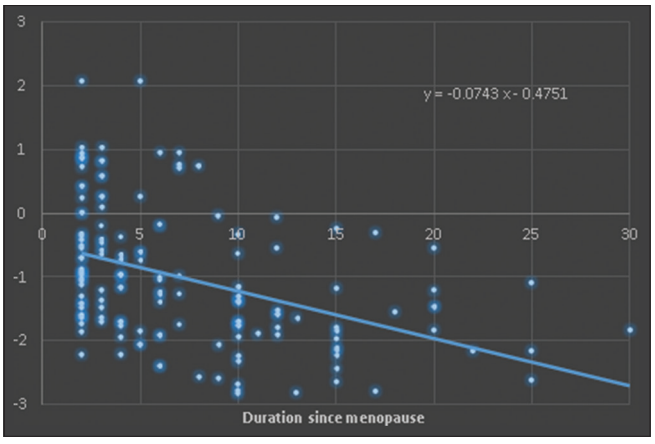

Figure 2: Correlation between duration since menopause and T-score reading

Table 2: Frequency distribution table showing lifestyle factors of the study participants

Determinant variable	Number (percentage) (*n*=148)
Postmenopausal women doing light household work	
Never	19 (12.8%)
Sometimes	43 (29.1%)
Always	86 (58.1%)
Postmenopausal women doing heavy household work	
Never	55 (37.2%)
Sometimes	28 (18.9%)
Always	65 (43.9%)
Postmenopausal women doing exercise	
Yes	43 (29.1%)
No	105 (70.9%)
Frequency of consumption of milk by postmenopausal women	
Daily	31 (20.9%)
<3 days a week	35 (23.6%)
>3 days a week	4 (2.7%)
Never	78 (52.7%)
Frequency of egg consumption by postmenopausal women	
Daily	18 (12.2%)
<3 days a week	72 (48.6%)
>3 days a week	15 (10.1%)
Never	43 (29.1%)
Frequency of fish consumption by postmenopausal women	
Daily	6 (4.1%)
<3 days a week	78 (52.7%)
>3 days a week	16 (10.8%)
Never	48 (32.4%)
Frequency of fruit consumption by postmenopausal women	
Daily	19 (12.8%)
<3 days a week	68 (45.9%)
>3 days a week	10 (6.8%)
Never	51 (34.5%)
History of addictions (tobacco chewing)	
Yes	11 (7.4%)
No	137 (92.6%)
History of backache and joint pain	
Yes	131 (88.51%)
No	17 (11.49%)

that as the duration since menopause increased, BMD T-score reading decreased.

Discussion

In the present study, 148 postmenopausal women participated. Among these, 43.9% had osteopenia and 12.8% had osteoporosis. Similar findings were obtained in a study conducted by Khinda *et al.*[3] in which among 672 postmenopausal women, 44.20% had osteopenia and 30.50% were osteoporotic. In the current study, the mean age of menopause among the participants was 45.93 ± 3.94 years (SD = 3.94). In a study conducted by Shaki *et al.*,[7] average age at menopause was 51.62 ± 5.72 years in postmenopausal women with normal BMD and 49.43 ± 4.52 years in postmenopausal women with low BMD. There was significant association of age and BMD status of participants in the present study. Similar findings were noted in a study conducted by Sharmin *et al.*,[8] which concluded that as age advances, BMD decreases and the risk of osteoporosis increases.

The mean body mass index (BMI) of participants in the current study was 26.18 ± 4.40 kg/m^2 and it was significantly associated with their BMD status. Similar findings were noted by Jain *et al.*[9] in their study in which low BMD was found in 77% of postmenopausal women, and also, their BMI had significant association with their BMD. The current study showed significant association between socioeconomic class and BMD status of the participants. Similar results were obtained by Garg *et al.*,[10] which concludes that socioeconomic status and, thereby, lifestyle factors play a significant role in increasing BMD level in postmenopausal women.

It was found that 16.21% of hypertensive women had osteopenia and 7.43% had osteoporosis in the present study. So also, the relationship between hypertension and BMD status of participants was significant. Muraduzzaman *et al.*[11] also found in their study that hypertensive postmenopausal women had lower BMD compared to normotensive women, but failed to reach statistical significance.

The current study showed significant association between exercise and BMD status of participants. Similar results were obtained by Feskanich *et al.*,[12] who reported that moderate level of physical activity like walking is associated with lower risk of developing osteoporosis in postmenopausal women. In the present study, the association of consumption of fruits and BMD status of participants was statistically significant. Similar findings were noted in a meta-analysis conducted by Hu *et al.*,[13] which indicated that fruit intake is beneficial for prevention of osteoporosis in postmenopausal women, and it also encouraged conducting further investigation for the same. Mean duration since menopause of study participants was 7.39 years ± 5.997 years. Pearson's correlation coefficient was found to be −0.419, which implied that as the duration since menopause increases, BMD decreases.

Primary care physician can play a vital role in improving bone health of postmenopausal women through organizing health awareness campaign in the communities, explaining them about adopting healthy lifestyle and adequately consuming locally available calcium-rich foods and fruits. Regular health checkup should be carried out for postmenopausal women. Outpatient clinic for postmenopausal women must be incorporated within regular primary care settings to address their health needs. Health education regarding daily exercise in any form, diet, and quitting tobacco should be provided by primary physician to postmenopausal women to improve their bone health.

Table 3: Association of key determinants with BMD status of study participants

Determinants	Distribution of postmenopausal women as per their BMD status			Chi-square value	*P*
	Normal	Osteopenia	Osteoporosis		
Age group					
42–58 years	56 (37.83%)	43 (29.05%)	8 (5.40%)	17.258	0.00
59–70 years	8 (5.40%)	22 (14.86%)	11 (7.43%)		(Sig)*
Socioeconomic status					
Class I–III	44 (29.72%)	36 (24.32%)	7 (4.72%)	6.709	0.035
Class IV and V	20 (13.51%)	29 (19.59%)	12 (8.10%)		(Sig)*
Hypertension					
Present	13 (8.78%)	24 (16.21%)	11 (7.43%)	10.509	0.005
Absent	51 (34.45%)	41 (27.70%)	8 (5.40%)		(Sig)*
Diabetes					
Present	16 (10.8%)	25 (16.89%)	8 (5.40%)	3.435	0.179
Absent	48 (32.43%)	40 (27.02%)	11 (7.43%)		
Body mass index					
16.0–24.9 kg/m^2	25 (16.89%)	32 (21.62%)	5 (3.37%)	11.305	0.023
25.0–29.9 kg/m^2	31 (20.94%)	22 (14.86%)	6 (4.05%)		(Sig)*
30.0–39.9 kg/m^2	8 (5.40%)	11 (7.43%)	8 (5.40%)		
Participants involved in exercises					
Yes	32 (21.62%)	11 (7.43%)	0	26.044	0.000
No	32 (21.58%)	54 (36.47%)	19 (12.8%)		(Sig)*
Taking calcium supplements					
Yes	34 (22.97)	32 (21.62%)	9 (6.08%)	0.291	0.865
No	30 (20.23%)	33 (22.8%)	10 (6.72%)		
Frequency of egg consumption					
Yes	46 (31.08%)	47 (31.75%)	12 (8.10%)	0.644	0.725
No	18 (12.16%)	18 (12.16%)	7 (4.72%)		
Frequency of fish consumption					
Yes	46 (31.08%)	45 (30.40%)	9 (6.08%)	4.161	0.125
No	18 (12.16%)	20 (13.51%)	10 (6.75%)		
Frequency of fruit consumption					
Yes	53 (35.81%)	38 (25.67%)	6 (4.05%)	19.599	0.000
No	11 (7.43%)	27 (18.24%)	13 (8.78%)		(Sig)*
Duration since menopause					
1–14 years	60 (40.54%)	52 (35.1%)	13 (8.78%)	8.917	0.012
15–30 years	4 (2.70%)	13 (8.78%)	6 (4.05%)		(Sig)*

BMD=Bone mineral density. (Sig)* – significant $P<0.05$

Table 4: Correlation between duration since menopause and T-score reading

Variables	Duration since menopause	T-score reading
Duration since menopause		
Pearson's correlation	1	-0.419**
Sig. (two tailed)		0.000
n	148	148
T-score reading		
Pearson's correlation	-0.419**	1
Sig. (two tailed)	0.000	
n	148	148

**Correlation is significant at the 0.01 level (two tailed)

Conclusion

In the current scenario, with regard to increase in population cohort of postmenopausal women and increase in their life expectancy, it is necessary to focus on the health aspects of postmenopausal women. The health-care providers need to encourage postmenopausal women on adopting healthy lifestyle and make them aware of preventive measures related to bone health, so that they can have healthy and happy aging.

Limitation and generalizability

- Confirmed diagnosis of having osteopenia or osteoporosis cannot be made with the study score as quantitative ultrasound (QUS) for BMD measurement is not the gold standard for diagnosing osteoporosis.
- QUS devices that measure BMD at different skeletal sites are available. Hence, score and, thereby, its interpretation may vary accordingly.
- Only those postmenopausal women who willingly gave their consent were included in the study. So, the findings of the study cannot be generalized.

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Name	Role
Dr. Dyaneshwar Gajbhare, MBBS MD Community Medicine, Ex-Assistant professor, Topiwala National Medical College, Mumbai	PG Guide

List of abbreviations:

Abbreviation	Definition
DALY	Disability-adjusted life year – It is a measure of overall disease burden, expressed as the number of years lost due to ill health, disability, or early death
BMD	Bone mineral density – It is the amount of bone mineral in the bone tissue. It is used in clinical medicine as an indirect indicator of osteoporosis and fracture risk
BMI	Body mass index – It is the body mass divided by the square of the body height and is expressed in units of kg/m^2
CVDs	Cardiovascular diseases are a group of disorders of the heart and blood vessels that includes diseases like coronary heart disease, cerebrovascular disease, and peripheral arterial disease
QUS	Quantitative ultrasound – A noninvasive method for estimating bone mineral density
DEXA	Dual-energy X-ray absorptiometry is a means of measuring bone mineral density using spectral imaging

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Conflicts of interest

There are no conflicts of interest.

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