Research Article

Changes in Bone Mineral Density in Indian Women: A Cross-Sectional Study

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Abstract: Thirty million women in India suffer from osteoporosis, of which 50% are post-menopausal. WHO has predicted Asians to be largely affected by osteoporosis by the year 2050. An Observational study was carried out in 100 women enrolled between age 40-65 years attending Gynecology OPD at VPIMS, over a period of one year, after obtaining informed consent. It was observed that osteoporosis and osteopenia were significantly more common in older age. Of 100 women studied, low BMD was observed in age group 40-50 years in 65.7%, in 51-60 years it was 22.9%; all (11.4%) above age of 60 years. Osteopenia and osteoporosis were more common in lower ($<18kg/m^2$) Body Mass Index (BMI) categories as compared to higher BMI groups. A statistically significant positive association between parity and osteoporosis was observed. Low BMD increases with age and in postmenopausal period, suggesting lack of estrogenic activity might be responsible for this increasing trend. Obesity can produce higher bone mass due to the association of fat mass with secretion of bone active hormones and due to the weight bearing effect of excess soft tissue and fat on skeleton.

Keywords: osteoporosis, bone mineral density, women

INTRODUCTION

Osteoporosis was an under recognized disease and considered to be an inevitable consequence of aging. Perceptions have changed since epidemiological studies highlighted the increasing burden of the disease and its costs to society and healthcare agencies. Intervention to prevent bone loss in early postmenopausal women is an effective approach to control the increasing incidence of osteoporosis. The remodeling process in the adult skeleton is continuous throughout life and it is required to maintain the strength of bone. Peak bone mass is reached in the middle of the third decade of life. A plateau period then ensues during which there is a constant turnover of bone formation, which approximates bone resorption. Following this plateau phase there begins, a period of net bone loss equivalent to about 0.3% to 0.5% per year. Beginning with the decrease in estrogen associated with the menopause, women accelerate this net bone loss about 10-fold for approximately 5 to 7 years [1].

Osteoporosis affects about 30% of post-menopausal white women in USA and the proportion rises to 70% in women over age of 80 years [2]. 30 million women in India suffer from osteoporosis, of which 50% are post-menopausal [3, 4]. WHO has predicted Asians to be largely affected by osteoporosis by the year 2050 [5].

Gandhi *et al.* [6] reported incidence of 34% osteopenia and 8% osteoporosis between 41-65 years of age in Indian women. Lewiecki *et al*. [7] found that 15% of premenopausal women had osteopenia and 0.6% had osteoporosis.

MATERIAL AND METHODS

Observational study was carried out in 100 women enrolled between age 40-65 years attending Gynecology Outpatient Department at VPIMS, (U.P), over a period of one year, after obtaining informed consent.

Inclusion criteria

● Women with body weight between 40-80 kilograms.

● 40-65 years of age.

Exclusion criteria

● Women suffering from hypertension, diabetes, thyroid and parathyroid disorders, asthma,

malignancies, liver disorders and prolonged immobilization.

● Women on corticosteroids or hormonal therapy.

All enrolled cases before bone mineral density were clinically evaluated by taking detailed history with special reference to age, Body Mass Index (BMI), educational status, diet, menstrual history, parity and lactation.

Bone mineral density was measured in right calcaneum with bone densitometer.

BMD values were measured in terms of T-score and Z-score.

T-score: It is the difference between the individual patients bone mineral density and the mean results obtained in young adult population expressed in units of young population standard deviation.

Z-score: It is the difference between the individual patient's results and the mean results obtained in an age matched population expressed in units of the age matched population standard deviation.

According to WHO osteoporosis definition, based on T-score results the categories are
Normal bone mass – T-score greater than –1.0
Osteopenia – T-score between –1 and –2.5
Osteoporosis –T-score less than –2.5
Severe osteoporosis– T-score less than –2.5 with at least one osteoporotic fracture.

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 Statistical Analysis Software.

OBSERVATIONS

Osteoporosis and osteopenia were significantly more common in older age group as compared to younger group. In osteoporosis group (T-Score -<2.5) 40% subjects were more than 60 years as against 6.7% in osteopenic group (T-score between –1 and –2.5). Of the 100 women studied, low BMD was observed in the age group 40-50 years in 65.7%, in 51-60 years it was in 22.9%; all (11.4%) above age of 60 years Statistically the differences amongst the groups were significant (p<0.001) (Table 1). Bivariate Correlation between age and T-Score showed a mild negative correlation coefficient (r=-0.322).

Osteopenia and osteoporosis were more common in lower (<18kg/m^2) Body Mass Index (BMI) categories as compared to higher BMI groups. In women with normal BMD there were 50.8% overweight cases and 15.4% obese as against zero in osteoporosis women and only 13.3% overweight women amongst osteopenic group (Table 2). Bivariate Correlation between BMI and T-Score showed a moderate positive correlation coefficient (r=-+0.535).

A statistically significant positive association between parity and osteoporosis was observed; 80% of the patients of osteoporosis were para 3 or more as against 50% in osteopenic group and 64.6% in normal group. However, no such association could be seen in osteopenic group, though the differences among groups were significant statistically (p<0.001).Osteoporosis was more common amongst those with longer durations of lactation (6 months or more). In normal BMD group there were only 22.6% subjects lactating more than 6 months, whereas in osteoporosis group this proportion was 60% and in osteopenia it 34.7% (Table 3).

Age at menarche showed correlation as it was observed that in normal BMD group 86.2% subjects had attained menarche before 14 years whereas in osteoporosis and osteopenia group this proportion was 20% and 26.7% only. Low BMD was observed in women who had attained menarche at later age.

No significant association between regularity of menstrual cycles and incidence of osteopenia/osteoporosis could be seen (p=0.198).

All the cases in osteoporosis group (100%) had attained menopause; 33.3% osteopenic women were menopausal and 26% postmenopausal had normal BMD. A statistically significant difference among groups was seen with menopause (p=0.003) (Fig. 1).

Table 1: Age wise distribution of BMD (n=100)

Variable Age (Years)	Osteo-porosis (n=5) (T-score < -2.5)		Osteopenic (n=30) (T-score <-1.0 to -2.5)		Osteopenia & Osteoporosis (n=35) (T-score <-1.0)		Normal (n=65) (T-score >-1.0)		Chi square	Statistical Significance
	No.	%	No.	%	No.	%	No.	%	χ^2	p
40-50	2	40.0	21	70.0	23	65.71	54	83.1	21.172	<0.001
51-60	1	20.0	7	23.3	8	22.9	11	16.9		
>60	2	40.0	2	6.7	4	11.43	0	0.0		

Table 2: Showing Correlation of BMI with T-score BMI and bone mineral density

Variable BMI Category (kg/m^2)	Osteo-porosis (n=5) (T-score < -2.5)		Osteopenic (n=30) (T-score <-1.0 to -2.5)		Normal (n=65) (T-score >-1.0)		Chi square	Statistical Significance
	No.	%	No.	%	No.	%	χ^2	p
<18 - Underweight	0	0.0	0	0.0	3	4.6	32.896	<0.001
18-25 - Normal weight	5	100.0	26	86.7	19	29.2		
>25-30 - Overweight	0	0.0	4	13.3	33	50.8		
>30 - Obese	0	0.0	0	0.0	10	15.4		

Table 3: Association between obstetric history, lactation and BMD (n=100)

Sl. No.	Variable Parity	Osteo-porosis (n=5)		Osteopenic (n=30)		Normal (n=65)		Statistical Significance	
		No.	%	No.	%	No.	%	χ^2	p
1.	0	0	0.0	2	6.7	0	0.0	32.896	<0.001
	1	0	0.0	0	0.0	8	12.3		
	2	1	20.0	13	43.3	15	23.1		
	3	1	20.0	7	23.3	23	35.4		
	4 or above	3	60.0	8	26.7	19	29.2		
2.	Lactation								
	Upto 3 mths	0	0.0	8	34.8	16	25.8	32.896	<0.001
	4-6 mths	2	40.0	7	30.4	32	51.6		
	7-9 mths	0	0.0	3	13.0	7	11.3		
	10-12 mths	3	60.0	5	21.7	7	11.3		
		5		23		62			

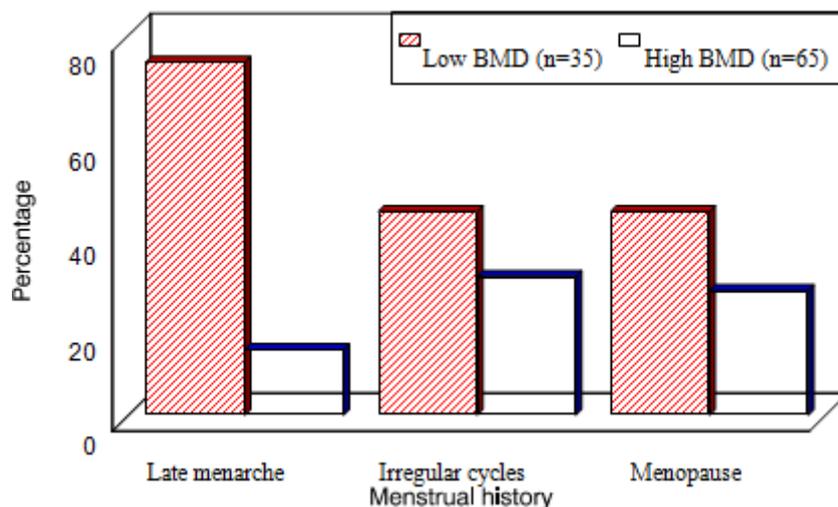(Ten cases were without history of lactation)

Fig.1: Correlation of menarche and menopause with BMD

DISCUSSION

Of the 100 women studied, low BMD was observed in the age group 40-50 years 65.7%, in 51-60 years it was in 22.9%; all (11.4%) above age of 60 years. Similarly Gandhi *et al.* [6] observed low BMD in 38.22% and 39.36% in age group of 41-50 and 51-60 respectively and in all above 60 years. Sharma *et al.* [8] observed osteoporosis in 20.25% and osteopenia 36.79% maximum in the age group of 55-64 years; beyond age of 65 years, 100% had osteopenia /osteoporosis which is similar to our observations. Low BMD increases with age and in postmenopausal period, suggesting lack of estrogenic activity might be responsible for this increasing trend.

We observed that osteopenia /osteoporosis were more common in normal (18-25 kg/m^2) BMI categories as compared to higher BMI groups; 50.8% of subjects having low BMD were overweight, 15.4% were obese. Whereas, 88.6% of women having low

BMD had BMI between 18-25 kg/m^2. Our findings were comparable to Kirchengart *et al.* [9] and Shapses and Reidt [10] where a low body weight was associated with low bone mass. Janssen *et al.* [11] observed that obese subjects were 26% less likely to develop osteoporosis as BMI offers some protection against osteoporosis in older adults. Obesity can produce higher bone mass due to the association of fat mass with secretion of bone active hormones and due to the weight bearing effect of excess soft tissue and fat on skeleton.

We observed that 45.7% patients having low BMD had parity less than 2 while 54.29% where para 3 or more. Statistically no significant association was seen between parity and BMD.Low BMD in 39.3% women and normal in 22.6% subjects who had lactated for 6 months or more was noted. No significant association between period of lactation and BMD could be seen (p=0.163) (Table 3). In the search for a relation between bone mineral content late in life and previous pregnancies, number of breastfed children, or total duration of lactation, Sower's *et al.* [12] have shown a direct proportionality, while others showed an inverse proportionality. Berehi *et al.* [13] authors found no relation. Our observations are comparable to that of Silverstein *et al.* [14] and Bererhi *et al.* [13] who investigated the influence of multiparity on bone mass and found that multiparity does not influence bone mineral density in normal women; also our observations are in accordance with Henderson *et al.* [15] who reported that in multipara, extended lactation without interval was not associated with lowered BMD compared to nulliparous. Our cases were from population who had frequent physical activity required for family maintainence; their physical activity on daily basis actively stimulates bone formation.

In contrast to our findings Streetan *et al.* [16] observed increasing parity was associated with later menopause (p=0.001) and higher BMD; among 50-59 years parity was strongly associated with BMD. They gave the explanation that high parity marked a delayed transition into menopause, so highly parous women were less likely to experience rapid bone loss that accompanies menopausal transition.

We observed an inverse correlation between age at menarche and osteoporosis/osteopenia (p<0.001). 86.2% cases having normal BMD had attained menarche before 14 years whereas in women with low BMD this proportion was in 25.7% cases. Percentage of osteopenia/osteoporosis increased in women who had attained menarche at later age (Fig. 1). It was seen that 42.9% of subjects having low BMD had attained menopause whereas 26.2% of women with normal BMD were postmenopausal. Regularity of cycles was observed in 57% of women in low BMD group; the studies of Gandhi *et al.* [6] observed regularity in

30.6%.Our observation were in accordance to that of Ito M *et al.* [17] who reported significant increase in osteoporosis in women with menarche at more 14 years of age and above and that a later age at menarche was known to be a determinant of osteoporosis in the postmenopausal period. It was suggested that earlier menarche decreases the risk probably by increasing peak bone mass attained early in life; also comparable with Keramat *et al.* [18] who reported that late menarche (after 14 years of age) were risk factors for osteoporosis. F. Parazzini [19] and colleagues observed no relationship between BMD and the age at menarche, characteristics of menstrual cycles and the duration of menses with regards to age of menarche but in accordance with characteristic of menstrual cycles.

Osteoporosis is an important cause of morbidity and mortality in elderly women. Its incidence is rising due to increase in elderly population in world. Screening by bone mineral density measurement is helpful in assessing bone health in women. Timely intervention can prevent bone loss and its associated complications.

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