Original Article

Does parity and duration of lactation have any effect on the bone mineral density of the femur and lumbar spine in Indian women? A cross-sectional study from the Northeast region of India

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Abstract

Background: The effects of multiple pregnancies and period of lactation on bone density have not been studied till date and there is very less data available, especially from developing countries like India. Lumbar spine and femoral neck were used to measure BMD and results were recorded. **Objective:** To find out the effect of parity and period of lactation on occurrence of osteoporosis in spine and femoral neck in women of the Northeast region of India. **Materials and Methods:** The cross-sectional study included 294 perimenopausal and postmenopausal women aged 30–65 year old. Age, body mass index (BMI), parity, total lactation period, menopausal status, duration of menopause socioeconomic status, and nutritional history were noted. The dual-energy X-ray absorptiometry system was used to measure the BMD of lumbar and femoral neck BMD. Multiple regression analysis was done for finding out the association of parity and lactation with BMD. **Results:** The parity was inversely related with BMD of lumbar spine ($\beta = -0.138$, $P = 0.00423$) and BMD of femoral neck ($\beta = -0.142$, $P = 0.00487$). This relation remained significant after adjusting for age, BMI, and duration of menopause. Period of lactation was also inversely correlated with BMD for lumbar spine ($\beta = -0.0812$, $P = 0.0012$) and BMD of femoral neck ($\beta = -0.033$, $P = 0.0031$). **Conclusion:** The number of parity and prolonged period of lactation have a negative effect on BMD in both regions especially in the lower socioeconomic strata with poor nutritional intake. Our data supports that parity and duration of lactation can be associated with future osteoporosis.

Keywords: Bone mineral density, dual-energy X-ray absorptiometry (DEXA), lactation, parity

Introduction

In developing and developed countries, osteoporosis is rampant and it is a silent chronic metabolic disease. It goes unnoticed until a fragility fracture occurs or an X-ray is taken for other illnesses. It is further observed that its effects are most significant in postmenopausal women. Osteoporosis is a silent metabolic bone disease characterized by reduced bone mineral density.[1] It goes unnoticed until fragility fracture occurs. It is a well-known fact that mobilization of calcium and increased bone resorption take place at the end of pregnancy and further increases during the lactation period.[2,3] In the present literature, there have been several controversies regarding whether high parity and/or prolonged lactation periods have any role in the appearance of osteoporosis and effects on bone density in this subset of women population.

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Low BMD has been noted during pregnancy and lactation, which was considered to be transient.[4,5] However, it may persist for a longer duration in developing countries like India where maternal care needs to be improved on many fronts like prehospital care, antenatal and postnatal care, diet and supplements, and family support.[6–9] There are many risk factors responsible for low bone density in Indian women, but the effect of number of pregnancies and period of lactation need to be studied.

Heidari *et al.*[10] noted that the number of pregnancies does not associate with occurrences of postmenopausal osteoporosis. Yazici *et al.*[11] noted that long or repeated periods of lactation do not significantly associate with the occurrence of postmenopausal osteoporosis. Turan *et al.*[12] noted that women with multiple pregnancies have the same BMD as nulliparous. On the contrary, Sharma *et al.*[13] and Lee *et al.*[14] noted that multiparity and longer lactation have a negative impact on BMD.

During pregnancy, it is estimated that about 2%–3% of maternal calcium is transferred to the fetus mostly in the second half of pregnancy. During the lactation period, women lose a further approximately 400-mg calcium per day during breastfeeding.[14-16] Thus, BMD further decreases during lactational amenorrhea, which further accentuates bone loss.

Many endocrine changes occur that initiate compensatory biochemical changes like higher levels of Vitamin D, changes in growth hormone, calcitonin, parathyroid hormone, and serum prolactin level. These endocrine changes increase calcium absorption in the kidney and intestine. These changes improve bone mineral density and reduce the negative effect of pregnancy on the skeletal system. It is noted that BMD decreases by 2%–3% despite these counterregulatory endocrine system activation during pregnancy. It is also noted that in the initial phases of lactation, especially within 6 months, there is decreases in bone density by 5%–6%, which regains in the subsequent next 6-month postlactation.

Thus, the multiple gestation and duration of lactation may affect BMD. In the present literature, confusing data and results exist. Heidari *et al.*[10] and Yazici *et al.*[11] noted that the long breastfeeding duration is not a risk factor for low bone mass later in life, further Turan[12] noted that an even grand multiparity (women with ten pregnancies) does not increase a risk for osteoporosis. Since the majority of published data is from a developed country where maternal care is much more advanced than developing countries like India, more so in these countries, women give birth to one or two children and the duration of lactation is variable. There is very scanty data available from India on effect of multiple gestation and lactation on BMD. The aim of present study is to find out whether parity and lactation has any association on BMD in these regions.

Materials and Methods

This is a hospital-based, cross-sectional study done in the Department of Orthopaedics and Obstetrics and Gynecology in the tertiary care institute from January 2018 to February 2020. The study protocol was approved by the Institute Ethics Committee (EC/2018/02). dated 01 Jan 2018. Consecutively, 294 women aged 30–65 years were included after informed consent. The study protocol was approved by the Institute Ethics Committee (EC/2018/02). A basic demographical data and questionnaire regarding age, height, weight, body mass index (BMI), parity, total lactation period, dietary habits, alcohol intake, smoking, excessive tea/coffee intake, socioeconomic status, and menopausal status were recorded for all the study population. Women who were taking medicine for any medical disorder, which can affect BMD in a greater way, like hypo- and hyperthyroidism, hypo-/hyperparathyroidism, glucocorticoid therapy, chronic kidney disease, and inflammatory bowel disease, etc were excluded from present study. Dual-energy X-ray absorptiometry was used for BMD at both regions.

Statistical Analysis

We used SPSS software (version 19; SPSS, Inc., Chicago, IL, USA) for all statistical analysis. Initially, we used descriptive statistics for the calculation of mean ± standard deviation (SD). Pearson's correlation was used for correlation between independent variables and the dependent variables of the spine and femur BMD. For independent effect of parity and lactation on BMD, a simple linear regression was used. To assess the effect of age, parity, period of lactation, BMI, and years since menopause on BMD, multiple regression analysis was used. We set the 95% limit and 5% level as significant and the *P* value was set at < 0.05 to be considered as significant.

Results

The demographic characteristics of the included subjects are shown in Table 1. Independent predictors of low BMD for the Lumbar spine and femoral neck are shown in Table 2. In the present study, it is noted that the parity was inversely proportional to BMD in relation to femoral neck ($r^2 = 0.4981$), standardized regression coefficient ($\beta = -0.142$, $P = 0.00487$) as well as to lumbar spine ($r^2 = 0.3275$, $\beta = -0.138$, $P = 0.00423$) in linear regression analysis. We noted a similar association after adjusting for age, BMI, period of lactation, and menopause ($\beta = -0.342$, $P = 0.00487$ and $\beta = -0.378$, $P = 0.00423$ for femur and spine, respectively) as shown in Tables 3 and 4 and Figures 1 and 2.

Period of lactation was also inversely proportional to femoral neck BMD ($r^2 = 0.3015$, $\beta = -0.033$, $P = 0.0031$) and for lumbar spine BMD ($r^2 = 0.2954$, $\beta = -0.0812$, $P = 0.0012$) in linear regression. While in multiple regression analysis, this relationship remained intact and significant after adjusting for age, BMI, parity, and period of menopause for both, femoral neck BMD ($\beta = -0.033$, $P = 0.0031$) as well as for lumbar spine BMD ($\beta = -0.0812$, $P = 0.0012$) as shown in Table 4 and Figures 3 and 4.

For the independent association between duration of lactation and low BMD at both regions, logistic regression analysis was performed. A significant value obtained from comparisons of BMD in both was included in the logistic regression analysis, as

shown in Table 2. Independent predictors of lower BMD in the femoral neck were age, BMI, physical activity, parity, and duration of menopause, duration of lactation, low socioeconomic status, and poor dietary habits, whereas age, BMI, parity, and duration of lactation were independent predictors of lower BMD in the lumbar spine. Subsequently, in multivariate logistic regression analysis, the period of lactation was also found to be an independent risk factor for BMD at both regions [Table 3].

Discussion

We investigated the effect of multiple pregnancies and period of lactation on BMD in Indian women and noted that there was a significant association between the parity and the total lactation period on BMD of the femoral neck and spine. The women with a longer period of lactation had the lowest BMD at both regions. We also noted that as multiple pregnancies increase, bone density decreases, in both places. This relationship remained intact significantly after adjusting for age, BMI, and menopausal years.

This may be because too many pregnancies were quite frequent in this region and population. Women in this region were not much educated and the majority belongs to poor socioeconomic strata, poor nutritional status, and cannot afford protein-rich food, milk, and any calcium-rich supplements in their diet and it is further added with inadequate maternal and child healthcare facilities.

The finding of our study is also supported by a few studies and consistent with the finding of Yilmaz *et al.*,[17] which noted that

Table 1: Demographical characteristics of the study population

Characteristics	Value
Age (Mean±SD)	50±3.149
BMI (kg/m^2)	30.9±5.3 kg/m
Parity	4.21±1.04
Total duration of lactation (sum of all breastfeeding in months)	39.23±11.65
Age at menopause (years)	44.42±3.15
Duration of menopause in years	6.34±5.31
Femoral neck BMD (g/cm^2)	0.846±0.127
T scoring of femur neck	−1.5±1.01
Lumbar spine BMD (g/cm^2)	0.975±0.171
T scoring of femur neck	−0.96±1.08

Table 2: Independent predictors of low BMD for the lumbar spine and femoral neck

Predictor	Independent predictors of low BMD for femoral neck			
	OR	95% Confidence Interval		*P*
		Lower	Upper	
Age	1.034	0.965	1.089	0.0034
BMI	0.912	0.865	0.92	0.0031
Parity	1.116	0.994	1.252	0.0023
Total duration of Lactation	1.086	0.956	1.103	0.0012
Age at menopause (years)	1.052	0.974	1.134	0.032
Duration of menopause	1.045	0.978	1.071	0.0079
Smoking	0.455	0.874	1.092	0.624
Alcoholism	0.762	0.763	1.102	0.087
Socioeconomic status	0.523	0.797	1.112	0.004
Dietary habits	0.812	0.562	2.056	0.002
Physical activity	0.752	0.437	1.034	0.046
Independent predictors of low BMD for lumbar spine				
Age	1.103	0.986	1.097	0.0042
BMI	0.942	0.623	0.871	0.0023
Parity	1.132	0.968	1.137	0.0027
Total duration of Lactation	1.076	0.977	1.120	0.0016
Age at menopause (years)	1.041	0.976	1.128	0.033
Duration of menopause	1.045	0.978	1.071	0.067
Diabetes	0.451	0.812	1.033	0.323
Hypertension	0.672	0.863	1.27	0.782

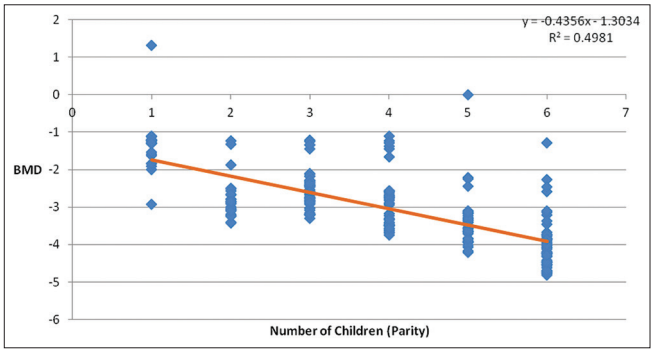

Figure 1: Correlation of bone mineral density of femoral neck with parity

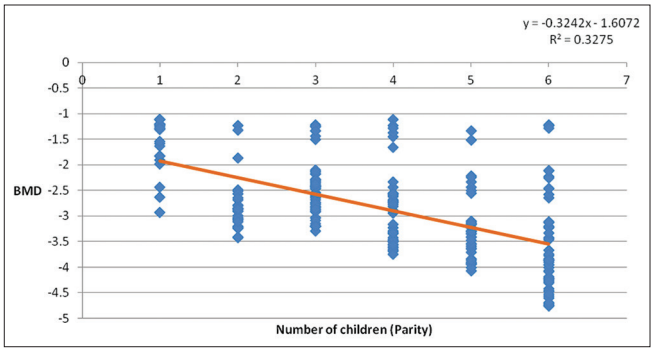

Figure 2: Correlation of bone mineral density of lumbar spine with parity

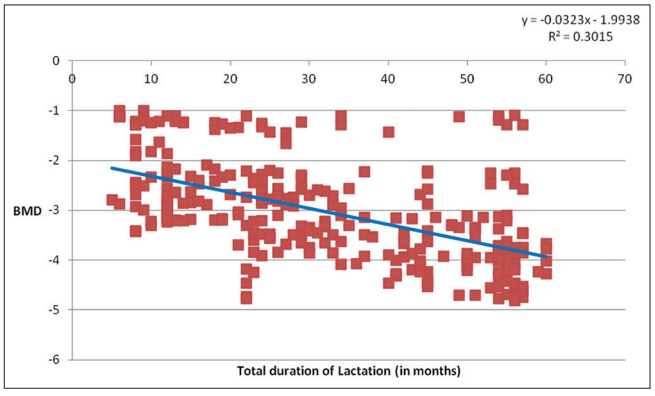

Figure 3: Correlation of bone mineral density of femoral neck with duration of lactation

spinal and femoral BMD in postmenopausal women are related to reproductive factors like period of lactation and number of pregnancy and suggested that both factors may be as a risk for development of osteoporosis in postmenopausal women. Allali *et al.*[18] in a study of 730 postmenopausal women noted a significant negative correlation between parity in both spine and femur BMD. However, Gur *et al.*[19] observed a significant decrease in BMD with parity for the spine and not for the femoral neck, but lower BMD was observed in trochanter and Ward's triangle of the femur. Another study by Hreshchyshyn *et al.*[20] study on 352 women noted that femoral neck bone density decreased with an increasing parity, without any effect on the spine BMD. Few studies, which observed similar results, have been summarized in Table 5.

On the other hand, few authors reported contrary results and observed that no association between parity and BMD is summarized in Table 5.

We feel that the entire period of lactation and the parity are related to each other and it is difficult to differentiate their individual effect on the BMD.

In the present study, multiparity and duration of lactation have a negative effect on both femur and spine BMD. Although in graph 4 there is an inverse relationship between lactation and BMD for both regions, our results are supported by Sharma *et al.*,[13] who studied 196 peri- and postmenopausal women between 40 to 60 years and noted that multiparity and prolonged period of lactation have a negative impact on bone density more in lower socioeconomic strata with poor dietary intake. A similar result was also noted by Kojima *et al.*,[30] who reported that the total period of lactation was inversely correlated with BMD ($r = -0.293$, $P < 0.01$).

However, Salari *et al.*[31] noted that the bone loss usually occurs in pregnancy, but if combined with lactation, it will have a protective effect on bone density. Lenora *et al.*[27] in their study noted that multiparity or prolonged lactation has no negative or detrimental effects on mother's BMD in a later age. Dursun *et al.*[32] in 1486 postmenopausal women over the age of 40 years observed that the total periods of lactation are a risk factor in the development of osteoporosis.

Some authors observed different results; Okyay *et al.*[33] noted that parity has a protective role against the osteoporosis; however, extended lactation period for more than one year per child, increases the risk by many folds, especially in the developing countries. Prolonged hypoestrogenemia caused by prolonged lactation added by the additional burden of frequent pregnancies with poor or inadequate nutrition may be responsible for osteoporosis and cannot be compensated by the various protective mechanisms.

These variations in the result may be due to difference in design studies (population characteristics, cross-sectional, comparative groups, number of the study population, follow-up period, and statistical analysis), the timing of the postpartum studies, dietary habits, and nutritional status of mothers, racial differences, maternal age, the onset of menarche, parity, and duration of lactation, which show inconsistencies of data.[34,35] Few studies commented on the protective effect of lactation on BMD[36–38]; however, other studies indicate detrimental effect,[17,39,40] while some authors reported no significant difference of parity on BMD.[41–45]

Furthermore, the variation of the results may be due to the wide variation in the period of lactation. According to the WHO, breastfeeding is two types: first, exclusive breastfeeding, which refers to absolute breastfeeding for 4 months that may be extended to 6 months without water included; and second,

Table 3: Independent predictors of femoral neck and lumbar spine BMD obtained from linear regression analysis

Predictor	Independent predictors of low BMD for femoral neck		
	SE	*B*	*P*
Age	0.011	−0.123	0.068
BMI	0.0087	0.313	0.0042
Parity	0.031	−0.142	0.00487
Total duration of lactation	0.001	−0.033	0.0031
Duration of menopause	0.018	−0.197	0.764
Low socioeconomic status	0.051	0.759	0.0042
Poor dietary habits	0.031	0.142	0.00487
Physical activity	0.0682	−0.0739	0.0031
Independent predictors of low BMD for lumbar spine			
Age	0.0157	-0.167	0.043
BMI	0.0045	0.734	0.0056
Parity	0.047	-0.138	0.00423
Total duration of Lactation	0.0782	-0.0812	0.0012
Low socioeconomic status	0.0812	0.0731	0.0301
Poor dietary habits	0.0589	0.0781	0.0351

Table 4: Multiple regression analysis of lumbar spine and femur neck bone mineral density versus age, body mass index, parity, total duration of lactation, years since menopause

Independent variables	Standardized regression coefficient (β) value for femoral neck BMD	*P*	Standardized regression coefficient (β) value for lumbar spine BMD	*P*
Age	−0.123	0.068	−0.167	0.043
BMI	0.313	0.0042	0.734	0.0056
Parity	−0.342	0.00487	−0.378	0.00423
Total duration of Lactation	−0.033	0.0031	−0.0812	0.0012

Table 5: Summary of the studies regarding correlation of parity and period of lactation on femur and lumbar spine BMD

Author	Population	Conclusion
	Positive results observed by the following authors	
Sharma[21]	-	Parity affect BMD of spine
Keramat[22]	From Iran 363 subjects and from India 354 subjects	Parity affect BMD of spine
Shin[23]	1991 women aged 40 years	Parity affect BMD of spine
El Maghraoui[24]	422 women	The increase in the parities was associated to a larger body mass index and a lower BMD both in the hips and the lumbar spine.
	Contrary results observed by the following authors	
Karlsson *et al.*[25]	73 women	Association of high parity with high BMD was observed. Neither an extended lactation period nor multiple pregnancies could be used as a risk factor when predicting women at risk for future osteoporosis.
Cure-Cure *et al.*[26]	1855 postmenopausal Hispanic women from Barranquilla	Pregnancies appear to be a protective factor against development of osteoporosis.
Lenora *et al.*[27]	210 Sri Lankan women	Multiparity or prolonged lactation has no negative effects on maternal bone mineral density in postmenopausal age.
Hiz[28]	320 postmenopausal women	No significant difference was found between the number of pregnancies and BMD within each group
Streeten *et al.*[29]	424 parous older order Amish	Increasing parity was associated with higher BMD at the hip and trochanter regions.

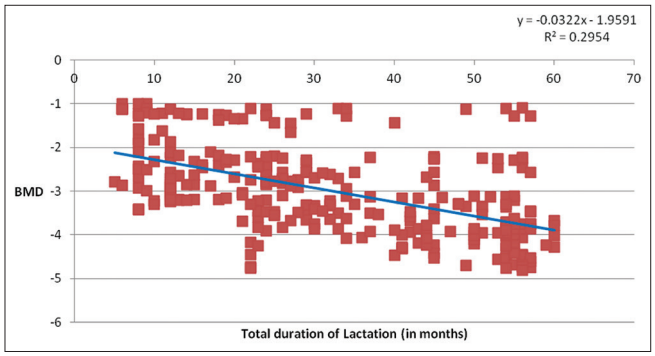

Figure 4: Correlation of bone mineral density of lumbar spine with duration of lactation

predominant breastfeeding in which in addition to breast milk, water, or juices will be given. The wide variation of results may be due to these different practices of lactation.

Miller *et al.*[46] suggested that during breastfeeding, estrogen causes an inhibitory effect on periosteal bone formation through osteoblast and increases subperiosteal new bone formation, which increases bone size after weaning.

Role of Primary Physician

Primary health caregivers must educate the women regarding family planning and maintain good bone health by encouraging calcium and Vitamin D rich diet during prepregnancy, during pregnancy, and thereafter.

Limitation of the Study

The present study has few limitations firstly small sample size; second, it was not a population-based study. Recalling of the periods of lactation in the past may be difficult and may not be accurate. To reach a definitive conclusion, a large population-based observational study is required.

Conclusion

Based on a present study, we may suggest that multiparity and longer periods of lactation have a significant negative effect on bone densities of both the regions i.e femoral neck and lumbar spine, especially in lower socioeconomic strata with poor nutrition. Present study supports that multiparity and period of lactation can be considered as a risk factor for future osteoporosis.

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Conflicts of Interest

There are no conflicts of interest.

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