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RESEARCH ARTICLE

A study to evaluate the relation between the age at menarche and bone mineral density in pre- and post-menopausal women

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ABSTRACT

Background: Bone mass loss is very common but ignored problem of elderly population. Many reproductive and menstrual factors such as parity, breastfeeding, age at first pregnancy, age at menarche, use of combined oral contraceptives, and age at menopause affect bone mineral density (BMD). Major hormonal changes occur at menarche; also, the age at which menarche attained is not same for all females. **Aims and Objectives:** The present study aimed to evaluate the correlation between the age at menarche and BMD in premenopausal and postmenopausal women. **Materials and Methods:** The study was conducted at tertiary care medical college and general hospital and at private hospitals of the metropolitan city on 73 normal healthy women in the age group of 20–75 years. Their age, sex, body mass index, age at menarche, and BMD values were recorded. BMD was measured by DXL Calscan (Demetech AB). **Results:** The readings were analyzed by Pearson Chi-square test. In the present study, we did not find any correlation between age at menarche and BMD. **Conclusion:** Many reproductive parameters including age at menarche are an important determinant of BMD; therefore, it is suggested that educational strategies are needed to increase awareness of factors that contribute to maintaining bone health among females.

KEY WORDS: Age at MENARCHE; Bone mineral density; Postmenopausal; Premenopausal

INTRODUCTION

"Osteoporosis - It is a major health concern, affecting many people worldwide"[1] Osteoporosis is a chronic bone disease characterized by low bone mass and microarchitectural disruption, leading to bone fragility and an increased susceptibility to fractures.[2] It is complex and most ignored health problem in the elderly women. Many reproductive and menstrual factors such as parity, breastfeeding, age at first pregnancy, age at menarche, use of combined oral contraceptives, and age at menopause influence the risk of osteoporosis. Of which we thought about menarche, which is a benchmark of puberty, may be affecting bone health. Puberty leads to lot of hormonal changes in one's body, one of the major change is increased production of estrogen. It is important at that stage because estrogen causes bone growth and development by its osteoblastic effect.[20] Thus, the present study aimed to correlate the effect of age at menarche on bone mineral density (BMD) in premenopausal and postmenopausal women. This will help in prevention and early intervention for the susceptible women.

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MATERIALS AND METHODS

Study Population

The study was conducted on 73 normal healthy subjects (females) in the age group of 20–75 years selected randomly by simple random sampling technique.

The current study was carried out at tertiary care medical college and general hospital and at private hospitals of the metropolitan city. Prior institutional ethics committee (IEC) permission was taken. Subjects who volunteered for the study were included in the study. Pre-test instructions were given. The test was properly explained and demonstrated. Before starting the test procedure, a written informed consent was obtained from all 73 voluntary participants fulfilling inclusion and exclusion criteria.

Inclusion Criteria

The following criteria were included in the study:
- Normal healthy females.
- Age group 20–75 years.
- Who had given written informed consent.

Exclusion Criteria

The following criteria were excluded from the study:
- Individual with chronic illness (chronic renal diseases, chronic liver diseases, etc.)
- Individual on calcium supplementation.
- Individual on hormonal replacement therapy.
- Chronic smokers and alcoholics.
- Individual with the regular physical exercise.
- Individual on steroid therapy.
- Pregnant and lactating women.
- Known case of osteoarthritis/rheumatoid arthritis.

The study was approved by IEC.

All the participants were given a structured questionnaire which was framed to obtain their demographic, reproductive, and menstrual history details.

Menopausal women are considered as those women who are not having menstrual cycle for complete 1 year.

Ethical Considerations

The study was conducted according to the Declaration of Helsinki; the protocol was reviewed and approved by the IEC. Written informed consent was obtained from all the subjects.

Equipment Used

DXL Calscan (Demetech AB) is used.

Measurement of BMD

The DXL Calscan (Demetech AB) was used to determine heel BMD. BMD was classified using the criteria of the World Health Organization as follows:[3]
- Normal is a T-score of −1.0 or higher.
- Osteopenia is defined as between −1.0 and −2.5.
- Osteoporosis is defined as −2.5 or lower, meaning a bone density that is two and a half standard deviations below the mean of a 30-year-old man/woman.

Statistical Analysis

Descriptive statistics for parameters are given as proportion, mean, and standard deviation. Chi-square test was used as a test of significance.

RESULTS

Chi-square tests			
	Value	**df**	***P*-value**
Pearson Chi-square	4.382	4	0.357

Pearson Chi-square was used for analysis. The sample consists of 73 women of premenopausal and postmenopausal group and their age varied between 20 and 75 years.

As per Table 1, there was no statistically significant association between age at menarche and BMD.

As per Table 2, there was no statistically significant association between age at menarche and BMD in postmenopausal group.

As per Table 3, there was no statistically significant association between age at menarche and BMD in premenopausal group.

DISCUSSION

Chi-square tests			
	Value	**df**	***P*-value**
Pearson Chi-square	2.59	4	0.629

Table 1: Distribution of study subjects according to important variables (*n*=73)

BMD				
Age at menarche	**Normal**	**Osteopenia**	**Osteoporosis**	**Total**
<12				
Count	0	4	1	5
% within BMD	0.00	9.30	4.50	6.80
12–14				
Count	5	31	19	55
% within BMD	62.50	72.10	86.40	75.30
>14				
Count	3	8	2	13
% within BMD	37.50	18.60	9.10	17.80
Total				
Count	8	43	22	73

BMD: Bone mineral density

Table 2: Association of age at menarche with BMD in postmenopausal group

BMD				
Age at menarche	**Normal**	**osteopenia**	**Osteoporosis**	**Total**
<12				
Count	0	1	1	2
% within BMD	0.00	4.50	6.20	5.10
12–14				
Count	1	18	15	34
% within BMD	100.00	81.80	93.80	87.20
>14				
Count	0	3	0	3
% within BMD	0.00	13.60	0.00	7.70%
Total				
Count	1	22	16	39
% within BMD	100.00	100.00	100.00	100.00

BMD: Bone mineral density

Table 3: Association of age at menarche with BMD in premenopausal group

BMD				
Age at menarche	**Normal**	**Osteopenia**	**Osteoporosis**	**Total**
<12				
Count	0	3	0	3
% within BMD	0.00	14.30	0.00	8.80
12–14				
Count	4	13	4	21
% within BMD	57.10	61.90	66.70	61.80
>14				
Count	3	5	2	10
% within BMD	42.90	23.80	33.30	29.40
Total				
Count	7	21	6	34
% within BMD	100.00	100.00	100.00	100.00

BMD: Bone mineral density

The present study was conducted on 73 healthy women, out of which 34 were premenopausal and 39 were postmenopausal. Women who attained menarche before 12 years of their age are categorized in one group, women who attained menarche between 12 years and 14 years are categorized in one group and those who attained menarche after 14 years are categorized in one group. Likewise, according to their BMD score, they are categorized in normal, osteopenic, and osteoporotic group. Table 1 shows association between age at menarche (n = 73) and BMD using Pearson Chi-square test; there is no statistically significant association between the age at menarche and BMD (P = 0.357). Table 2 shows association of age at menarche with BMD in premenopausal group females (n = 34); there is no statistically significant association between the age at menarche and BMD in premenopausal age group (P = 0.629).

Table 3 shows association of age at menarche with BMD in postmenopausal group females (n = 39); there is no statistically significant association between the age at menarche and BMD in postmenopausal age group (P = 0.628).

Osteoporosis is a major disease of concern, especially for females; thus, it is necessary to study the association of possible risk factors with this disease. As osteoporosis is having a multifactorial etiology, the present study is done to find association of one of the reproductive risk factors, that is, age at menarche with osteoporosis. In some past studies, it is proved that delayed puberty decreases bone mass, and hence, the possibility of fractures in pre- and post-menopausal age increases.[4] Estrogen is very important hormone for bone health, therefore, after menopause when there is decreased or no production of estrogen, it makes bones very susceptible to fractures. Apart from menopause, many events which affect circulating estrogen levels such as menarche, pregnancy, lactation, and use of oral contraceptive pills also affect bone health and increase the risk of osteoporosis, but these factors are inconsistent.[4,5] Menarche causes many physiological changes and it includes secretion of estrogen, which makes menarche a very important associating factor for osteoporosis.[6]

Clarke and Khosla proved that "onset of gonadal sex steroid secretion at puberty is the major factor responsible for skeletal longitudinal and radial growth, as well as significant gain in bone density, until peak bone density is achieved in the third decade of life" in their research they also concluded that at menopause, gonadal sex steroid production decreases and that leads to rapid bone loss.[7] Vikho and Apter proved that early menarche also causes higher estrogen production both during and even after menarche.[8,9]. Studies show that early menarche has a protective effect on osteoporosis and some studies show that late menarche has adverse effect on menarche means it decreases BMD.[10,11]

The present study shows no statistically significance between age at menarche and BMD in premenopausal as well as in postmenopausal age group. Previous literature which shows similar results are Gerdhem and Oberant[12] who concluded that age at menarche or menopause has no or limited effect on BMD when subjects are at age 75 or older. The study conducted by Sioka *et al*.[13] found that age at menarche does not affect BMD but menopause between 40 and 45 years lower the BMD in postmenopausal females. A study conducted on Indian population by Hooda *et al*. found no correlation between parity, age at menarche, duration of breastfeeding, and BMD values.[14]

In contrary, many studies show statistical significance between age at menarche and BMD. Research conducted by Li and Zhu[15] concluded that later the menarche and earlier the menopause, the higher the degree of osteoporosis; the more deliveries and period of lactation, the lower the BMD. Kuh *et al*.[16] concluded that late puberty lowers BMD in old age. Cheng *et al*.[17] done a study on Korean females aged

20–50 years and found that age at menarche had a small but significant effect on BMD of lumbar spine at premenopausal stage. Research conducted by Parker *et al*. showed association between earlier menarche and increased BMD.[6] Grainge *et al*. and Galuska and Sowers show similar results.[18,19] Ito *et al*.[20] concluded that age at menarche strongly affects peak bone mass and proved it in their study by having a positive correlation of early menarche with higher BMD. Bass *et al*. proved that if puberty happens early, then it stimulates rapid skeletal growth, whereas late puberty causes low skeletal growth.[21]

Strength and Limitations

In future, we would like to extend our research by considering other factors such as exposure to sunlight, calcium intake, and other reproductive factors such as smoking, diet, age at menopause, number of pregnancy, and duration of lactation in addition to sources of exogenous estrogen, such as oral contraceptives and postmenopausal hormones and so forth. As prevention is always better than cure, bone health is important, especially in females. Women are not very aware of the effect of reproductive factors on bone health, and hence, it is very neglected parameter of the society. Various educational strategies should be implemented to spread the awareness of osteoporosis.

CONCLUSION

Age at menarche is one of the important reproductive parameters which can affect BMD in female population. These parameters can be assessed by simple and non-invasive method, requiring less expertise. Hence, they can be promoted for use at community level. The study with more sample size will be of more value. Biochemical markers such as lipid profile studies, blood glucose level, and newer biochemical markers such as Vitamin D and parathyroid hormone can be incorporated for further studies for more accuracy.

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