



A COMPARATIVE STUDY OF SERUM CALCIUM AND ALKALINE PHOSPHATASE LEVELS WITH BONE MINERAL DENSITY IN PREMENOPAUSAL WOMEN

Biochemistry

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ABSTRACT

Osteoporosis is a multifactorial disorder characterized by low bone mass and enhanced skeletal fragility. In women Osteoporosis is the most common form of metabolic bone disease especially in postmenopausal age group. Premenopausal fractures may be an important indicator of underlying poor bone quality. Maintaining physiological balance of Calcium and Alkaline phosphatase are important for good bone health. Bone Mineral Density (BMD) is a key determinant for prediction of fracture chances in future along with biochemical parameters like Calcium and Alkaline phosphatase. **Aim:** To study the Correlation between Serum Calcium and Alkaline phosphatase levels with Bone Mineral Density in premenopausal women **Methods:** A cross sectional study was conducted at ESIC Medical College & PGIMSR, Bangalore in a total of 171 study participants with age group 35-50 years. Blood samples were analyzed for Calcium, Alkaline Phosphatase and Bone Mineral Density was measured by Dual Energy X-ray Absorptiometry (DEXA). **Results:** Our study showed low serum calcium level and high alkaline phosphatase level in patients with T score showing osteopenia (T score between -1 and -2.5) when compared to patients with T score showing normal (T score -1 and above). Further this study showed positive correlation between calcium and BMD, negative correlation between ALP and BMD. **Conclusion:** Our study showed that increasing number of premenopausal women are in a state of osteopenia which makes them more vulnerable for premature fracture and osteoporotic changes which can develop if not diagnosed early and treated.

KEYWORDS

Calcium, Alkaline Phosphatase, Bone Mineral Density, Premenopausal women

INTRODUCTION

Osteoporosis is a public health problem which reduces the quality of life. Osteoporosis is a systemic skeletal disease triggering micro-architectural degradation of bone. Age related bone loss is asymptomatic. Osteoporosis and its worst outcomes such as fractures and chronic pain are common in both genders, however, women are more liable, accounting for 70-80 percent of all traumas encountered including hip, spine and wrist fractures.¹ In India the prevalence of osteoporosis in women above the age of 40 years is found to be 20%.² This prevalence increases further in postmenopausal women because of reduced estrogen levels resulting in accelerated loss of bone mass.³ Menstrual status is an important determinant of peak bone mass. Based on the menstrual bleeding patterns, premenopausal women are those having atleast 12 menses in the past 12 months with no change in regularity. After age 35, bone breakdown outpaces bone build-up, resulting in gradual bone loss. Once this loss of bone reaches certain point, a woman has osteoporosis.⁴ Bone remodeling allows repair of micro damage, maintaining skeletal structure and involves a careful equilibrium between the action of osteoclasts, tightly coupled with that of osteoblasts.⁵

It is well established that Serum Calcium and Alkaline phosphatase (ALP) are major determinants of bone health. During growing years, it is important to maximize dietary intake of calcium to maintain positive calcium balance and achieve peak bone mass, thereby possibly decreasing the risk of fracture when bone is subsequently lost. Serum T-ALP levels have been considered a potential biomarker of bone formation. ALP level reflects the physiological bone status in the body, which is more sensitive marker than usual weight or age for predicting subtle changes in BMD during the preclinical phase of osteoporosis.⁶ Bone mineral density detects osteoporosis before fracture occurs, detects rate of bone loss and monitors effect of treatment. Dual-energy X-ray Absorptiometry is the standard technique to measure BMD.⁷ Hence the present study was undertaken to correlate between Serum Calcium and Alkaline phosphatase levels with Bone Mineral Density in premenopausal women.

Methods

A cross sectional study was conducted in female patients in premenopausal age group 35 – 50 years presenting to Orthopaedic OPD at Tertiary teaching hospital. After getting approval from the Institution scientific and Ethics committee, 171 participants with back pain or hip pain were studied for 18 months from March 2021 to August 2022.

Patients with history of fracture and osteomalacia, chronic kidney disease, Ischemic heart Disease and Malignancies involving bone, kidney, breast and liver and patients who are under calcium, Vitamin D supplements were also excluded.

After obtaining informed consent, under aseptic precautions blood is collected and allowed to clot, then centrifuged at 3000 rpm and analysed.

Serum Calcium by Modified OCPC method and serum Alkaline phosphatase by IFCC recommended method were analysed in Cobas Integra 400 plus. Bone Mineral Density measured by Dual energy x-ray absorptiometry at the lumbar spine regions (L1-L4 vertebrae). Serum calcium between 8.6-10.2 mg/dL, ALP level between 35-104 U/L are considered as normal range. Patients with T score -1 and above are considered as normal, between -1 and -2.5 as osteopenia and T score at or below -2.5 as osteoporosis.

Statistical Analysis

All statistical analysis was performed using the prism pad software to indicate the significance. Descriptive data of Calcium and ALP were presented as Mean $\pm$ SD. Relationship between Bone mineral density and biochemical parameters was done using Pearson Correlation coefficient. $P < 0.05$ were considered statistically significant.

RESULTS

The age group of people included in our study is from 35-50 years of which majority were between 45-50 yrs (76.02%) (Table-1) (Graph-1). Of the total 171 patients, 36.84% were having low Calcium levels and 47.95% were having increased ALP levels. The mean value of calcium is 8.74 ± 0.44 and ALP is 107.59 ± 40.65 (Table-2). Based on BMD T score measurements (DEXA), 39 cases (22.8%) were having osteopenic T score, 2 cases (1.17%) were having osteoporotic T score and remaining 130 (76.02%) were having normal T score. There is moderate positive correlation between Calcium and T score ($r = 0.55$) ($p < 0.0001$) (Graph-2) and negative correlation is found between ALP and T score ($r = 0.55$) ($p < 0.0001$) (Graph-3) (Table-3).

DISCUSSION

Decreased bone mineral density is associated with feeble, delicate and fractured bones. Osteoporosis has been linked to an increased fracture risk and subsequent morbidity and mortality in the later life. It has been reported that 50 million Indians have low bone mass with high prevalence of osteoporosis.⁸ The aging population is expanding at an unprecedented rate. This explosion in population will lead to a greater number of individuals with osteoporosis, more so in females. Role of Calcium and Alkaline phosphatase with its consequence in bone health have been well understood in postmenopausal women, but not in premenopausal women.

Osteoporosis is a condition which can be prevented and treated if it is identified early. In our study we found that 22.8% of women in the study group (35-50 years) had osteopenia i.e. T scores between -1 and -2.5. The study showed that serum Calcium is decreased and ALP is

increased in osteopenic women, when compared to women having normal T score.

The mean value of serum Calcium in our participants with normal T score is 8.81 ± 0.44 and with abnormal T score is found to be 8.50 ± 0.46 . Khadka B et al in their study found that minimum value of Calcium in premenopausal women is 8 mg/dL whereas in our study minimum value is found to be 7.4 mg/dL and they have found in postmenopausal women minimum value of calcium is 6 mg/dL.⁹ Many studies have concluded that in postmenopausal women, calcium supplementation can decrease bone loss by $\approx 1\%$ per year.¹⁰ Calcium and vitamin D supplementation also helps to improve the efficacy of antiresorptive therapy, such as Hormone Replacement Therapy (HRT) on bone mass.¹¹

In our study there is positive correlation between Calcium and BMD ($r=0.55$), which is consistent with Mishra S et al study, that shows significant positive correlation between Calcium and Bone mineral density ($r=0.64$) in premenopausal women.⁴

Samiya B et al in their cross sectional study found that there was no correlation between serum ALP and BMD in perimenopausal women, but in our study there was negative correlation ($r=-0.55$) ($p<0.0001$)¹²

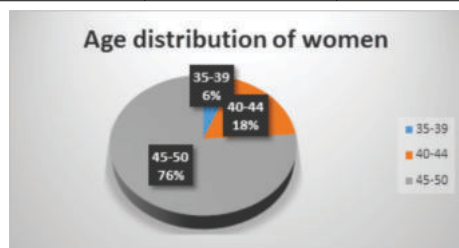
Premenopausal women with an ongoing cause of bone loss mainly due to hormonal changes and those who have had, or continue to have, low trauma fractures may require pharmacological intervention. The finding of low bone mineral density in a premenopausal women prevents specific diagnostic and management challenges that are quite different from those in postmenopausal women. Predicting the risk of osteoporosis at an earlier age (i.e. premenopausal) or a preclinical phase (i.e. osteopenia) is crucial for early prevention of osteoporosis.

Future research possibilities: Understanding about bone remodelling in molecular level will give higher inputs about osteoporosis.

Limitations of the study: Study was conducted in the Urban ESIC patients, therefore it cannot be generalized. Secondly, Purposive sampling was used, so there can be selection bias.

Table – 1: Distribution Of Cases According To Age (n=171)

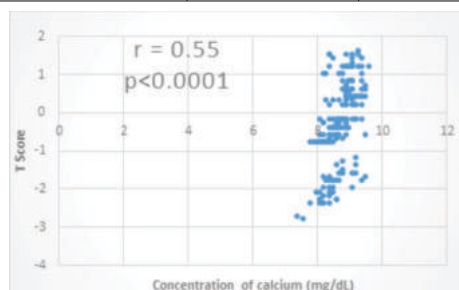
Age group (years)	Number	Percentage(%)
35-39	10	5.85 (6)
40-44	31	18.13 (18)
45-50	130	76.02 (76)
Total	171	100



Graph – 1: Age Group Wise Distribution Of Cases

Table – 2: Correlation Of Biochemical Parameters With Bmd

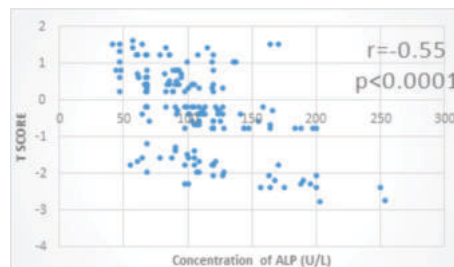
Biochemical parameters	Correlation	P value
Calcium	0.55	<0.0001
Alkaline Phosphatase	-0.55	<0.0001



Graph – 2: Correlation Of Calcium With T Score

Table – 3: Distribution Of Cases According To Biochemical Parameters

Biochemical parameters	Mean + SD	Normal values	Abnormal values
Calcium	8.74 ± 0.44	108(63.16%)	63(36.84%)
Alkaline Phosphatase	107.59 ± 40.65	89(52.05%)	82(47.95%)



Graph – 3: Correlation Of Alkaline Phosphatase With T Score

CONCLUSION

Osteoporosis is a serious global health issue due to rapid increase in the size of the aging female population. In the present study we found that serum Calcium levels are decreased and ALP levels increased which is correlating with Bone Mineral Density <0.0001 in premenopausal women.

Since the pathogenesis is complex and multifactorial, the screening of common biochemical markers like Calcium, Alkaline phosphatase together with Bone Mineral Density measurements in premenopausal women will provide information about future bone loss at individual level.

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