

# Evaluation of Serum Alkaline Phosphatase Level in Pre and Postmenopausal Women

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**ABSTRACT: Background:** Serum Alkaline Phosphatase (ALP) is the earliest bone marker in postmenopausal women as it plays an important role in bone formation and resorption. ALP is a universal enzyme that has a role in osteoid formation and mineralization of bone. The serum ALP pool consists of several dimeric isoforms that originate from various tissues such as the liver, bone, intestine, spleen, kidney and placenta. **Methods:** This was a cross-sectional comparative study and carried out in the Department of Physiology, Rajshahi Medical College, Rajshahi over a period of 12 months from July 2021 to June 2022 on 60 pre and postmenopausal women residing in Rajshahi city. Data was collected through a semi-structured questionnaire and a good laboratory setting. **Results:** In premenopausal group, all (100%) of the women had normal alkaline phosphatase level. On the other hand, in the postmenopausal group, most (96.7%) of the respondents had normal alkaline phosphatase level and only 3.3% of the respondents had increased alkaline phosphatase level. In both groups, none had decreased alkaline phosphatase level and also in premenopausal group none had increased alkaline phosphatase level. Serum alkaline phosphatase level in postmenopausal women was higher than the premenopausal women and it was statistically highly significant ( $p < 0.001$ ). **Conclusions:** As serum alkaline phosphatase is associated with bone formation and resorption, so regular screening of serum ALP in postmenopausal women might be helpful for early detection of postmenopausal osteoporosis.

**Keywords:** Serum Alkaline Phosphatase, Premenopausal Women and Postmenopausal Women.

## Article at a glance:

**Study Purpose:** The purpose of this study was to measure and compare the serum ALP level between premenopausal and postmenopausal women in Rajshahi City.

**Key findings:** Postmenopausal women had significantly greater levels of serum alkaline phosphatase compared to premenopausal women ( $p < 0.001$ ).

**Newer findings:** There was a positive correlation between age and serum alkaline phosphatase in both pre and postmenopausal women but in premenopausal group this relation was statistically significant ( $p=0.03$ ) but not in postmenopausal group.

**Abbreviations:** ALP: Alkaline Phosphatase, ERC: Ethical Review Committee and SD: Standard Deviation.

## INTRODUCTION

Menopause is associated with various physiological and biochemical changes that have effects on various systems in our body. As a result of lower level of estrogen postmenopausal women are at increased risk for a number of health conditions, such as osteoporosis and heart diseases. Osteoporosis, one of the most important public health problems in postmenopausal life which not only gives rise to morbidity but also markedly reduces the quality of life in this population.<sup>1</sup> Calcium is important to

prevent bone loss and to help restore the bone that might have been lost due to osteoporosis. Calcium also helps to keep heartbeat regular.<sup>2</sup> Magnesium is important for healthy bones and its deficiency may play a role in postmenopausal osteoporosis. Magnesium helps to promote healthy cardiovascular systems and helps to prevent heart attacks.<sup>3</sup> Alkaline Phosphatase is used as a marker for bone metabolism for several years. Serum alkaline phosphatase (ALP) is the most commonly used biomarker of bone formation. ALP is a universal enzyme that plays an

important role in osteoid formation and mineralization of bone.<sup>4</sup> The serum ALP pool consists of several dimeric isoforms that originate from various tissues such as the liver, bone, intestine, spleen, kidney and placenta. High levels of ALP are often encountered during routine blood investigation in elderly patients because ALP includes various isoenzymes from other tissues.<sup>5</sup> An accurate diagnosis is usually not possible on the basis of elevated ALP alone. If liver function is normal, bone metabolism can be considered to be the cause of increase in serum ALP and it is very important marker after menopause.<sup>6</sup> Thus, even without measuring BSAP, the state of bone metabolism can be determined by measuring ALP and can be used to diagnose osteoporosis and osteopaenia. It is fact that global average life expectancy is increasing day by day and half of the total population is female.<sup>6</sup> So, health issue of postmenopausal women is a time demanding issue. Menopause may alter serum ALP levels which can lead to increased risk of osteoporosis. So, it is imperative to know the changes in serum alkaline phosphatase levels of postmenopausal women. To the best of our knowledge a very few studies have been addressed this problem in the context of Bangladesh. Moreover, the present study would also facilitate the clinicians and gynecologists to update their knowledge regarding serum alkaline phosphatase levels in postmenopausal women.

## METHODS

This cross-sectional comparative study was conducted in the Department of Physiology, Rajshahi Medical College, Rajshahi from July 2021 to June 2022 to assess and compare the level of serum alkaline phosphatase in premenopausal and postmenopausal women. The study included premenopausal women aged 20 to 40 and postmenopausal women aged 50 to 60 who lived in Rajshahi. The Ethical Review Committee (ERC) approved the study before it began, and a purposive sampling technique was used with a total sample size of 60. The questionnaire for the study was created after speaking with the guide and studying the previously available literature. The responses were drawn from Rajshahi Medical College and Hospital's neighbors, family and staff. After obtaining informed written consent from each responder, a comprehensive history and physical examination were conducted and recorded in a prepared data sheet. Blood samples were collected from the median cubital vein in the antecubital fossa, while the individual sat comfortably on a chair. Approximately three milliliters of blood are collected in EDTA-coated vacutainers using a sterile DISPOVAN syringe under sterile conditions. The sample was then tested for serum alkaline phosphatase using an auto analyzer equipment. All tests were statistically significant at the acceptable probability level of  $p < 0.05$ .

## RESULTS

**Table 1: Distribution of the respondents according to marital status, educational status and occupational status (n=30 in each group).**

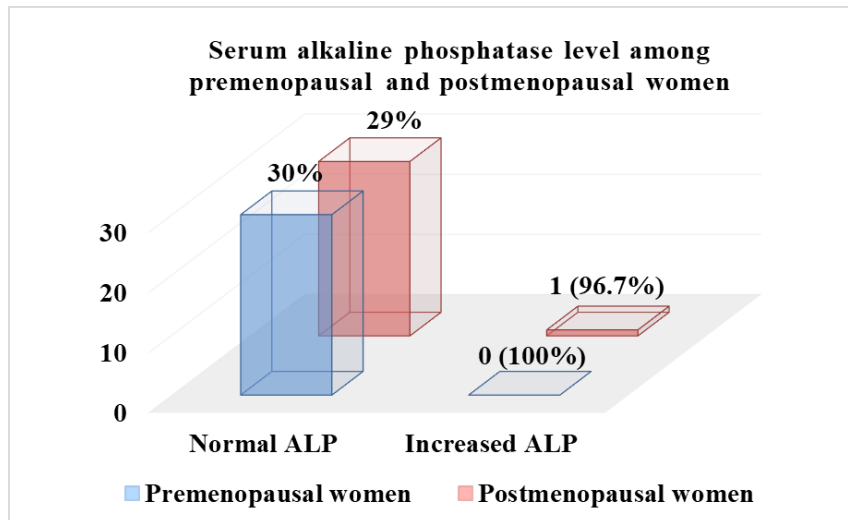
Variables	Premenopausal women (n=30)	Postmenopausal women (n=30)
<b>Marital status</b>		
Unmarried	8 (26.70%)	0 (0%)
Married	22 (73.30%)	30 (100.00%)
<b>Educational status</b>		
Illiterate	0 (0%)	14 (46.70%)
Primary	4 (13.30%)	4 (13.30%)
Secondary and higher secondary	17 (56.70%)	8 (26.70%)
Graduate	9 (30.00%)	4 (13.30%)
<b>Occupational status</b>		
Housewife	13 (43.30%)	28 (93.30%)
Service holder	17 (56.70%)	2 (6.70%)

Marital status of the women showed that among the premenopausal women, less than  $\frac{3}{4}$ <sup>th</sup> (73.3%) of the respondents were married and only

near  $\frac{1}{4}$ <sup>th</sup> (26.7%) of the respondents were single. On the other hand, in the postmenopausal group, all (100%) were married. Secondary and higher

secondary level of education (56.7%) were predominantly higher among the premenopausal women and illiterate respondents (46.7%) were comparatively higher in the postmenopausal group. No respondent was illiterate in the premenopausal group. On the other hand, in the premenopausal

women, more than half (56.7%) of the women were involved in service and remaining less than half (43.3%) were housewives. On the other hand, in the postmenopausal group more than 9/10<sup>th</sup> (93.3%) of the were housewives and only 6.7% were service holder (Table 1).



**Figure 1: Distribution of the respondents according to their serum alkaline phosphatase level (n=30 in each group).**

Serum alkaline phosphatase level revealed that in premenopausal group, all (100%) of the women had normal alkaline phosphatase level. On the other hand, in the postmenopausal group, most (96.7%) of the respondents had normal alkaline phosphatase

level and only 3.3% of the respondents had increased alkaline phosphatase level. In both group none had decreased alkaline phosphatase level and also in premenopausal group none had increased alkaline phosphatase level (Figure 1).

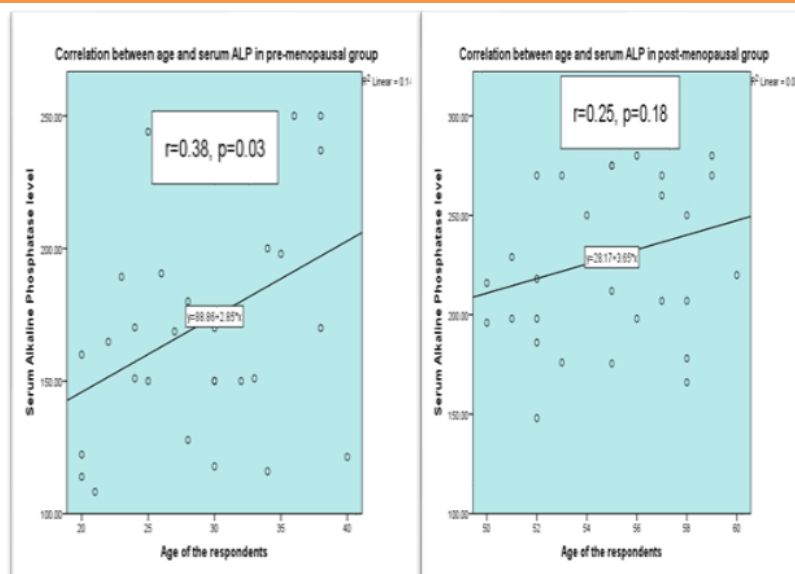
**Table 2: Comparison of serum alkaline phosphatase between postmenopausal and premenopausal women (n=30 in each group).**

Serum alkaline phosphatase	Group		t-value	p-value
	Postmenopausal women (n = 30)	premenopausal women (n = 30)		
mean $\pm$ SD (U/L)	228.65 $\pm$ 42.27	172.07 $\pm$ 44.72	5.04	< 0.001
Range (U/L)	148 to 291	108.20 to 250		

(Data were analyzed by Unpaired t-Test and were presented as mean  $\pm$  SD.)

Among the postmenopausal women mean serum alkaline phosphatase level was 228.65  $\pm$  42.27 U/L and among the premenopausal women mean serum alkaline phosphatase level was 172.07  $\pm$  44.72 U/L. So, it was clear that serum alkaline phosphatase

level in postmenopausal women was higher than the premenopausal women (mean difference 56.58, 95% CI [34.09, 79.07]), t (df=58) = 5.04 and it was statistically highly significant (p < 0.001) (Table 2).



**Figure 2: Scatter diagram showing correlation between age and serum alkaline phosphatase level of the respondents in the pre and postmenopausal group (n=30 in each group).**

Scatter diagram revealed positive correlation between age and serum alkaline phosphatase of the respondents in both pre and postmenopausal women

but in premenopausal group this relation was statistically significant ( $p=0.03$ ) but not in postmenopausal group (Figure 2).

## DISCUSSION

The improvement of health quality of life for women after menopause is one of the major concerns today. Rapid bone loss occurs in postmenopausal women due to hormonal factors that lead to an increased risk of fractures. In postmenopausal women, there is a drop in serum calcium and magnesium level. So, there is abrupt fall in bone density due to osteoclasts exceeds the osteoblasts formation. Serum alkaline phosphatase is an important marker which is increased during postmenopausal period due to decreased bone mineral density. The mean levels of serum alkaline phosphatase in postmenopausal group were ( $228.65 \pm 42.27$ ) and in controls was ( $172.07 \pm 44.72$ ). Serum alkaline phosphatase in postmenopausal group was significantly higher (mean difference 56.58, 95% CI [34.09, 79.07]) than the premenopausal group ( $p < 0.001$ ). These findings were in accordance with studies done by Saha *et al.*, Prabha *et al.*, Ali, D & Pujar, ELmalik *et al.*, Pardhe *et al.*, Khadka *et al.*, Bhattarai *et al.*, and Marimuthu & Reddy *et al.*<sup>6, 7-14-29</sup> ALP is considered as a potential marker for alveolar bone resorption in postmenopausal women. It increases in the postmenopausal period due to increased bone turnover. In adults with normal liver function, approximately 50% of the total ALP activity in serum

is derived from the liver, whereas 50% arises from bone. In our study, the total ALP levels were significantly high in postmenopausal women in comparison to premenopausal women. This shows that the bone mass continues to decline with age. The increase in ALP levels was a result of hormonal changes and also due to the effect of parathyroid hormone on bone. There were some limitations of the study such as this was a cross-sectional type of study in a single community with comparatively small number of sample sizes. So, the study result may not reflect the exact scenarios of the whole country. Selection bias could not be avoided as purposive sampling technique was selected. Vitamin D level was not assessed in the study which is required for bone mineralization.

## CONCLUSION

Menopause is associated with various biochemical changes in our body. Serum alkaline phosphatase level was higher among the postmenopausal women, and it was statistically significant. After menopause bone resorption exceeds the bone formation. The main cause behind this process is oestrogen deficiency which alter the rate of bone turnover. In Bangladesh nutritional deficiency and lack of health awareness make this problem more

severe and ended with serious complications. As serum alkaline phosphatase was associated with bone formation and resorption, so regular screening of serum ALP in postmenopausal women might be helpful for early detection of postmenopausal osteoporosis.

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### Authors' contributions

LH, EAL: Concept and design, data acquisition, interpretation and drafting. LH and MNK: Data acquisition, interpretation, drafting, final approval and agree to be accountable for all aspects of the work.

### Ethical approval

Ethical approval of the study was obtained from the Ethical Review Committee from Rajshahi Medical College, Rajshahi. Informed consent was taken from all women. All the study methodology was carried out following the relevant ethical guidelines and regulations.

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### Conflict of interest

Authors declared no conflict of interest.

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