



## A cross sectional study evaluating the serum calcium levels in premenopausal, perimenopausal and postmenopausal women in a tertiary care center in Karnataka

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### Abstract:

**Background:** Osteoporosis is a silent disease; if it remains undiagnosed and untreated nearly 60% of women will sustain fragility fractures during their life time. The reported prevalence of osteoporosis among Indian women varies between 53% to 81%. Calcium plays an important role in osteoporosis. Calcium intake varies between sexes, socioeconomic classes. Indian diets are predominantly vegetarian, and the contribution of dairy products to the overall calcium intake is minimal in the lower socioeconomic classes. Phytate and oxalate in fibre rich Indian diet also retard the absorption of calcium. Hence this study was conducted in the present institute with the objective to determine serum calcium levels in premenopausal, Perimenopausal and postmenopausal women and to correlate serum calcium levels with respect to age.

**Methods:** A cross sectional study was conducted among 350 women in the Department of Obstetrics and Gynecology under outpatient department basis by convenient sampling method. All women between the age group of 24 to 75 years were included in the study and classified as perimenopausal, Menopausal and Post-Menopausal. Predesigned questionnaire was used to collect data. An informed consent was obtained prior to the start of the study. Serum calcium levels was estimated by photocolormetry method. Data was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test, ANOVA test and Pearson Correlation was used as test of significance. p value <0.05 was considered as statistically significant.

|                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| <b>Results:</b> Mean age of Premenopausal women was $33.81 \pm 4.29$ years, Perimenopausal was $44.44 \pm 3.40$ years and post-menopausal women was $59.82 \pm 6.88$ years. Mean calcium levels among Premenopausal women was $9.175 \pm 0.398$ mg/dl, among Perimenopausal women was $9.032 \pm 0.386$ mg/dl and among | Postmenopausal women was $8.897 \pm 0.419$ mg/dl. There was significant difference in calcium levels between three groups. There was significant negative correlation between age and calcium ( $r = -0.398^*$ ).<br><b>Conclusion:</b> From the study findings it was concluded that women in Perimenopausal state and post menopause had significantly lower serum calcium levels compared to premenopausal women. Irrespective of menopausal state with increase in age there was decrease in serum calcium levels among women.<br><b>Keywords:</b> Serum Calcium, premenopausal, perimenopausal, postmenopausal |
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## Introduction:

Osteoporosis is a silent disease; if it remains undiagnosed and untreated nearly 60% of women will sustain fragility fractures during their life time.<sup>1</sup> The reported prevalence of osteoporosis among Indian women varies between 53% to 81%.<sup>2,3</sup> The current life expectancy for India in 2022 is 70.19 years.<sup>4</sup> There is a steady rise in the proportion of elderly population throughout the world.

Projections indicate that, globally, the life expectancy is expected to increase to 77.1 years in 2050.<sup>5</sup> In India, the life expectancy is expected to increase to 71 years by 2025 and to 77 years by 2050.<sup>6</sup> With increasing life-expectancy more women are going to be diagnosed with osteoporosis and its associated morbidity. Most often, the diagnosis of osteoporosis is made only after the occurrence of the fractures. Osteoporosis related fractures can be prevented, if osteoporosis is diagnosed and treated early.

Calcium ion is an essential structural component of the skeleton. There is growing evidence for the importance of nutrition in the maintenance of bones and joints health. Nutrition imbalance with endocrine abnormalities may be involved in osteoporosis.<sup>7,8</sup> and also controls the timing of osteoclast apoptosis. Estrogen deficiency, therefore, results in a longer life span of osteoclasts.<sup>9</sup> In female, at the age of 40–50 years, the monthly menstrual cycle becomes irregular, ovulation fails to occur during many cycles, and ultimately, there is cessation of the cycle which is called menopause. The female sex hormone diminishes to almost nil. In woman, the two major causes of bone loss are estrogens deficiency after menopause and age-related process.<sup>10</sup> Calcium is obtained from the diet through dairy as well as from non-dairy sources. The bioavailability of calcium from dairy sources is much higher than non-dairy sources. Several studies have reported that Indian diet does not meet the recommended dietary allowance of 600 mg/day of calcium for adult women, which has been recommended by Indian council of medical research.<sup>11</sup> Milk and milk product are expensive commoditize, and amount purchased by the lower socioeconomic classes are likely to be merger.<sup>12</sup> Further, unequal distribution of milk and milk product between male and female is another factor for worsening the situation. The difference in calcium intake between sexes is high in lower socioeconomic classes. Indian diets are predominantly vegetarian, and the contribution of dairy products to the overall calcium intake is minimal in the lower socioeconomic classes. Phytate and oxalate in fibre rich Indian diet also retard the absorption of calcium.<sup>13,14</sup> Government supplementation program provides pregnant and lactating mother with 500 mg/day of calcium through a serving of 165 g of micronutrient of fortified food per day; however, there is no national program for supplementation of calcium for promotion of bone health.<sup>15</sup> Hence this study was conducted in the present institute with the objective to determine serum calcium levels in premenopausal, Perimenopausal and postmenopausal women and to correlate serum calcium levels with respect to age.

### Material and Methods:

A cross sectional study was conducted among 350 women in the Department of Obstetrics and Gynecology under outpatient department basis by convenient sampling method. Out of these 80 were premenopausal between the age of 24 to 39, 73 were perimenopausal who were in the age group of 40 to 50 who had not yet attained menopause and 197 were postmenopausal who were between the age of 46 to 75 who had attained menopause with cessation of menstruation for at least one year. All women between the age group of 24 to 75 years were included in the study. Surgical menopause or women who have undergone hysterectomy, Postmenopausal women on any kind of hormone therapy, Women with other co-morbidities like diabetes, hypertension, thyroid disorders, Women with fractures, Pregnant women and Lactating women were excluded from the study. Predesigned questionnaire was used to collect data. An informed consent was obtained prior to the start of the study from these women. **Methods:** All women underwent a blood test, 5ml of venous blood was drawn undertaking all necessary aseptic precautions. Blood was sent to the laboratory, where it underwent centrifugation at 3000rpm for about 10 minutes until the serum was separated. This serum was then used to estimate the serum calcium levels by photocolormetry method. **Statistical analysis:**<sup>16,17</sup> Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software (IBM SPSS Statistics, Somers NY, USA). Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Normality of the continuous data, was tested by Kolmogorov–Smirnov test and the Shapiro–Wilk test. ANOVA (Analysis of Variance) was the test of significance to identify the mean difference between more than two groups for quantitative data. Post Hoc Bonferroni test was used to determine the intergroup analysis. Pearson or Spearman's correlation was done to find the correlation between two non-parametric data. p value <0.05 was considered as statistically significant after assuming all the rules of statistical tests.

### Results:

In the present study 80 (22.9%) were premenopausal women, 73 (20.9%) were Perimenopausal women and 197 (56.3%) were post-menopausal women.

Mean age of Premenopausal women was  $33.81 \pm 4.29$  years, Perimenopausal was  $44.44 \pm 3.40$  years and post-menopausal women was  $59.82 \pm 6.88$  years [Table 1].

**Table 1: Age distribution between three groups**

|       |                | Age   |       |        |         |         |
|-------|----------------|-------|-------|--------|---------|---------|
|       |                | Mean  | SD    | Median | Minimum | Maximum |
| Group | Premenopausal  | 33.81 | 4.29  | 34     | 23      | 41      |
|       | Perimenopausal | 44.44 | 3.40  | 44     | 40      | 56      |
|       | Postmenopausal | 59.82 | 6.88  | 60     | 43      | 79      |
|       | Total          | 50.67 | 12.40 | 51     | 23      | 79      |

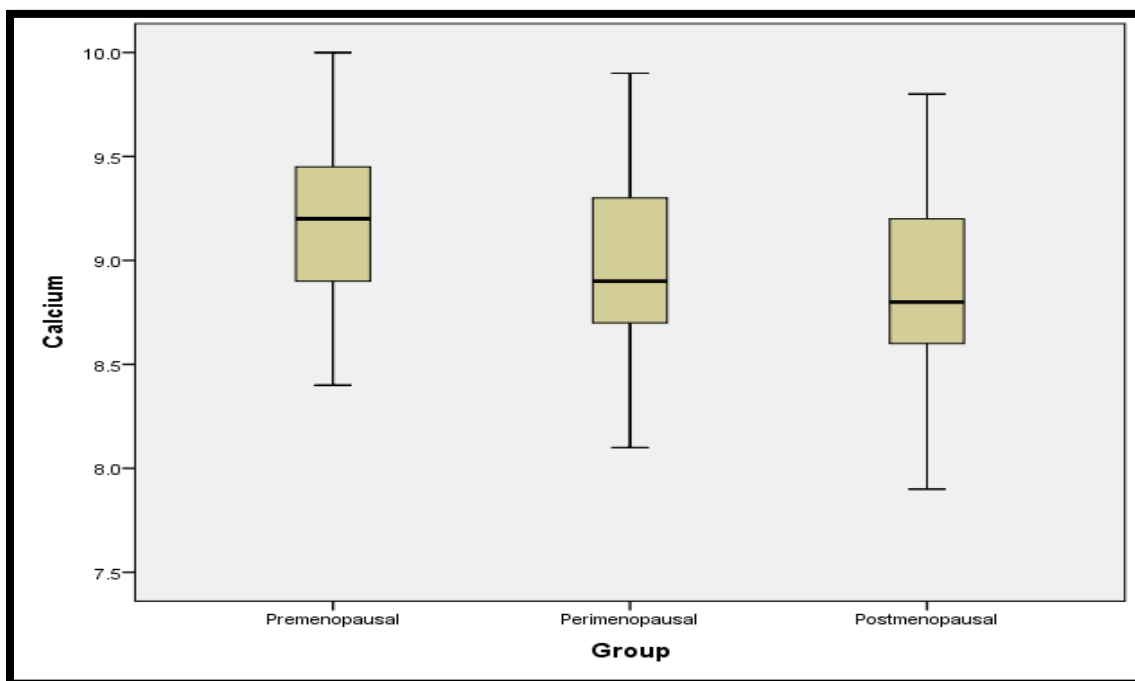
**Table 2: Mean Calcium comparison between three groups**

|       |                | Calcium |       |        | P value b/w 3 groups |
|-------|----------------|---------|-------|--------|----------------------|
|       |                | Mean    | SD    | Median |                      |
| Group | Premenopausal  | 9.175   | 0.398 | 9.2    | <0.001*              |
|       | Perimenopausal | 9.032   | 0.386 | 8.9    |                      |
|       | Postmenopausal | 8.897   | 0.419 | 8.8    |                      |
|       | Total          | 8.989   | 0.422 | 8.9    |                      |

|                                  |         |
|----------------------------------|---------|
| P value with in the group        |         |
| Premenopausal vs Perimenopausal  | 0.092   |
| Premenopausal vs Postmenopausal  | <0.001* |
| Perimenopausal vs Postmenopausal | 0.051   |

#### ANOVA Test and Post Hoc Bonferroni test

Mean calcium levels among Premenopausal women was  $9.175 \pm 0.398$  mg/dl, among Perimenopausal women was  $9.032 \pm 0.386$  mg/dl and among Postmenopausal women was  $8.897 \pm 0.419$  mg/dl. There was significant difference in calcium levels between three groups. More specifically between Premenopausal and Postmenopausal women. There was no difference in calcium levels between Premenopausal and Perimenopausal women Perimenopausal and Postmenopausal women [Table 2].



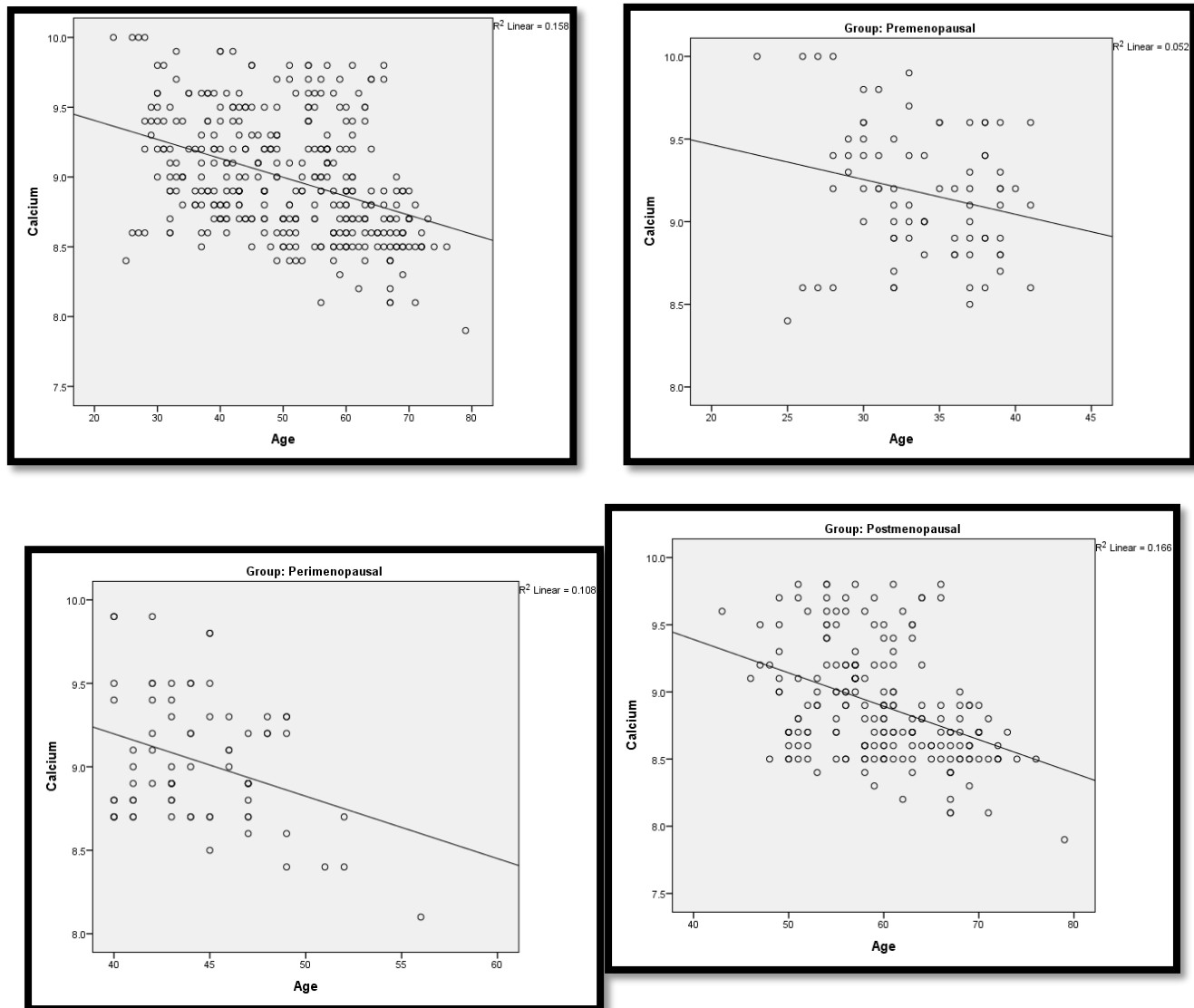
**Figure 1: Box plot showing Median Serum Calcium values between three groups**

**Table 3: Correlation between Age and Serum Calcium**

|     |                         | All subjects | Premenopausal | Perimenopausal | Postmenopausal |
|-----|-------------------------|--------------|---------------|----------------|----------------|
| Age | Pearson Correlation (r) | -0.398**     | -0.227        | -0.328**       | -0.407         |
|     | P value                 | <0.001*      | 0.043         | 0.005          | <0.001*        |
|     | N                       | 350          | 80            | 73             | 197            |

\*\*. Correlation is significant at the 0.01 level (2-tailed).

In the study there was significant negative correlation between age and calcium. I.e. with increase in age there was decrease in calcium and vice versa. In the Premenopausal group, Perimenopausal group and Postmenopausal group there was negative correlation between Age and calcium levels i.e. with increase in age there was decrease in calcium levels and vice versa[Table 3].



**Figure 2: Scatterplot showing negative Correlation between age and calcium**  
**a. Overall, b. Premenopausal group, c. Perimenopausal group, d. Postmenopausal group**

### Discussion:

This cross-sectional study was conducted among premenopausal, Perimenopausal and postmenopausal. In the present study 80 (22.9%) were premenopausal women, 73 (20.9%) were Perimenopausal women and 197 (56.3%) were post-menopausal women. Mean age of Premenopausal women was  $33.81 \pm 4.29$  years, Perimenopausal was  $44.44 \pm 3.40$  years and post-menopausal women was  $59.82 \pm 6.88$  years. Mean calcium levels among Premenopausal

women was  $9.175 \pm 0.398$  mg/dl, among Perimenopausal women was  $9.032 \pm 0.386$  mg/dl and among Postmenopausal women was  $8.897 \pm 0.419$  mg/dl. There was significant difference in calcium levels between three groups. There was significant negative correlation between age and calcium. I.e. with increase in age there was decrease in calcium and vice versa.

In a similar study by **AchieLN et al**,<sup>18</sup> mean age of premenopausal women was  $33.60 \pm 4.59$  years, peri menopausal women was  $46.00 \pm 5.80$  years and Post-Menopausal women was  $57.67 \pm 9.19$  years. **Bagade MB et al**,<sup>19</sup> observed that, mean age of Pre-menopausal women was  $36.73 \pm 3.8$  years and among Post-menopausal women was  $53.64 \pm 6.30$  years.

**AchieLN et al**,<sup>18</sup> observed that Mean serum calcium levels were slightly lower amongst both postmenopausal and perimenopausal subjects,  $2.30 \pm 0.35$  mg/dl and  $2.36 \pm 0.13$  mg/dl respectively as compared with the premenopausal women  $2.37 \pm 0.15$  mg/dl. The values of serum calcium was lower compared to the present study, which could be attributed to the metallochromogen Arsenazo III principle used to estimate serum calcium.

**Kumari A et al**,<sup>20</sup> in their study observed that mean serum calcium levels among Premenopausal women was  $8.2 \pm 5.7$  mg/dl and among post-menopausal women was  $7.6 \pm 7.1$  mg/dl. Significant difference was noted between two groups similar to the present study. Serum calcium levels were slightly lower compared to the present study calcium levels. In a similar study by **Bagade MB et al**,<sup>19</sup> mean calcium among premenopausal women was  $10.07 \pm 0.66$  (mg/dl) and among post-menopausal women was  $8.4 \pm 0.076$  (mg/dl). Significant difference was noted between two groups similar to the present study.

**Bhattarai et al**,<sup>21</sup> observed a similar lower serum calcium in postmenopausal women. **Kalita et al**,<sup>22</sup> also reported a marked significant decrease in serum calcium in postmenopausal women as compared with their premenopausal subjects. However, another study in Nigerian menopausal women by **Usoroet al**,<sup>23</sup> reported a significantly higher mean serum calcium levels in the postmenopausal women as compared to the premenopausal women.

Inferring that menopause alters the metabolism of calcium. Some of the mechanisms include diminished dietary intake of calcium containing foods. Dairy products, meat and some vegetables serve as sources of calcium. Other factors reported to influence calcium homeostasis in menopause include increased urinary excretion of calcium, which is both menopause and age related. A decrease in intestinal absorption of calcium is also reported in menopause and declining levels of vitamin D is implicated.

**Conclusion:** From the study findings it was concluded that women in Perimenopausal state and post menopause had significantly lower serum calcium levels compared to premenopausal women. Irrespective of menopausal state with increase in age there was decrease in serum calcium levels among women. Hence women in these age groups should receive calcium supplementation and also should be advised to consume calcium from dietary sources. This can prevent osteoporosis and other complications among women.

**Limitations:** Influence of other factors such as dietary uptake, dietary supplements could not be studied. Selection bias cannot be ruled out due to convenient sampling method.

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