

CORRELATION OF SERUM CALCIUM AND BONE MINERAL DENSITY IN ADULT FEMALES

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ABSTRACT

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Background: The episodes of fracture are increasing steadily in women even before menopause due to deficiency or malabsorption of calcium. Thus, causing detrimental effect on the bone mass. **Objective:** This study was done to assess the correlation of serum calcium with bone mineral density (BMD) in adult females. **Materials and Method:** This work was done in a cross sectional manner in the Physiology Department of Dhaka Medical College from July 2018 to June 2019. Based on inclusion and exclusion criteria with age range of subjects from 18-44 years, the study involved 122 adult females residing from various regions of Dhaka city. The subjects were interviewed in details regarding personal, dietary, family and history of drug consumed. A written consent was taken from the participants before the sample was collected. The eligible subjects were advised for measurement of bone mineral density. Data were noted in a pre-designed structured data collection form. For statistical analysis, Pearson's correlation coefficient (r) was performed as applicable using SPSS for windows version 25.0. **Results:** The mean ($\pm$ SD) serum calcium and BMD T score of lumbar spine were 8.3 ± 0.28 mg/dl and -1.2 ± 0.75 respectively. We found a positive correlation ($r = +0.69$) between both the study parameters which was statistically significant ($p < 0.05$). **Conclusion:** After scrutinizing the outcome of the study, it is found that decreased serum calcium is associated with decreased bone mineral density among the adult females.

Keywords: Serum calcium, Dietary calcium, BMD, Reproductive age, Females.

INTRODUCTION

Bone is a metabolically active tissue that is remodeled continuously for the maintenance of bone health and for the homeostasis of phosphorus and calcium¹. Bone density is defined as the grams of calcium present per square centimeter of the bone². The attainment of maximum strength and density of a bone is known as peak bone mass. The peak bone mass is a measurable factor that is attained by 18 years in girls and 20 years in boys³. According to the World Health Organization (WHO), an increase of peak bone mass of 10% would delay the bone loss by 13 years⁴.

Bone loss is a natural phenomenon of aging process and occurs in both genders⁵. An average of 0.7% of bone loss occurs normally per year⁶. Life time loss may cumulate to 30-40% in women and 20-30% in men⁷. If peak bone mass is not achieved during adolescent life than it increase the chances of developing early osteoporosis².

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Dietary calcium intake is also important for the maintenance of ideal bone health⁸. Diets rich in calcium such as milk and milk products, fresh fish, dry fish, shrimp and leafy vegetables mainly dark green colored are recommended to women of reproductive age⁹. The Food and Nutrition Board in Asia has stated that the recommended daily allowance of calcium for adult females is 400-500 mg/day⁸. Several studies done in Bangladesh have shown inadequate intake of calcium in their diet¹⁰⁻¹². Bangladeshi staple food is rice that contains phytate and dark leafy vegetables is rich in oxalate. The contents of the staple food act as calcium chelating agents^{9,13}. Even the widespread use of cheap fertilizers and pesticides like cadmium, used in cultivating rice interferes with the absorption of nutrients¹³.

Serum calcium is an important biochemical parameter which gives us an idea about the integrity of the bone¹⁴. Bone mineral content are measured at the femur and lumbar spine region using dual energy X-ray absorptiometry method. It is the most acceptable method used worldwide which helps to predict the risk of fracture^{15,16}. The results are then expressed in 'T' score. 'T' score indicates the difference of patient's measured BMD with the ideal peak bone mass of a young healthy adult of matched gender and ethnic group¹⁷. According to WHO, the diagnostic guidelines for osteoporosis is 'T' score from + 2.5 to -1 is normal; score -1 to -2.5 is osteopenia and 'T' score -2.5 or below is osteoporosis¹⁸. Many researchers of different countries have performed studies to evaluate the relation between serum calcium and bone mineral density among population of all age groups. So this study is carried out to find the correlation between serum calcium with bone mineral density among adult females.

MATERIALS AND METHOD

Study design

The study was performed in cross sectional manner.

Study place and period

The place of study was Physiology Department, Dhaka Medical College, Dhaka, Bangladesh from 2018 July to 2019 June.

Study Population

The study population consisted of 122 females.

Recruitment of participants

The procedure, benefits and main focus of the research was explained in details before the participants were incorporated into the study. Before being recruited, the individuals signed an informed written consent.

Criteria of selection

Inclusion criteria- The subjects were females between 18-44 years of age with normal Body Mass Index (BMI)¹⁹.

Exclusion criteria- Subjects with history of chronic inflammatory disease, chronic disease of liver, chronic kidney disease, diabetes, thyroid disease, hypertension, any bone disease, malignancy and trauma were not incorporated in the study. Also excluded were those having history of acute infection, taking medications like vitamin D, calcium, long time use of steroid (5mg/day for last 3 months) and anticonvulsant and thiazide diuretics. Pregnant, lactating mothers were not recruited in this research.

Sampling technique

Subjects were selected randomly.

Data collection

The recruits were interviewed in details regarding their personal, socioeconomic status, dietary, medical, drug and family history. The subjects' height and weight were measured and BMI was calculated. Recording of the radial pulse and blood pressure were done. The particulars of the subject were noted in an already prepared questionnaire.

Sample collection and analysis

After taking all the required precautions, blood was collected from antecubital vein of the participants. To fulfill the inclusion and exclusion criteria necessary blood works were done. Serum calcium was evaluated by calcium method in Automated Biochemistry Analyzer. BMD measurement was performed using QDR-2000 (Hologic, USA) constructed on the principle of Dual Energy X-ray Absorptiometry (DEXA) method performed in the Institute of Nuclear Medicine and Allied Sciences (INMAS), Dhaka Medical College.

Ethical approval

The research work was commenced after acquiring the ethical clearance certificate from the Research Review and Ethical Review Committee board of Dhaka Medical College, Dhaka.

Statistical analysis

For statistical analysis SPSS (Statistical Package for Social Sciences) version 25.0 was used. The outcomes were expressed in mean with standard deviation (mean $\pm$ SD). Pearson's correlation coefficient (r) test was done to evaluate the relation between serum calcium and BMD. A p value < 0.05 is considered statistically significant.

RESULTS

Mean ($\pm$ SD) of age, BMI, systolic and diastolic blood pressure are shown in Table 1. The mean ($\pm$ SD) serum calcium level is 8.3 ± 0.28 and the mean ($\pm$ SD) BMD T score in lumbar spine is -1.2 ± 0.75 shown in Table 2. The results showed positive correlation between serum calcium level and BMD T score in lumbar spine which was statistically significant ($r = +0.69$, $p < 0.05$) shown in Table 3 and Figure 1.

Table 1: General characteristics of the study subjects (N=122)

Parameters	Mean $\pm$ SD
Age (years)	28.09 ± 4.713
BMI (kg/m^2)	23.77 ± 1.35
Systolic pressure (mmHg)	113.28 ± 12.18
Diastolic pressure (mmHg)	70.78 ± 9.05

Expressed as mean $\pm$ SD; N = total subjects; BMI = body mass index

Table 2: Study parameters of the subjects (N=122)

Parameters	Mean $\pm$ SD
S. calcium (mg/dl)	8.3 ± 0.28
BMD (T score) Lumbar spine	-1.2 ± 0.75

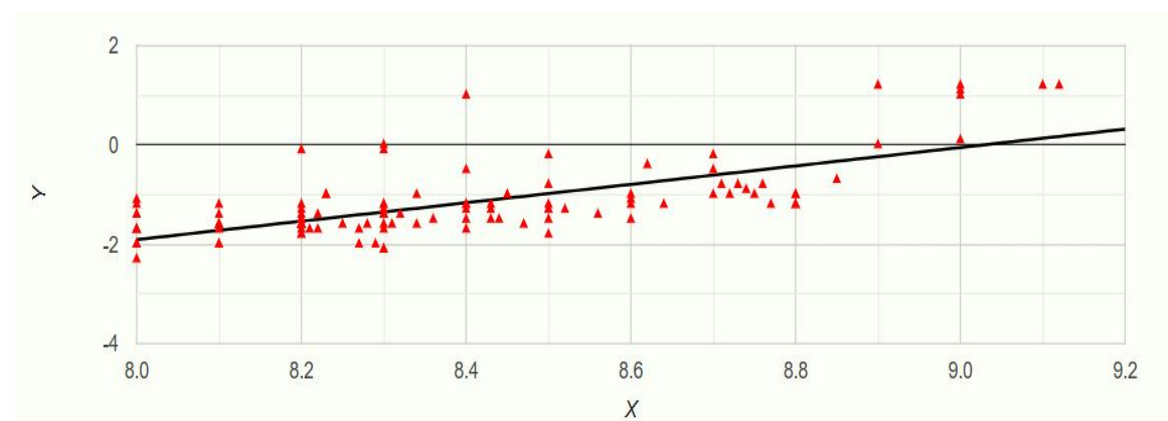
Expressed as mean $\pm$ SD; N = total subjects; BMD = Bone Mineral Density

Table 3: Correlation of serum calcium with BMD T score in study subjects (N=122)

Parameters	r value	p value
Serum calcium with BMD (T score) lumbar spine	+ 0.69	< 0.05

N = total subjects; BMD=Bone Mineral Density

Pearson's correlation coefficient (r) test was performed to observe relationship among serum calcium and BMD T score. The test of significance was calculated and p value<0.05 was accepted as level of significance; N= total subjects; BMD=bone mineral density

**Figure 1: Correlation of serum calcium with BMD T score in study subjects (N=122).**

Y value- BMD T score; X value- serum calcium vs BMD T score; $r = +0.69$, p value < 0.05

DISCUSSION

Osteoporosis is a disorder of the skeleton system characterized by impairment of bone mass, micro-architecture and strength that increases the susceptibility of fracture. The bone loss occurs gradually but it remains undiscovered for many years²⁰. Osteopenia is also a condition of the bone with diminished calcification that causes decrease in its density or mass²¹. Bone plays a crucial part in maintenance of blood calcium level and calcium homeostasis⁸. The bone calcium content depends on the availability of calcium in the diet, amount of calcium being absorbed and excreted by the intestine²².

The mean ($\pm$ SD) of serum calcium and BMD (T score) lumbar spine were 8.3 ± 0.28 mg/dl and -1.2 ± 0.75 respectively. The intake of dietary calcium was found much below the recommended quantity among the population being studied. The National Micronutrients Status Survey done in 2011 in icddr, b on 631 non-pregnant non-lactating reproductive women residing in rural, urban and urban slums of Bangladesh the mean serum calcium was 8.9 mg/dl²³.

The low intake of food rich in calcium for a prolonged period of time might have had an adverse effect on the bone mass among our study subjects. Alekel et al. has stated that the risk of osteoporosis was found more in the Indian premenopausal women in comparison to American Caucasians due to the differences in dietary habits and genetic constitution²⁴. Shatrugna et al., 2005 also reported that Asians from the south were more susceptible to bone fragility than the western Caucasians which occurred 10-20 years advanced due to low peak bone mass, early menopause and other underlying reasons²⁵.

The aim of the present study was to explore the correlation between serum calcium and BMD among adult females. The result showed a positive correlation between the study parameters ($r = +0.69$, p value < 0.05). In accord with the study results, similar type of observation was found by other researchers^{8,9,14,22,26,27}. Liu et.al 2019 found negative association between the parameters in their study. This may be due to the heterogeneity among the research work which includes the differences in study population like age and ethnicity, study design, sample size²⁸

LIMITATIONS

Since this is a cross-sectional study, the influence of blood calcium levels on BMD over time could not be assessed. Similarly the causality could not be determined. Also excluded from the study were patients suffering from malignancy as in such cases there is major influence on BMD and serum calcium. Thus the conclusion of this study may not be used for them.

CONCLUSION

A positive correlation was found between low serum calcium and low bone mineral density in the study subjects after the results were analyzed. Therefore, to preserve bone health, early measures could be taken by providing sufficient information about the importance of calcium in our well-being. Easy, accessible and cost effective calcium rich food can be enhanced by introducing large scale dairy farming, fish and poultry farming and home gardening.

CONFLICT OF INTEREST

There is no conflict of interest.

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