

**Original article**

## Study of Serum Calcium and Magnesium Levels in Geriatric Population

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### Abstract

**Introduction:** The increasing number of elderly is well perceived in Indian society. Among various diseases which are common in old age like osteoporosis, cataract, hypertension etc. homeostatic alteration in calcium and magnesium distribution is seen. But there exists paucity of evidence as to whether alteration in Calcium and magnesium homeostasis is the cause or the effect of these diseases. Thus the aim of this study is to ascertain the levels of serum total and ionized calcium and serum magnesium in healthy ambulatory elderly population and to view the alterations if any.

**Materials and Methods:** In the present study 82 apparently healthy subjects were selected and serum Calcium (Total and Ionized) and serum Magnesium levels were measured using standard methods. These 82 subjects were categorized into two groups: Group I (n = 40), (Age 60 – 70 years) and statistically compared with that of Group II (n=42), (Age 30 – 40 years) by using t- test.

**Results:** Serum Total Calcium and Ionized Calcium levels were reduced significantly ( $p < 0.05$ ) whereas serum magnesium revealed no significant difference in Group I subjects when compared to Group II subjects.

**Conclusions:** There are statistically significant altered serum calcium levels in the geriatric population. We as healthcare providers must be aware of these alterations to prevent further complications by guiding the preventive and therapeutic principles based on the evidence.

**Keywords:** Geriatric, Serum Calcium, Ionized calcium, Magnesium.

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### Introduction:

Geriatric health was never so important as it is today, due to the fact that advances in medicine have resulted in increased longevity in population worldwide. Hence today, the faster growing population than any other age group is older people.<sup>1</sup> Thus, it has become mandatory to study the molecular changes that results in aging.

In India about 8.0% of its total population comprises of elderly, i. e., people above the age of 60 years and this has been projected to increase to 19% in the upcoming four decades.<sup>2</sup>

Aging is universal phenomenon. Alteration in hormonal, salt and water homeostasis has been found to be a major event in the progression of aging. The biological changes associated with ageing that lead to functional deterioration of organs with an increased susceptibility to disease increases the risk of electrolyte imbalance especially that of Sodium ( $\text{Na}^+$ ), potassium ( $\text{K}^+$ ), magnesium ( $\text{Mg}^{++}$ ), and calcium ( $\text{Ca}^{++}$ ) in elderly persons. These four elements ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{++}$  and  $\text{Ca}^{++}$ )

have significant role in maintenance of homeostasis by participating in various physiological activities and thus their altered levels may induce series of events leading to progression of aging and irreversible damage to vital organs which may have serious implications in the aged.<sup>3</sup>

Also there is altered levels of hormone resets in ageing. Such as relationship between calcium and parathyroid hormone is altered with ageing.<sup>4</sup> The elderly patients on diuretics may suffer from decreased serum magnesium levels.<sup>5</sup> Also there are altered levels of serum calcium and magnesium in postmenopausal women with osteoporosis.<sup>6</sup>

Thus there have been numerous studies on the patients of geriatric wards which shows that the age related alterations in conditions of stress predisposes elderly to altered levels of serum sodium, potassium and magnesium and also there is a mal-distribution of calcium. These altered levels are also implicated in the pathogenesis of various diseases like osteoporosis, senile cataract, diabetes mellitus, hypertension, etc. which are again common in old age.<sup>6-9</sup>

But there is limited evidence on alterations in serum electrolyte levels in healthy, ambulatory elderly Indian population which are apparently not under any physical stress. This approach can help in understanding the alterations, if any, in electrolyte homeostasis that occurs in aged is a cause or the effect of various diseases associated with ageing and will make healthcare providers familiar with these alterations. Thus an analytical case-control study was undertaken.

**Aim and Objectives:** Aim is “To study the levels of serum total and ionized Calcium and serum Magnesium in elderly population” and the objectives were to estimate the levels of serum total and ionized calcium and serum magnesium in healthy asymptomatic elderly population and to compare them with healthy young adults.

**Material and Methods:** The study was conducted as a community based analytical case - control study. The proposal of the study was put forth to the ethical committee of the institute and necessary permissions and clearance were obtained.

- **Study Population:**-The study population was derived from the apparently healthy ambulatory persons from urban area of Pune city. These subjects were selected randomly and categorized into two groups depending on their age. Group I, i.e., study group consisted of 40 elderly ambulatory individuals of either sex between the age of 60 years to 70 years and the Group II, i.e., control group consisted of 42 young ambulatory individuals of either sex between the age 30 years to 40 years.
- **Inclusion and Exclusion criteria:**-All the participants included in the study were non-diabetic,

non-hypertensive, were not on any medications or supplements and were without any documented acute or chronic systemic illness and were apparently free from signs and symptoms suggestive of the same. A written informed consent in their local language was obtained from all the eligible individuals. Individuals who were on medications or with some apparent or documented acute or chronic illness and those who were not willing were excluded from the study.

- **Sample Collection:**- Fasting venous blood samples were collected from the ante-cubital vein without tourniquet into 3 ml plain conical centrifuge capped tube filled till brim for estimation of ionized Ca<sup>++</sup> for the purpose of anaerobic sampling<sup>10</sup> which is a pre-requisite or crux of estimation of ionized Ca<sup>++</sup>. The remaining sample was used for estimation of serum total Ca<sup>++</sup>, serum Mg<sup>++</sup>.The samples were allowed to clot and serum was separated within 30 – 45 minutes of collection and processed immediately on the same day.
  - Serum ionized (Free) Ca<sup>++</sup>-measured by Ion Selective Electrodes<sup>10</sup>
  - Serum total Ca<sup>++</sup> - measured by Photometric method (Arsenazo III Method)<sup>11</sup>
  - Serum Mg<sup>++</sup> - measured by Photometric method (Calmagite Method).<sup>12,13</sup>

Analysis of the data was done and the means of the two groups were compared by students’ unpaired t-test.

**Observations and Results:** The mean age and standard deviation of study group and control group were 65 ± 2.9 years and 33.9 ± 3.3 years respectively.

Table No. 1

Age distribution and number of study population:-

Study population	Group I	Group II
Age	60 – 70 years	30 – 40 years
Number	40	42

Table No. 2

Levels of serum total Ca<sup>++</sup>, ionized (free) Ca<sup>++</sup>, Mg<sup>++</sup> in terms of Mean ± S.D. and its group distribution:-

Study group	Group I(n = 40)	Group II(n = 42)	P Value
Serum total Ca <sup>++</sup> (mmol/l)	2.28 ± 0.14*	2.35 ± 0.13	0.023
Serum ionized Ca <sup>++</sup> (mmol/l)	1.13 ± 0.06*	1.16 ± 0.06	0.016
Serum Mg <sup>++</sup> (mmol/l)	0.82 ± 0.07	0.83 ± 0.09	0.85

\*P < 0.05 - statistically significant

Mean ± S.D. values given in table no.2 on statistical analysis shows

- Statistically significant decrease in serum total calcium and ionized calcium in Group I as compared to Group II. (P < 0.05 for both total and ionizedCa<sup>++</sup>)
- Decreased levels of serum Mg in Group I than Group II, but the decrease was statistically non-significant (P > 0.05).

**Discussion:**

**Calcium:-**Altered calcium homeostasis has been linked to various disorders like hypertension, cardiovascular disorders because of the disturbances in vascular smooth muscle excitation and contraction and negative calcium balance and bone loss leading to osteopenia and osteoporosis etc. which are again usually associated with ageing.<sup>14,15</sup>

Our study shows that there is a significant decrease in serum calcium (Ca<sup>++</sup>) concentration, both total and ionized (or free) in the elderly group as compared to the younger group though the values for both total and ionized calcium in elderly were within the normal range.

Studies have indicated that there are age related changes in absorption of calcium. Calcium absorption efficiency decreases with age; after the age of 40 years at a rate of about 0.21% per year.<sup>16, 17</sup> Further the elderly persons may have poor adaptation to lower dietary calcium intakes. As in the normal elderly there is an age related decrease in the activity of 1-α-hydroxylase enzyme in the kidney leading to low serum 1, 25(OH)<sub>2</sub>D levels and decreased 1,25(OH)<sub>2</sub>D : 25(OH)D ratio which suggests inadequate metabolism of 25(OH)D to 1,25(OH)<sub>2</sub>D.<sup>16</sup> The resultant decrease of 1, 25(OH)<sub>2</sub>D may contribute to reduced calcium absorption and adaptation.

Decreased absorption may lead to lower serum calcium levels, but still it may remain within normal range only at the expense of chronically elevated levels of calcium regulating hormones such as parathyroid hormone (PTH). Some workers has also observed decreased 25(OH)<sub>2</sub>D; and a significant negative correlation has been observed between PTH and 25(OH)<sub>2</sub>D leading to increased serum PTH in elderly. Serum PTH is also inversely related to serum ionized calcium.<sup>4, 18, 19</sup> Thus the relationship between PTH and serum calcium is altered in ageing. Thus the low total and ionized calcium values in serum in elderly can be due to decreased calcium intake, and defective 25(OH)D metabolism due to decreased activity of 1-α-hydroxylase but remain within normal range due to increased levels of serum PTH in elderly.

Further it has been shown that there is an age related decrease in serum albumin levels in elderly which can also influence the measured levels of serum ionized calcium leading to hypocalcaemia due to hypoalbuminaemia.<sup>20,21</sup>

Our finding of decreased serum ionized calcium levels in elderly as compared to younger subjects is consistent with Barbagallo et al<sup>9</sup> and that of decreased serum total Calcium is in contention with Saxena et al<sup>3</sup> and Stefikova et al<sup>14</sup>. Whereas

no significant age difference in serum calcium level was found by Bohnenet al<sup>22</sup>.

**Magnesium:-**Magnesium deficit may participate in the clinical pattern of ageing, particularly in neuromuscular, cardiovascular and renal symptomatologies. Magnesium deficit is important in the etiology of insulin resistance, adrenergic, osseous, oncogenic, immune and oxidant disturbances of ageing.<sup>23</sup>

In this study we did not find any significant difference in serum magnesium levels between Group I and Group II. This finding of ours is in contention with N Bohnen and associates<sup>22</sup> who did not find any significant age or sex differences for serum magnesium in elderly. Mladenet al<sup>24</sup> also showed that there are no differences in serum magnesium in elderly as regards to age group and gender.

Stefikovaet al<sup>14</sup> has shown that there is decreased urinary excretion of magnesium in ageing but plasma magnesium levels does not depend on the age. Whereas Saxena R and Lal A M<sup>3</sup> showed that there are decreased serum magnesium levels in elderly as compared to young group.

Barbagalloet al<sup>25</sup> stated that ageing constitutes a risk factor for primary or secondary magnesium deficit. Still total plasma magnesium levels remain remarkably constant in healthy subjects, while total body magnesium and intracellular magnesium tend to decrease with age. Since we have not measured intracellular magnesium, maybe we could not document the magnesium deficit in elderly.

#### **Conclusion:**

This study concludes that there are differences in serum Calcium levels (both in total as well as ionized) in ambulatory geriatric population as compared to younger individuals due to altered homeostatic mechanisms and this difference may become clinically significant especially during the periods of physical stress leading to adverse outcomes. Thus health care providers should take into consideration these changes during the treatment of this vulnerable population. And also the role of calcium supplements in elderly diet is to be considered since previous studies have indicated the decreased serum PTH levels in elderly with calcium supplements.

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