

**A STUDY OF ASSOCIATION OF SERUM CALCIUM WITH BLOOD PRESSURE****VITTAL B.G.\*<sup>1</sup> AND NAVEENKUMAR G.H.<sup>2</sup>**<sup>1</sup> Associate Professor of Biochemistry, Bidar Institute of Medical Sciences, Bidar<sup>2</sup> Assistant Professor of Community medicine, Bidar Institute of Medical Sciences, Bidar**ABSTRACT**

Hypertension is a global epidemic. In India hypertension is attributable to 10% of all deaths. Langford and Watson in 1972 hypothesised that hypertension is directly proportional to sodium intake and inversely proportional to calcium intake. Many studies have been conducted to elucidate the role of calcium in pathogenesis of hypertension. The present study aims to assess the association of serum calcium with blood pressure in normotensives, prehypertensives and hypertensives. One hundred patients who met inclusion/exclusion criteria and consented formed study population. Blood pressure of participants was measured and their serum calcium was estimated. In normotensives, a statistically significant positive association was observed between diastolic blood pressure and serum calcium. In stage 1 hypertensives, systolic blood pressure showed a significant correlation with serum calcium levels. Mean serum calcium levels did not show any increasing or decreasing trend among Joint National Committee 7 sub categories.

**KEYWORDS:** Association, Blood pressure, Correlation, Hypertension.**VITTAL B.G.**

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## INTRODUCTION

Hypertension is a global epidemic. Accordingly it is one of the diseases to be well studied internationally. Globally overall prevalence of raised blood pressure (BP) in adults aged 25 and over was around 40% in 2008 and is rising. Number of people affected with uncontrolled hypertension rose from 600 million in 1985 to 1 billion in 2008. Worldwide raised blood pressure causes nearly 7.5 million deaths, about 12.8% of all deaths.<sup>1</sup> Hypertension is one of the major diseases resulting in cardiac mortality and morbidity.<sup>2</sup> In India hypertension is attributable to 10% of all deaths. The prevalence of adult hypertension has risen from 5% to 20-40% in urban areas and to 12-17% in rural areas.<sup>3</sup> Aetiology of hypertension is not clear in many patients. Many factors like changing lifestyle, dietary habits, type of personality, genetic predisposition, lack of physical activity and electrolytes like sodium, potassium and calcium have been attributed as causative agents. Langford and Watson in 1972 hypothesised that hypertension is directly proportional to sodium intake and inversely proportional to potassium and calcium intake.<sup>4</sup> Since then, many studies have been conducted to elucidate the role of calcium in hypertension. Low serum calcium has been linked to high blood pressure by many researchers.<sup>5,6,7,8</sup> On the contrary; some researchers have demonstrated a positive association of elevated serum calcium with raised blood pressure.<sup>9,10,11,12</sup> Few researchers have reported no association between blood pressure and calcium.<sup>13,14,15,16,17</sup>

### OBJECTIVE

The present study is an effort to enhance our understanding of the pathophysiology of hypertension. It aims to assess the association of serum calcium with blood pressure in normotensives, prehypertensives and hypertensive patients.

## MATERIALS AND METHODS

This prospective study was conducted at regional diagnostic laboratory (RDL) of teaching hospital affiliated to the Bidar

Institute of Medical Sciences, Bidar. The study population was chosen from outpatients who attended RDL for routine investigations and met inclusion and exclusion criteria of the study. Selected subjects were briefed about the study and after written informed consent 100 participants were included in the study. The study included subjects from 20 to 60 years of age. Known hypertensives, patients on calcium channel blockers, oral calcium supplementation, and immobilized patients were excluded from the study. Vulnerable groups like paediatric subjects, pregnant women and psychiatric patients were excluded from the study. A study was conducted, after Institutional ethical committee approval for a period of two months. Our procedures were in accordance with the Helsinki Declaration of 1975, as revised in 2000. After taking brief history, participants were allowed to sit comfortably in a chair for five minutes. Blood pressure was measured two times, by the auscultation method using mercury sphygmomanometer. Korotkoff's first and fifth sounds were considered as criteria for recording Systolic blood pressure (SBP) and diastolic blood pressure (DBP) respectively. The arithmetic mean of the two readings was calculated and used for analysis.<sup>18</sup> Participants were categorised into four classes as per Joint National Committee (JNC)7 classification of blood pressure as Normotensives (SBP/DBP is <120 mm of Hg / and < 80 mm of Hg), Prehypertensives (SBP/DBP is 120-139 mm of Hg / and 80 -89 mm of Hg), Hypertension stage 1 (SBP/DBP is 140 -159 mm of Hg / and 90 - 99 mm of Hg), and Hypertension stage 2 (SBP/DBP is  $\geq$  160 mm of Hg / and  $\geq$  100 mm of Hg).<sup>19</sup> Venipuncture was performed and 2ml of blood was collected into a red stopper vacutainer, a sterile evacuated plastic tube with no additives. Care was taken to avoid venous stasis during blood collection. After standing for thirty minutes at room temperature, samples are centrifuged at 1500g for 15 minutes to separate serum. The necessary precautions are observed to avoid calcium contamination during storage and processing of sample.<sup>20</sup> Serum calcium levels were measured using ERBA transasia kit on ERBA

Chem 5 plus, a semiauto analyser. Calcium kits used for study employed 'O-Cresol Pthalein Complexone (OCPC) method of Moorehead and Briggs.<sup>21</sup>

### Statistical Analysis

IBM SPSS Statistics software version 20 was used to analyse data. The data was analysed to understand the basic characteristics of population and to check for the association between Serum calcium and blood pressure. Results were expressed as a mean  $\pm$  Standard deviation.

## RESULTS

The study included one hundred participants (mean age  $\pm$  Standard deviation of  $39.6 \pm 14.33$  years) of whom 48 were men (mean age  $\pm$  Standard deviation of  $42.96 \pm 13.56$  years) and 52 were women (mean age  $\pm$  Standard deviation of  $36.5 \pm 14.46$  years). The mean systolic blood pressure of the study population was  $124.44 \pm 18.27$  mm of Hg; and mean diastolic blood pressure of the study population was  $81.32 \pm 10.50$  mm of Hg. Mean of serum calcium level of study population was  $10.22 \pm 1.38$  mg/dl. Age sex distribution of the study population is illustrated in Table.1.

**Table 1**  
**Age sex distribution of study population**

Age group in years	Females	Males	Total
20-29	22	12	34
30-39	10	7	17
40-49	5	9	14
50-60	15	20	35
<b>Grand Total</b>	<b>52</b>	<b>48</b>	<b>100</b>

The study population was categorized into four categories as per JNC 7 Classification of blood pressure. Mean SBP, mean DBP and mean serum calcium levels of all categories are illustrated in Table 2. Mean serum calcium levels of the study population among JNC 7 subcategories did not show any increasing or decreasing trend. However statistically significant ( $p < 0.05$ ) difference (increase or decrease) in mean Serum calcium levels between normotensives and Prehypertensives; Prehypertensives and Hypertension stage -1; and Hypertension stage -1 and Hypertension stage -2 was observed.

**Table 2**  
**Serum calcium and blood pressure of categories as per JNC 7 Classification**

JNC 7 Blood Pressure Category (SBP/DBP in mm of Hg)	Men	Women	Total	Mean SBP* (mm of Hg)	Mean DBP* (mm of Hg)	Mean Serum Calcium* (mg/dl)
Normotensives (<120/and <80)	17	27	44	$110.45 \pm 6.62$	$72.90 \pm 4.43$	$10.06 \pm 1.37$
Prehypertensives (120-139/or 80-89)	16	13	29	$123.65 \pm 5.29$	$82.83 \pm 4.39$	$10.35 \pm 1.38$
Hypertensives Stage 1 (140 - 159/ or 90 - 99)	7	9	16	$138.87 \pm 8.51$	$87.63 \pm 6.93$	$10.13 \pm 1.37$
Hypertensives Stage 2 ( $\geq 160/$ or $\geq 100$ )	8	3	11	$161.45 \pm 15.1$	$101.81 \pm 6.2$	$10.65 \pm 1.42$

\* Mean  $\pm$  Standard deviation

In normotensives, a statistically significant positive association was observed between diastolic blood pressure and serum calcium. In stage 1 hypertensives, systolic blood pressure showed a statistically significant correlation with serum calcium levels. When total population was taken into account, statistically significant positive association was noted between serum calcium and diastolic blood pressure. (Table 3)

Table 3

**Association of serum calcium levels with systolic, and diastolic blood pressure across JNC 7 categories (depicted as Pearson's correlation coefficient; r)**

		Normotensive	Prehypertensive	Hypertensive Stage 1	Hypertensive Stage 2	Total Population
Systolic Pressure	Blood	-0.008	0.081	0.516*	-0.343	0.042
Diastolic Pressure	Blood	0.315*	0.156	0.089	0.443	0.221*

\* Statistically significant ( $p < 0.05$ ) Pearson's correlation coefficient (r)

## DISCUSSION

The present study demonstrated a statistically significant association between serum calcium and DBP in normotensives and in the whole study population. In stage 1 hypertensives, SBP showed a statistically significant correlation with serum calcium levels. Serum calcium was not significantly associated with either systolic or diastolic blood pressure in the rest of population categories. An association of diastolic blood pressure with serum calcium levels was also demonstrated by many other researchers.<sup>9, 10, 11, 12, 22</sup> Unlike our study, they demonstrated an association between serum calcium and systolic blood pressure in both sexes<sup>9, 11, 12, 22</sup> or only in men.<sup>10</sup> A weaker correlation was observed in men than in women in a study.<sup>12</sup> However the association was shown to be due to confounders and vanished after adjustment with serum albumin, globulin and haematocrit.<sup>11</sup> A statistically significant positive association of serum calcium with systolic and diastolic blood pressure was noted in normotensives during calcium infusion in a study. It can possibly be explained by diffusion of calcium from the blood to arterial smooth muscle leading to vascular muscle contraction and vasoconstriction causing elevated blood pressure.<sup>23</sup> Few studies, like our study, demonstrated no association between serum

calcium with hypertension.<sup>8, 14, 17</sup> But a study showed an association of hypertension with membrane calcium levels.<sup>16</sup> In our study, mean serum calcium levels did not show any increasing or decreasing trend across JNC 7 blood pressure categories. Statistically significant differences in serum calcium were observed among JNC 7 subcategories in our study. However its causal role in hypertension is not known. Similar observations were also noted in a study in china.<sup>24</sup> However other studies noted that mean serum calcium levels showed an increasing trend with increasing blood pressure in hypertensives.<sup>22</sup> A statistically significant decrease in mean serum calcium level was noted in hypertensives<sup>5, 7</sup> and their first degree relatives when compared with controls of normal blood pressure.<sup>6, 25</sup> The association between serum ionized calcium levels and hypertension was studied by a few researchers who observed negative<sup>7, 8, 15</sup> or no<sup>13, 14, 22</sup> correlation between parameters. Limitations of study: Study had a small sample size and did not take into account of confounders like serum albumin, globulin, haematocrit, and serum parathyroid hormone levels. Small sample size was also a limitation.

## CONCLUSION

Except statistically significant association between serum calcium and DBP in normotensive and between SBP with serum calcium in stage 1 hypertensives, a significant association of serum calcium was not noted with either systolic or diastolic blood pressure in prehypertensives and hypertensives. So serum calcium does not seem to be associated with blood pressure and hypertension.

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