

## Serum calcium and vitamin D level in hypertensive patients and its correlation with severity of disease – a cross sectional study.

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### ABSTRACT

**Background:** Hypertension and its co-morbidities have crippled many in both developed and developing countries. Vitamin D deficiency is an environmental risk factor which serves as a trigger to contribute to the development of hypertension in vulnerable middle-aged people. Vitamin D deficiency causes hypocalcemia, which in turn causes increased secretion of parathyroid hormone, i.e. secondary hyperparathyroidism. Increased parathyroid hormone has direct relationship with development of hypertension. This study was taken up to estimate the level of serum calcium and vitamin D in hypertensive cases and to study the correlation between the level of vitamin D and severity of hypertension.

**Materials and Methods:** It is a cross sectional study conducted in the Dept. of Gen. Medicine, Agartala Government Medical College and GB Pant Hospital from October 2019 to September 2021. Data has been recorded, entered and analyzed with computer using SPSS version 15.0 and Epi-info-version-7. Descriptive statistics and other statistical tests like Chi square test; binary logistic regression analysis etc has been used as per applicability. P value of <0.05 has been considered as statistically significant.

**Result:** In this study, 17% are having low vitamin D3 level, out of which 75% belonged to the age group 50 -70 years. Low calcium level was found in 21% out of which 77% belonged to age group 50 – 70 years. The mean Vitamin D3 (ng/ml) (mean±s.d.) of patients was 38.7835± 9.3486, the mean SBP (mean±s.d.) of patients was 156.4300± 10.7915, the mean DBP (mean±s.d.) of patients was 93.6400± 3.7977. The value of Pearson Correlation Coefficient (r) is .055. The positive correlation is found between calcium(mg/dl) vs vitamin d3(ng/ml). The P-Value is .435. The result is not statistically significant.

**Conclusion:** Increased intake of dietary calcium along with vitamin D supplementation has beneficial effect on prevention of development of hypertension.

**Keywords:** Vitamin D, Calcium, hypertension

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### I. Background:

Burden of lifestyle related deceases has steadily shown an upstroke pattern in recent days, among which hypertension and its co-morbidities have crippled many in both developed and developing countries. With rapid growth in economy India has currently been witnessing increased pattern of cases of hypertension and associated co-morbidities i.e. cardiovascular disease, stroke and renal disease.

From an epidemiologic perspective, there is no obvious level of blood pressure that defines hypertension. Clinically, hypertension may be defined as that level of blood pressure at which the institution of therapy reduces blood pressure related morbidity and mortality. Systolic blood pressure below 120 mmHg and diastolic pressure below 80 mmHg is considered to be normal in adults. Systolic blood pressure between 120 - 139 and diastolic blood pressure between 80 – 89 mmHg is considered to be prehypertensive. Blood pressure above 140/90 mmHg is called hypertension which again has different stages.<sup>1</sup>

Vitamin D plays a critical role in calcium homeostasis in human body. Various animal and human studies have shown direct association between vitamin D deficiency and development of hypertension.<sup>2</sup> Vitamin D deficiency causes decreased intestinal absorption of dietary calcium leading to hypocalcemia, which in turn causes increased secretion of parathyroid hormone, i.e. secondary hyperparathyroidism. Increased parathyroid hormone has direct relationship with development of hypertension. Therefore increased intake of dietary

calcium along with vitamin D supplementation has beneficial effect on prevention of development of hypertension.<sup>3</sup>

However studies exist suggesting that disturbed calcium homeostasis in the setting of vitamin D deficiency, may independently of parathyroid hormone (PTH) contribute to blood pressure regulation. Calcium is involved in the regulation of peripheral vascular resistance by modulating contractility of vascular smooth muscle cells.<sup>4</sup> Moreover, it has also been shown that ionized extracellular calcium inhibits renin secretion in the juxta-glomerular cells of the kidneys.

**Objectives:** This study aims to determine the level of serum calcium and vitamin D in hypertensive patients & to study the correlation between the level of vitamin D and severity of hypertension.

**Materials and Methods:** This is a Cross sectional study conducted in the Department of General Medicine, Agartala Government Medical College and GB Pant Hospital from October 2019 to September 2021. Consecutive patients satisfying the inclusion criteria were taken as sample size.

The Inclusion Criteria were

1. All diagnosed hypertensive patients in OPD of Medicine
3. Patient who have given written informed consent for this study.
4. Exclusion of Pregnancy, Malignancy & Chronic Kidney Disease patients

Informed consent has been obtained after informing the study subjects the details of the procedure. After obtaining the informed consent from the subject, he/she has been included in the study. After detailed history, being investigated, data has been collected on Demographic factors (age, Gender) serum calcium and vitamin D level has been measured among patients selected after fitting inclusion and exclusion criteria. Study has been assessed by certain biochemical test. Ethical approval taken from Institutional Ethics committee of Agartala Government College.

## II. Results:

In our study, 10 (5.0%) patients were 21-30 years old, 11 (5.5%) patients were 31-40 years old, 37 (18.5%) patient were 41-50 years old, 102 (51.0%) patients were 51-60 years old, 23 (11.5%) patients were 61-70 years old and 17 (8.5%) patients were 71-80 years old. The value of z is 6.8252. The value of p is < .00001. The result is significant at p < .05. In our study, 31 (15.5%) patients were Female and 169 (84.5%) patients were Male. The mean Age (mean±s.d.) of patients was 54.7400± 11.5233. the mean calcium, vitamin D, Systolic blood pressure and Diastolic Blood pressure are shown in table 1. The details of correlation between AGE, VITAMIN D3(ng/ml),SBP,DBP vs CALCIUM(Mg/dl) and correlation between AGE,CALCIUM(Mg/dl),SBP,DBP vs VITAMIN D3(ng/ml) are shown in table 2 and 3 respectively.

**Table 1: Distribution of Mean Calcium, Vitamin D3, SBP & DBP**

	Number	Mean	SD	Minimum	Maximum	Median
<b>Calcium(Mg/dl)</b>	200	8.6230	.8589	6.0000	10.2000	8.8000
<b>Vitamin D3(ng/ml)</b>	200	38.7835	9.3486	11.0000	66.8000	39.0000
<b>SBP</b>	200	156.4300	10.7915	140.0000	200.0000	156.0000
<b>DBP</b>	200	93.6400	3.7977	88.0000	108.0000	92.0000

**Table 2: Correlation between AGE, VITAMIN D3(ng/ml),SBP,DBP vs CALCIUM(Mg/dl)**

<b>AGE</b>	<b>Pearson Correlation Coefficient (r)</b>	-.143*	Negative correlation
	<b>p-value</b>	.044	Significant
	<b>Number</b>	200	
<b>VITAMIN D3(ng/ml)</b>	<b>Pearson Correlation Coefficient (r)</b>	.055	Positive correlation
	<b>p-value</b>	.435	Not Significant
	<b>Number</b>	200	
<b>SBP</b>	<b>Pearson Correlation Coefficient (r)</b>	.016	Positive correlation
	<b>p-value</b>	.817	Not Significant
	<b>Number</b>	200	
<b>DBP</b>	<b>Pearson Correlation Coefficient (r)</b>	.024	Positive correlation
	<b>p-value</b>	.735	Not Significant

	Number	200	
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**Table 3: Correlation between AGE, CALCIUM (mg/dl),SBP,DBP vs VITAMIN D3 (ng/ml)**

<b>AGE</b>	<b>Pearson Correlation Coefficient (r)</b>	-.282* *	Negative correlation
	<b>p-value</b>	.000	Significant
	<b>Number</b>	200	
<b>Calcium(mg/dl)</b>	<b>Pearson Correlation Coefficient (r)</b>	.055	Positive correlation
	<b>p-value</b>	.435	Not Significant
	<b>Number</b>	200	
<b>SBP</b>	<b>Pearson Correlation Coefficient (r)</b>	.202*	Positive correlation
	<b>p-value</b>	.004	Not Significant
	<b>Number</b>	200	
<b>DBP</b>	<b>Pearson Correlation Coefficient (r)</b>	.108	Positive correlation
	<b>p-value</b>	.130	Not Significant
	<b>Number</b>	200	

### III. Discussion:

In this study, the maximum number of vitamin D3 deficiency was found in the age group of 40 – 60 years old and hypocalcemia in 50 – 70 years. Calcium and Vitamin D3 has also been found to be comparatively deficient in older age group. There was no gender variation for the level of calcium & vitamin D3. Peterlick found that a compromised vitamin D and serum calcium levels deficit are widely encountered in European and North American counties, but they were independent of age and gender, whereas a study conducted by Vidya S et al found that calcium levels were correlated with systolic and diastolic blood pressure, age, gender, family history of hypertension, sedentary life style, smoking, alcohol intake and BMI.<sup>5,6</sup> In my study, 17% are having low vitamin D3 level, out of which 75% belonged to the age group 50 -70 years. Lips et al also found that vitamin D deficiency is common in elderly, especially in housebound and geriatric patient.<sup>7</sup> The synthesis of vitamin D3 in the skin under influence of UV light decreases with ageing due to insufficient sunlight exposure and a decreased functional capacity of the skin. The diet contains a minor part in it.

Low calcium level was found in 21% out of which 77% belonged to age group 50 – 70 years. Vidya S et al found that calcium is a key factor in regulating cardiovascular function and alteration in calcium metabolism and has been shown to be associated with human hypertension. Calcium levels were correlated with systolic and diastolic pressure, age, gender, family history of hypertension, sedentary life style, smoking, alcohol intake and BMI. A total of 100 patients were studied. 71% were over 60 years.<sup>6</sup>

In our study, which above has been shown in table form that the mean Calcium (Mg/dl) (mean±s.d.) of patients was 8.6230± .8589. Moradi M et al found that vitamin D deficiency, as a predisposing factor for coronary artery disease (CAD), is a subject of increasing interest.<sup>8</sup>The serum vitamin D level in the “positive for CAD” group was 20.98 ng/mL, significantly lower than the level in the “negative for CAD” group (30.47 ng/mL; P<0.001). The mean calcium score among participants was 533.5±87.9. Based on the Spearman test, a significant negative correlation (–0.21) was detected between the serum vitamin D level and coronary artery calcium score (CACS) (P=0.005).

Scragg found that previous randomized controlled trials of vitamin D supplementation and blood pressure (BP) mainly have given vitamin D for short periods (<6 months) or at low doses (400 IU per day). BP was measured at baseline, 5, and 18 months. Subjects had a mean (SD) age of 47.6 (9.7) years, 75% were women, and 94% were of European ancestry (white). Mean (SD) 25-hydroxyvitamin D3 changed from 73 (22) nmol/L at baseline to 124 (28) nmol/L at 18 months in the vitamin D group, and from 71 (22) nmol/L to 56 (22) nmol/L in the placebo group.<sup>9</sup>

#### **IV. Conclusion:**

Although strong observational data suggest that vitamin D deficiency is associated with high blood pressure by mechanisms, which include direct regulation of the renin-angiotensin-aldosterone axis. Large randomized trials are much needed before vitamin D can be recommended for prevention or treatment of hypertension.

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