RELATIONSHIP OF VITAMIN D LEVELS WITH SYSTOLIC, DIASTOLIC AND MEAN ARTERIAL PRESSURE IN MALE RESIDENTS OF LAHORE

Saima Mukhtar[1], Iram Qamar[1], Javaria Latif[2], Sobia Niaz[3], Rahat Naseem[4], Mah e Jabeen Sear[1]

[1]Department of Physiology, Rahbar Medical & Dental College, Lahore - Pakistan

[2]Department of Physiology, CMH Medical College, Bahawalpur - Pakistan

[3]Department of Physiology, Fatima Memorial Medical College, Lahore - Pakistan

[4]Department of Physiology, King Edward Medical University, Lahore - Pakistan

ABSTRACT

Objectives: To correlate vitamin D levels with severity of hypertension.

Material and Methods: This study was conducted from September 2016 to December 2016 which comprised seventy-five male subjects from outdoor department of Lahore General Hospital, Lahore Pakistan, and divided into stage I and stage II hypertension groups and healthy attendants were taken as controls. Newly diagnosed hypertensive male patients were included and patients having secondary hypertension, low vitamin D, known kidney, liver, thyroid, parathyroid or cardiac disease were excluded. Blood pressure of subjects was measured using a mercury sphygmomanometer and blood samples for analysis of vitamin D levels were taken.

Results: Subjects included had a mean age of 39.97 ± 8.24 years. Mean vitamin D levels (ng/mL) were 35.99 ± 8.08, 28.71 ± 10.85 and 28.12 ± 9.94 in controls, stage I hypertension and stage II hypertension groups respectively. Mean systolic blood pressure (SBP) and mean diastolic blood pressure (DBP) was 110.72 ± 5.59 mm Hg 73.24 and ± 3.35mm Hg in controls, 131.20 ± 8.83 mm Hg and 91.80 ± 5.86 mm Hg in stage I HTN and 144.28 ± 19.28 mm Hg and 103.40 ± 12.05 mm Hg in stage II HTN group, respectively. Both SBP and DBP were inversely related to low 25 (OH) D levels (r=-0.289 & -0.315) respectively.

Conclusion: There is an association suggestive of increased SBP, DBP and mean arterial pressure with lower levels of Vitamin D.

Keywords: Vitamin D, Systolic, Blood pressure, Diastolic.

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INTRODUCTION

Blood pressure (BP) is the force exerted by blood on unit area of vessel wall and its normal is taken as 120 mmHg of systolic blood pressure (SBP) and 80 mmHg diastolic blood pressure (DBP). A value of more than / equal to 140 systolic and/or 90 diastolic taken while patient is in seated position on three consecutive visits is considered hypertension or high blood pressure[1].

Correspondence
Dr. Saima Mukhtar
Associate Professor
Department of Physiology, Rahbar Medical College, Lahore - Pakistan
Email: symarb@gmail.com
Cell: +92-300-8263509
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Since long, high blood pressure has been considered the reason behind early deaths and acts as a prelude to develop cardiovascular disease (CVD) events like myocardial infarction (MI), stroke, cardiac failure and kidney disease[2].

About 1.13 billion people are affected by high blood pressure world over with the majority belonging to low and middle income countries. In the span of only one year, the adult population suffering from high BP in Pakistan has about risen from 23.8% to 25.4%[3,4].

There is much speculation about the pathophysiology of hypertension. A substantial number of cases have no apparent underlying determinable cause. A number of possible causes like disturbances in cardiac output, peripheral resistance, autonomic nervous system, renin-angiotensin-aldosterone system over-activation, bradykinin and endothelin levels etc are considered causative in in-

creased blood pressure[5].

The sun shine vitamin, more commonly known as vitamin D has long been associated with bone health and calcium homeostasis through kidney, bone, intestine and parathyroid. Low levels of vitamin D are responsible for multiple health issues ranging from minor infections to acceptance of transplant, built up of autoimmunity, multiple sclerosis, inflammatory bowel disease, T-cell regulation.6 There is growing evidence that vitamin D deficiency has some role in the development of cardiac risk factors and elevated BP which is worth investigating[7].

Vitamin D is naturally produced in our body by irradiation of exposed skin by ultraviolet B (UVB) radiations. This leads to conversion of 7-dehydrocholesterol of skin into Cholecalciferol. In liver, 25-hydroxy vitamin D3 is formed and finally inside the kidney, converted into a biologically functional product, calcitriol or 1, 25-(OH)2 D[3-8].

Biologically active 1, 25-$(OH)^2$ D3 binds to vitamin D receptor and couples with retinoid X receptor (RXR) to attach to sequence of deoxyribonucleic acid (DNA) called vitamin D response element (VDRE) which brings about transcription leading to protein synthesis and effects of vitamin D[6]. The cutoff serum level of ≥30-g/mL with regard to 25 (OH) D is taken as sufficient; below 20 ng/ml as deficient, levels of 21–29 ng/ml as sufficient and levels of ≥150 -g/mL are taken as toxicity[9].

Vitamin D deficiency has emerged as a global epidemic with almost one billion people suffering from either insufficiency or deficiency. Low vitamin D status is a problem even in countries with sun exposure all year round. Pakistan also has a considerable population showing low levels of vitamin D[10].

Mc Greevy et al in their review found a strong relation between high systolic blood pressure and low vitamin D level but did not find a contributory link of vitamin D with raised BP[11]. Similarly, other studies suggest certain contributing factors like disturbance in renin angiotensin aldosterone system leading to CVD development subsequent to lowered vitamin D levels[12]. Our study was aimed at finding out any association between low vitamin D levels and blood pressure in our population, taking a cohort from catchment areas of Lahore General Hospital (LGH), Lahore.

MATERIAL AND METHODS

This study was conducted from September 2016 to December 2016 which comprised seventy-five male subjects from outdoor department of Lahore General Hospital, Lahore Pakistan through non probability convenience sampling. The cohort consisted of three groups of Controls, stage I and stage II hypertension, having 25 subjects in each group. Newly diagnosed hypertensive male patients between ages of 30-55 years were included and grouped into stage I and stage II patients and the healthy attendants were taken as controls. Patients having secondary hypertension, low vitamin D, known kidney, liver, thyroid, parathyroid or cardiac diseases were excluded. History, examination and laboratory tests of patients were recorded on questionnaire pro forma. Vitamin D assay was done using enzyme linked immunosorbent assay (ELISA) kit and automated analyzer. Data was analyzed by SPSS 20.0. Vitamin D, SBP and DBP were described as mean and standard deviation (mean± SD).

One way analysis of variance (ANOVA) was used to compare variables in the three groups. Post hoc Tukey test was done to find out which means were different from other by comparison of all possible pairs of means. Pearson's coefficient of correlation was applied to find out association between dependent (SBP, DBP) and independent (vitamin D) variables. P value of ≤ 0.05 was taken as statistically significant.

RESULTS

A total of 75 male subjects were included in the study group. Mean age of the cohort was 39.97 ± 8.34 years. Mean ± SD systolic BP (mm Hg) was 128.73±18.69 (range: 92-180), mean ± SD diastolic BP (mm Hg) 89.48 ± 14.77 (range: 70-130) and mean arterial pressure (MAP) was 107.29 ±16.08 mm Hg (range: 80-140). Mean ± SD vitamin D (ng/mL) in our study population was 30.94 ±10.22 (range: 10.5-56.9). Fig. 1 demonstrates vitamin D levels as per the control and hypertension groups (stage I and stage II). Decreasing trends in vitamin D levels were noticed as the blood pressure changed from normotensive in controls to higher values in stage I and stage II hypertensive patients (Table 1).

Although vitamin D levels were significantly lower in stage I and II when compared to controls (p=0.026 and 0.015 respectively), the levels did not differ significantly between stage I & stage II hypertensive groups (p=0.975). Table.2 depicts the Pearson's correlation of systolic BP with vitamin D in the study population with a statistically significant p value of 0.012 (r = - 0.289). The diastolic BP was compared to vitamin D and r = - 0.315 showed that both were inversely related in a highly significant manner having p= 0.006. The 'r' value of -0.405 also showed a statistically significant inverse association between mean arterial pressure and serum vitamin D levels (Fig. 2).

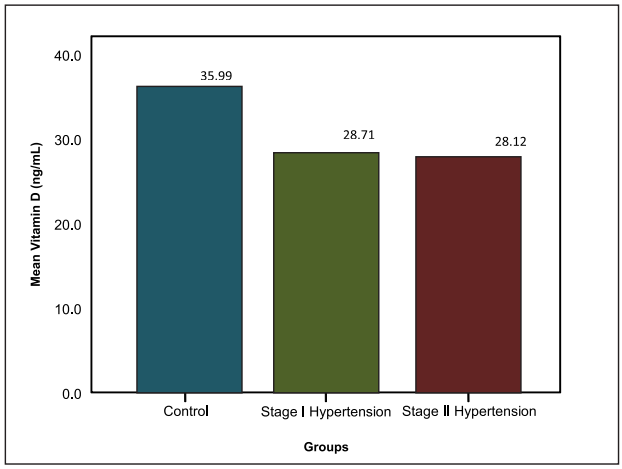

Figure 1: Mean Values of Serum vitamin D (ng/mL) levels in various groups

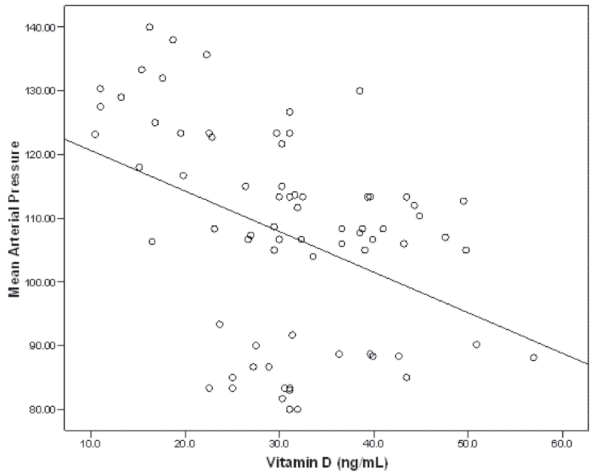

Figure 2: Correlation between vitamin D (ng/mL) and mean arterial pressure (mm Hg) in the study population

Table 1: Comparison of vitamin D, Systolic and Diastolic BP in Control, Stage I Hypertension and Stage II Hypertension Groups

	Control (n=25)	Stage I Hypertension (n=25)	Mean difference	p-value
Vitamin D (ng/mL)	8.082±35.99	10.85±28.71	7.29	0.026*
Systolic BP (mm Hg)	5.59±110.72	8.83±131.20	20.48-	0.000***
Diastolic BP (mm Hg)	3.35±73.24	5.86±91.80	18.56-	0.000***
	Control (n=25)	**Stage II Hypertension (n=25)**	**Mean difference**	**p-value**
Vitamin D (ng/mL)	8.082±35.99	9.94±28.12	7.88	0.015*
Systolic BP (mm Hg)	5.59±110.72	19.28±144.28	33.56-	0.000***
Diastolic BP (mm Hg)	3.35±73.24	12.05±103.40	30.16-	0.000***
	Control (n=25)	**Stage III Hypertension (n=25)**	**Mean difference**	**p-value**
Vitamin D (ng/mL)	10.85±28.71	9.94±28.12	0.59	0.975††
Systolic BP (mm Hg)	8.83±131.20	19.28±144.28	13.08-	0.001**
Diastolic BP (mm Hg)	5.86±91.80	12.05±103.40	11.60-	0.000***

Results expressed as mean ± SD, n= number of cases in each group, *p- value< 0.05 =statistically significant, **p- value< 0.01 = highly significant, ***p- value< 0.001 = very highly significant.

Table 2: Correlation of Serum Vitamin D with Systolic BP, Diastolic BP and, in study population

Correlation (Pearson's)	Control (n=25) (r)	Stage I Hypertension (n=25) (r)	Stage II Hypertension (n=25) (r)	Study population (n=75) (r)
Vitamin D with Systolic BP	0.388-	0.193	0.131-	0.289-*
Vitamin D with Diastolic BP	0.264-	0.011-	0.060-	0.315-**

r =Coefficient of correlation, n= number of cases in each group, *p- value< 0.05 = statistically significant, **p- value< 0.01 = highly significant, ***p- value< 0.001 = very highly significant
***= very highly significant

DISCUSSION

Both hypertension and vitamin D deficiency have emerged as a global pandemic. About one billion people are vitamin D deficient worldwide and in 2015, an estimated 3.5 billion adults had SBP of at least 110 to 115 mm Hg and 874 million adults had SBP of 140 mm Hg or higher.13,14 We planned our study aiming to find a plausible relation between hypertension and low vitamin D levels.

We noticed that lower vitamin D levels were associated with high blood pressures, both systolic and diastolic, finding strength from data showing abnormalities in vitamin D endocrine system relation to increment in blood pressure, vascular smooth muscle stiffness cardiac size, coronary and peripheral artery disease and an overactive renin- angiotensin- aldosterone system resulting in an increased BP[15,16].

Vitamin D levels of the control group having a normal blood pressure were in sufficient range (>30ng/mL) as categorized by other studies[17,18].

Our study gets support from NHANES III data that documented a reciprocal relation between 25 (OH) D and blood pressure involving both systolic and diastolic blood pressures in subjects with BP ranging from normotensive to mildly hypertensive. Framingham Offspring Cohort inferred that hypertensive patients with deficient vitamin D levels, had a greater risk of developing CVD as compared to individuals without hypertension. And that rise in CVD risk was in incremental manner[19,20].

We concluded from our modest endeavor that there is a trend of higher blood pressure values among vitamin D deficient people, as we obtained highest levels of vitamin D (57 ng/mL) in the control group and the lowest levels of vitamin D (11 ng/mL) in patients having stage II hypertension (BP range of ≥160 mm of Hg systolic and/or ≥100 mm of Hg diastolic)[21].

Considerable number of studies carried out on vitamin D supplementation and their subsequent effects on SBP and DBP showed promising results in the previous years as well as in present days[22,23].

This study had a small sample size and although matching was done to reduce the effect of confounding factors like dietary intake of salt, calcium, duration of sun exposure, time of the year and seasonal variation in vitamin D levels, it did not translate into a significant relationship. Being a comparative study of small cohort, it could not establish a causal role or directionality of association. Nevertheless, under the present circumstances of a deficient or insufficient vitamin D status and a rising trend in blood pressure related conditions prevalent in our country, our study can be helpful in supporting the notion of reduced vitamin D levels in hypertensive people.

CONCLUSION

Our findings in newly diagnosed hypertensive male subjects, suggests a correlation between low plasma 25(OH) D levels and high blood pressure. These findings may help relate higher risk of developing hypertension with vitamin D deficiency and insufficiency to some extent.

RECOMMENDATIONS

Large scale randomized placebo controlled trials and studies involving supplementing people with vitamin D are needed to substantiate or refute this link in patients with high blood pressure.

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AUTHOR'S CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under

Mukhtar S: Principal Investigator, Concept & Data Analysis.

Qamar I: Data handling & Critical analysis.

Latif J: Manuscript Drafting.

Niaz S: Bibliography.

Naseem R: Data entry.

Sear MJ: Proof reading & critical analysis.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.