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ORIGINAL ARTICLE

Epidemiological Profile of Vitamin D Deficency Among Hypertensive Patients

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Abstract

Background: Vitamin D deficiency is a worldwide epidemic health problem. Variable results are available with few studies favouring and others denying the association of Vit D deficency and Hypertension. **Material and Methods**: An Epidemiological prospective Cross-sectional 3 year observational study was conducted to determine the point prevalence of vitamin D deficiency among hypertensive patients in comparison to age , sex matched, healthy controls among urban and rural population of the Jammu region and also to evaluate the correlation between vitamin D deficiency and hypertension.Group1 (n = 856) patients of Hypertension with any co-morbid profile with or without complications presenting in tertiary care Medical college. Group 2 (n= 1006) healthy subjects. **Results:** The study included 1862 patients (856 cases and 1006 controls) with male-to-female ratios of 1.62:1 and 1.13:1, respectively, Prevalence rates of vitamin D sufficiency (>30 ng/mL), insufficiency (20-30 ng/mL), and the deficiency (<20 ng/mL) were 21.2%, 21.3%, and 57.3% in hypertensive, and 19.7%, 19.3%, and 60.8% in non-hypertensive, respectively. The Mantel-Haenszel Chi-Square test (MH Chi-Sq. value = 2.345, CI=95%, p = 0.309) indicated no significant linear trend between vitamin D levels and hypertension.**Conclusion:** Despite notable high prevalence rates of Vitamin D deficiency both in hypertensive arm (78.7%) and healthy control arm (80.2%) in the study population, this study found no significant association between Vitamin D levels and hypertension.

Keywords

Vitamin D deficiency, Hypertension, Cardiovascular Disease

Inroduction

Vitamin D deficiency is a worldwide epidemic health problem, with a high range of prevalence (70%-100%) reported across the world, whereas in the Indian population, a prevalence as high as (50%-90%) has been reported.[1, 2]

Even in the Jammu region, a very high Vitamin D deficiency, with a prevalence rate of 76.39% among the healthy population has been reported. [3]

It is a worldwide health problem that affects not only musculoskeletal health but can be associated with many chronic diseases such as osteoporosis, Type 1 Diabetes, cancer, depression, epilepsy, insulin resistance, autoimmune disease, migraine, polycystic ovary syndrome, autoimmune diseases, (such as multiple sclerosis). [4]

It is also related to increased risk of Type 2 diabetes mellitus (T2DM), metabolic syndrome (MS), and cardiovascular disease (CVD) like hypertension, heart failure, and ischemic heart disease & increased visceral adipose tissue and body mass index (BMI), and other CVS risk factors as well as the frequently associated hypercholesterolemia. [5]

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There are few studies in the literature, which suggest that association do exits between hypertension and Vitamin D Deficiency. [6-8]

However, by large many studies failed to show any association between Vitamin D deficiency and Hypertension also many studies failed to establish any benefit of Vitamin D deficiency correction in control of hypertension effectively against non intervention arms. [9-11]

Despite extensive Western research, comprehensive data on Vitamin D deficiency and its medical correlations with Hypertension are lacking in India and particluraly from this region.

Thus, the results of such epidemiological studies may prove invaluable for healthcare providers in assessing the widespread prevalence of Vitamin D deficiency across the country. Given the potential negative consequences of Vitamin D deficiency on public health, understanding its correlation with common medical disorders such as hypertension is crucial. These findings can significantly help health policy providers and enhance the clinical management of patients.

Total Study Period - 3 years

Study Design: Epidemiological prospective Cross-sectional observational study.

Primary Objective:

1.The objective of this study is to determine the point prevalence of vitamin D deficiency among hypertension in comparison to age sex matched healthy controls among urban and rural populations of the Jammu region.

Secondary Objective:

2.To evaluate the correlation between vitamin D deficiency and hypertension in urban and rural populations of the Jammu region.

Material and Methods:

A total of 1,862 participants were ultimately included in the study. The research was conducted under the multidisciplinary research unit at Jammu, affiliated with the Indian Council of Medical Research (ICMR). The study included patients with hypertension and healthy controls and was approved by the Institutional Ethics Committee (IEC) of GMC Jammu vide No.IEC/2016/238 Dated 15.1.2016, registered with registration number ECR/454/INST/JK/2013 CDSO/FDA Bhawan, Government of India. This study included two groups of participants: Group1 (n = 856) patients of Hypertension with any co-morbid profile with or without complications presenting in tertiary care medical college. Group 2 (n= 1006) healthy subjects without a known history of hypertension, diabetes, thyroid, renal or hepatic disease, or malignancy. Patients with a history of surgery, hospitalization, or major medical illness within the past year were excluded from the study. Patients on hormone replacement therapy, glucocorticoids, bisphosphonates, teriparatide, and other drugs affecting bone metabolism were excluded as well.

All subjects were enrolled after obtaining written informed consent.

The 25-hydroxy vitamin D [25 (OH) D] concentrations were measured by competitive in-vitro quantitative immunoassay in human serum using Elecsys & Cobas e analyzers (Roche) kit. Inter-assay Coefficient of Variability (CV) was 9.9% and intra-assay CV was 5.7% in the current analysis.

The minimal detectable limit of the 25 (OH) D assay was 1.5 ng/mL. The subjects were classified as vitamin D-deficient, insufficient or sufficient on the basis of 25 (OH) D concentrations of < 20 ng/mL, 20-30 ng/mL or > 30 ng/mL respectively, according to consensus.[12,13]

Subjects were included in a cross-sectional manner. Fasting blood samples were collected, and 2 mL of serum was prepared using standard sampling tubes containing separating gel before analysis for Vitamin D levels. The data were analyzed by a single laboratory after standardization. The inclusion of patients in the hypertension group was based as per JNC 7 Guidelines on clinical and biochemical investigations according to standard diagnostic guidelines for respective medical disorders.

Statistical Analysis

The data were categorized as mean ± SD and n (%). The correlation between Vitamin D levels and hypertension was established using the Mantel-Haenszel Chi-square correlation test for linear trend. A two-tailed P-value of < 0.05 was considered significant.

Results:

The study included 1862 subjects (856 cases and 1006 controls) with male-to-female ratios of 1.62:1 and 1.13:1, respectively, revealing significant differences across several parameters. The case group was older (mean age 52.40 vs. 39.83 years, t = 22.328, p < 0.001), taller (mean height 1.6192 vs. 1.6049 meters, t = 3.999, p <

0.001), and heavier (mean weight 74.20 vs. 69.35 kg, t = 9.032, p < 0.001), with higher BMI (28.28 vs. 26.95, t = 6.727, p < 0.001) and waist circumference (87.08 vs. 83.64 cm, t = 6.789, p < 0.001). No significant differences were found in waist/hip ratio (t = 0.191, p = 0.848) or serum vitamin D levels (t = 0.282, p = 0.778) [*Table 1*]. Analyzing vitamin D levels, hypertensives with levels <20 ng/mL had a mean of 11.9952 ng/mL (SD = 4.11148, N = 491), those with 20-30 ng/mL had 24.2217 ng/mL (SD = 2.81880, N = 183), and those >30 ng/mL had 50.5656 ng/mL (SD = 20.94971, N = 182). Non-hypertensives showed similar patterns: <20 ng/mL had 12.0003 ng/mL (SD = 4.15016, N = 612), 20-30 ng/mL had 24.7382 ng/mL (SD = 2.85107, N = 195), and >30 ng/mL had 52.8924 ng/mL (SD = 25.81071, N = 199) [*Table 2*]. Prevalence rates of vitamin D sufficiency (>30 ng/mL), insufficiency (20-30 ng/mL), and the deficiency (<20 ng/mL) were 21.2%, 21.3%, and 57.3% in hypertensives, and 19.7%, 19.3%, and 60.8% in non-hypertensives, respectively [*Table 3*]. The Mantel-Haenszel Chi-Square test (MH Chi-Sq. value = 2.345, CI=95%, p = 0.309) indicated no significant linear trend between vitamin D levels and hypertension,

Table1: Demographic Profile of the Subjects

	Group	N	Minimum	Maximum	Mean	Std. Deviation	Statistical significance	
							t-value	p-value
Age (years)	Case	856	18.00	90.00	52.4007	11.11143	22.328	<0.001
	Control	1006	1.50	90.00	39.8301	13.18207		
Height (m)	Case	856	1.30	1.98	1.6192	.07470	3.999	<0.001
	Control	1006	1.37	2.55	1.6049	.07849		
Weight (kg)	Case	856	31.00	125.00	74.1988	11.26985	9.032	<0.001
	Control	1006	23.00	100.00	69.3489	11.77283		
BMI=K/(j2)	Case	856	15.63	48.83	28.2783	4.19725	6.727	<0.001
	Control	1006	10.15	41.62	26.9520	4.27148		
Waist Circumference(cm)	Case	856	56.00	122.00	87.0818	10.21456	6.789	<0.001
	Control	1006	56	141	83.6431	11.43821		
Waist / Hip Ratio	Case	856	0.74	1.162	1.0467	3.01049	0.191	0.848
	Control	1006	0.65	1.61	1.0231	2.31836		
Serum Vit D levels (ng/dl)	Case	856	4.20	145.02	22.8098	18.32674	0.282	0.778
	Control	1006	1.20	150.00	22.5583	19.85685		

Table2 : Mean Vitamin D status in Hypertensive and Non-hypertensive Subjects

	Vit-D (ng/dl)	N	Minimum	Maximum	Mean	Std. Deviation
Hypertensive	<20	491	4.20	19.93	11.9952	4.11148
	20 - 30	183	20.01	29.99	24.2217	2.81880
	>30	182	30.39	145.02	50.5656	20.94971
Non-Hypertensive	<20	612	1.20	19.97	12.0003	4.15016
	20 - 30	195	20.00	29.91	24.7382	2.85107
	>30	199	30.01	150.00	52.8924	25.81071

Table3: Point Prevalence of Vitamin Deficiency and Insufficiency among Hypertensive and Healthy Control

Vitamin D status (ng/dl)	Hypertensives (n=856)	Point Prevalence (%)	Non-Hypertensives (n=1006)	Point Prevalence (%)
Sufficient (>30)	182	21.2	199	19.7
Insufficient (20-30)	183	21.3	195	19.3
Deficient (<20)	491	57.3	612	60.8

Table 4: Correlation Between Vitamin D Deficiency and Hypertension.

Vit -D (ng/dl)	Hypertension		Total	MH Chi. Sq. for linear trend value	p-value
	Present	**Absent**			
<20	491	612	1103		
20 – 30	183	195	378	2.345	0.309
>30	182	199	381		
Total	856	1006	1862		

The correlation between Vitamin D levels and hypertension was established using the Mantel-Haenszel Chi-square correlation test for linear trend. A two-tailed P-value of < 0.05 was considered significant

suggesting that despite high deficiency rates, vitamin D status is not significantly associated with hypertension in this population [*Table 4*].

Discussion

The correlation between vitamin D deficiency and hypertension has been extensively studied with varying results. Like many studies done in past, our study also didn't find any significant association between serum vitamin D levels and hypertension (p= 0.778), despite high rates of vitamin D deficiency in both hypertensive and non-hypertensive groups. Key parameters like age, height, weight, BMI, and waist circumference showed significant differences between cases and controls, but vitamin D levels did not differ significantly. The relationship between vitamin D levels and hypertension has been examined through various studies with mixed results. Renke *et al*. [5] aslo suggested that Vitamin D deficiency is associated with increased risk of type 2 diabetes mellitus (T2DM), metabolic syndrome (MS), and cardiovascular disease (CVD) like hypertension, heart failure, and ischemic heart disease & increased visceral adipose tissue and body mass index (BMI), and other CVS risk factors as well as the frequently associated hypercholesterolemia. [5]

Alagacone, *et al*. identified independent associations between serum 25-hydroxyvitamin D concentrations and blood pressure among US adults, suggesting a potential link between vitamin D status and hypertension [6].

Similarly, Zhao *et al.* found that low serum 25-hydroxyvitamin D concentrations were associated with elevated systolic blood pressure in children, highlighting the potential early influence of vitamin D on blood pressure regulation [7]. However, Moore & Liu documented a higher percentage of vitamin D-deficient and vitamin D-insufficient children (1.7%) vs vitamin D-sufficient children (0.6%) had prehypertension or hypertension, and thus concluded that the association of low serum 25(OH)D concentrations with elevated systolic blood pressure in children is likely related to body weight and markers of adiposity [8].

Kim & Kim also reported no significant association between serum 25-hydroxyvitamin D and hypertension in middle-aged and older Korean adults, suggesting that the relationship might vary across different populations [9] . Latic & Erben emphasized that despite some evidence linking vitamin D with cardiovascular diseases such as hypertension, the overall findings remain inconclusive [10] . Chen *et al.* provided a comprehensive review, indicating inconsistencies in the evidence and underscoring the need for further research to establish a clearer understanding of the potential correlation between vitamin D and hypertension [11] .

Similarly, one meta-analysis suggested that there is no increased risk of hypertension among older age subjects who were vitamin D deficient. However, Younger females showed strong associations between high 25OHD levels and hypertension risk, especially in prospective studies (RR =0.36 (0.18-0.72); OR =0.62 (0.44-0.87)). [14]

Thus, while there are indications of a possible link, the evidence is not sufficiently robust to confirm a definitive association, necessitating more well-designed, large-scale studies. Limitation of the studies was that various covariates were not studied for any possible correlation.

Conclusion

Despite notable high prevalence rates of Vitamin D deficiency both in hypertensive arm (78.7%) and healthy control arm (80.2%) in the study population, this study found no significant association between Vitamin D levels and hypertension. These findings suggest that factors other than Vitamin D status may play a more substantial role in the development of hypertension . Further research is warranted to elucidate the complex relationship between Vitamin D and hypertension.

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Conflicts of Interest

There are no conflicts of interest.

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