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A CROSS SECTIONAL STUDY TO EVALUATE THE INTER-RELATIONSHIP OF VITAMIN D AND HYPERTENSION IN SENIOR CITIZENS OF BANGALORE CITY

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ABSTRACT Ageing is a natural process and healthy ageing has become a growing global challenge. The process of ageing affects nutritional needs, they are particularly prone to inadequate intake of calcium and vitamin D. Vitamin D deficiency is widely prevalent across all ages, races, geographical regions, and socioeconomic strata. Vitamin D deficiency has been linked to cardiovascular disease and risk factors including hypertension. The relationship between Vitamin D and Hypertension has varied across studies; hence this study was taken up to evaluate the relationship between hypertension and Vitamin D levels in the senior citizens of Bangalore City. The objective of this study is to assess Serum 25(OH) Vitamin-D, and Blood Pressure in senior citizens of Bangalore city, and to evaluate the interrelationship of the above parameters in the same subjects. As part of the methodology, after obtaining Ethical Clearance, 80 eligible elderly subjects were recruited for the study. Written informed consent was taken. For each subject, fasting blood sample of 4ml was collected for Serum 25(OH) Vitamin-D assessment. Height and weight were measured, and Blood pressure was measured, and Hypertension was diagnosed based on JNC VII criteria. Results were compiled and statistically analyzed. The analysis showed that severe vitamin D deficiency was present in subjects with hypertension than in people without hypertension (P value <0.05). To conclude, this study demonstrates increased rates of hypertension in individuals who tested for lower levels of 25 .hydroxyvitamin D starting at levels < 20 ng/ml. Elevated Blood Pressure levels associated with Vitamin-D deficiency in the elderly warrants a need for clinical monitoring and appropriate intervention.

KEYWORDS : Hypertension, Vitamin D, Blood pressure

INTRODUCTION

The number of older adults worldwide is expected to increase from 420 to 974 million (Jeyalakshmi S et al, 2012) India has around 100 million elderly at present and expected to increase to 323 million, constituting 20% of the total population by the year 2050.(United Nations Population Fund, 2012).

Adequate nutrition is fundamental to healthy ageing. Energy requirements decrease with age due to decline in lean body mass and decreased physical activity and slowed rates of protein turnover. Despite this decrease, older adults are at risk of under nutrition due to medication side effects, functional, visual, or cognitive impairment, oral disease, swallowing disorders, or loss of smell/taste, depression and social isolation, and chronic illnesses

Although vitamin requirements do not change with age, older adults are particularly prone to inadequate intake of Vitamin D, Vitamin B12 and Calcium and are also associated with reduced Calcium and Vitamin D absorption (Caruso LB,Silliman RA. 2008).Low levels of vitamin D have been described with a multitude of disease processes, including increased blood pressure (BP), cardiovascular disease, and all.cause mortality (Holick MF.2007;Vasan RS et al.2001)

Hypertension is the most common cardiovascular disease, emerging as a major public health problem in developed as well as developing countries such as India with a prevalence ranging between 20-40%.(Todkar S S et al.2009;Gupta R et al.2002) Chronically sustained high blood pressure is associated with a number of adverse health effects such as myocardial infarction, renal failure and stroke.

Vitamin D has been shown to regulate the renin, angiotensin, aldoster one system, suppress vascular smooth muscle proliferation, inhibit parathyroid hormone (PTH) secretion, and regulate calcium and phosphorous levels, which are all possible mechanisms by which vitamin D may impact BP (Carthy EP et al.1989 ; Li YC et al.2002)

Hence this study was undertaken to find the Interrelationship between Vitamin D and Blood pressure in the elderly of Bangalore city, a population which is genetically different from those referred in previous studies or in the reference mentioned below.

OBJECTIVES

A. To assess Serum 25(OH) Vitamin-D and Blood Pressure in elderly of Bangalore city
B. To evaluate the interrelationship of the above parameters in the same subjects

MATERIALS & METHODS

It was a cross sectional comparative study. The study subjects were recruited from enrichment center in Bangalore city. A total of 80 subjects aged above 60 years and willing to participate in the study were included for the study. To be included in this study the subjects were 1) to have no history of Alzheimer's, hepatic disorders, renal disorders, Bone related disorders, intake of Vitamin D or Calcium supplements or drugs known to influence Vitamin D metabolism and sleep, 2) possessing verbal communication skills necessary to understand and respond to questions, 3) to be able to care for themselves independently (Informed consent was taken from all subjects or their families if the subject was unable to read or write), 4) to be non-alcoholic and non-smokers, 5) more than High school level education. Individuals with depression, anxiety, stress, visual or hearing impairment, history of diabetes mellitus, stroke, myocardial infarction, thyroid dysfunction, any major surgery and those on any drugs that impair cognition like sedatives, anti-histaminics, anti psychotics and antidepressants were excluded from the study. Written informed consent was obtained from all subjects prior to their participation. Ethical clearance was taken from the institutional ethics committee. Demographic characteristics, past medical history and use of medications were collected via structured questionnaires. Dietary intake was measured using 24-Hour Dietary Recall Questionnaire. General Physical examination and systemic examination was done. For each subject, fasting blood sample of 4ml was collected by trained registered medical personnel for Serum 25(OH) Vitamin-D assessment a. Height and weight were measured, and BMI was calculated using Quetlets Index. The study was done during the period of June to August which is neither winter nor summer in Bangalore city. After explaining the entire procedure.

Measurement of Serum Vitamin D Levels:

This study measured serum 25-hydroxyvitamin D, which is the best indicator of vitamin D conditions in the body [Norman AW]. Specimens were kept frozen until they were analyzed by fully automated chemiluminescence immunoassay method. This study used 20 ng/mL as the cut-point for serum vitamin D deficiency. Less Than 20ng/dl were categorized as Cases and more than 20ng/dl as controls.

Blood Pressure Measurement:

Blood pressure using a mercury sphygmomanometer. Hypertension was defined according to seventh report Joint National Committee (JNC) for detection, evaluation and treatment of high blood pressure, as systolic blood pressure more than or equal to 140 mm of Hg or diastolic blood pressure more than or equal to 90 mm of Hg or those individuals currently taking antihypertensive treatment. (Chobanion AV et al.2003) Respondents were asked to refrain from smoking or drinking coffee or alcohol for at least an hour before recording blood pressure. Blood pressure was measured by pulse obliteration and auscultation method in sitting position using mercury sphygmomano meter. Two blood pressure readings with at least 30 minutes interval in

between were taken and the mean of two readings was used for analysis.

Statistical Analysis:
Using the independent-samples t-test, the participants' serum vitamin D levels and mean scores for Systolic and diastolic blood pressure were tabulated using SPSS version 21. Results of continuous measurements are presented in Mean ± SD and results of categorical measurements are presented in number (%). Statistical tests applied are student t test (two tailed, independent) and Pearson's Chi- square test and p value of less than 0.05 was considered as significant.

RESULTS
After procuring the results of serum analysis, all the parameters were tabulated, and statistical treatment was given to the data and represented in appropriate charts, graphs, and tables. Serum 25(OH) D levels of all the subjects were measured. Based on Vitamin D concentration subjects were classified into cases and controls.

Study Sample:
CASES: 60 Subjects with decreased Vitamin-D levels
CONTROLS: 20 Subjects with normal Vitamin-D levels.

The baseline characteristic of the participants is shown in Tables 1 to 3.

Table – 1 Average Age Of Subjects And Gender Distribution

	Count	Average Age (Years)
Female	47	69.72 ± 9.25
Male	33	68.72 ± 6.29
Overall	**80**	**69.31 ± 8.13**

Table – 2 BMI of Subjects

	Average BMI
Female	26.78 ± 6.87
Male	23.90 ± 5.48
Overall	**25.59 ± 6.46**

Table – 3 Dietary habits of Subjects

Diet	
Vegetarian	43
Non-Vegetarian	37

Table – 4 Comparison of 25(OH)D levels in cases and controls of the study groups

Serum 25 (OH)D Concentration	Cases Vitamin D Deficient (n = 60)	Controls Vitamin D Sufficient (n = 20)
25 (OH) D ng/ml	13.5 ± 3.6	24.7 ± 3.0

Table – 5 Comparison of Systolic and Diastolic Blood Pressure in Cases (Vitamin D < 20ng/dl) & Controls (Vitamin D ≥ 20ng/dl)

Variables	Cases Mean ± SD	Controls Mean ± SD	P Value
Systolic Blood Pressure (mmHg)	140.87±7.69	122.73±5.29	< 0.001 **
Diastolic Blood Pressure (mmHg)	92.27±3.44	84.07±2.65	< 0.001 **

** P < 0.01 (Significant)

DISCUSSION
In this Case Control study, 80 elderly citizens of age more than 60 years who met the inclusion and exclusion criteria were recruited for the study after obtaining the ethical committee clearance. Serum 25(OH) D were estimated and all the results were tabulated, statistically treated and expressed in appropriate graphs and tables. Age distribution of participants is shown in Table 1. The Mean ± SD age of subjects ranged from 65 to 91 years with a mean age (±SD) of 67 (±7.1) years for cases and 67 (±7.1) years for controls. Worts man et al in their study have proven that vitamin D bio availability is affected by obesity. Table 2 shows average BMI of the subjects which was 25.59 (±6.46) kg/m2. The average BMI of female subjects was 26.78 (±6.78) kg/m2 whereas the average BMI of male subjects was 23.90 (±5.48) kg/m2. Both the groups were not obese, thus nullifying one of the confounding factors that would have affected this study. Table 3 shows the dietary habits of the subjects. There were 46% non vegetarians and 54% vegetarians in the study. All subjects consumed the same diet every day. Vitamin D intake was almost negligible through vegetarian food. Moreover, the non-vegetarians in the group hardly consumed any nonvegetarian food.

SERUM VITAMIN D LEVELS:
Table 4 shows comparison of serum 25(OH)D levels of Cases and Control study groups. Several previous studies like Fradinger et al and Holick MF et al have reported low serum 25(OH)D levels in the older population. Older adults are at a risk of lower vitamin D due to decreased cutaneous synthesis, decreased dietary intake, and decreased intestinal absorption. In this study the dietary intake of vitamin D was negligible. This was in accordance with study done by Omdahl et al. With advancing age, a gradual vitamin D deficiency becomes evident. This is due to a reduction of the concentration of 7-dehydrocholesterol in the epidermis, typical during aging, and to a consequent decrease of synthesis under UV irradiation. On the other hand, a decreased exposition to UV light is frequent in the elderly people. In addition, a low nutritional intake of vitamin D is present.

Table 5 shows Comparison of Systolic and Diastolic Blood Pressure in cases and controls which shows that Systolic Blood pressure was 140.87 (±7.69)mm Hg in cases and 122.73 (±5.29)mm Hg in Controls whereas Diastolic blood pressure was 92.27 (±3.44) mm Hg in cases and 84.07 (±2.65) mm Hg in controls which clearly shows negative Low Vitamin D levels had increased Systolic and Diastolic BP which was in Unison with several studies (Scragg et al; Martins et al; Bhandari et al and Forrest KYZ et al).

Scragg et al recently reported their findings of the relationship between serum 25(OH)D concentration and blood pressure. Martins et al. found that a low vitamin D level was associated with a higher risk of having hypertension. Forman et al. prospectively investigated the independent association between plasma 25(OH)D levels and risk of incident hypertension which was similar to the results of our study.

The probable explanation for this is as follows. The renin angiotensin system (RAS) is a regulatory cascade that plays a critical role in the regulation of blood pressure, electrolyte, and plasma volume homeostasis. Inappropriate stimulation of the RAS has been associated with hypertension. Li et al demonstrated that vitamin D is a potent endocrine suppressor of renin biosynthesis to regulate the RAS. Mice lacking vitamin D receptor (VDR) have elevated production of renin and angiotensin II, leading to hypertension, cardiac hypertrophy, and increased water intake. These abnormalities can be prevented by treatment with an ACE inhibitor or AT1 receptor antagonist. Vitamin D suppression of renin expression is independent of calcium metabolism, the volume and salt-sensing mechanisms, and the angiotensin II feedback regulation. In normal mice, vitamin D deficiency stimulates renin expression, whereas injection of 1,25-dihydroxyvitamin D3[1,25(OH)2D3] reduces renin synthesis. In cell cultures, 1,25(OH)2D directly suppresses renin gene transcription by a VDR-dependent mechanism.

Thus, growing literature suggests that vitamin D deficiency may increase the risk of hypertension, and vitamin D supplementation may be beneficial to the cardiovascular system.

CONCLUSION
In conclusion, limited yet growing literature indicates that Vitamin D deficiency is a potential risk factor for Hypertension in elderly. Current study provides an important extension to the existing literature. Based on the results of this study, Hypertension can be controlled in the elderly by making them aware of the importance of nutrition and providing regular examinations checking their Blood Pressures and Serum Vitamin-D levels, and supplementing Vitamin-D to the elderly to enhance the quality of life.

REFERENCES:

[1] Jeyalakshmi S, Chakrabarti S, Gupta N. Situation Analysis of The Elderly in India. New Delhi : Central Statistic s office ,Ministry of statistics & Programme Implementation. Government of India; 2012
[2] United Nations Population Fund. Elderly to constitute 20 percent of India's population by 2050: Report. New Delhi; 2012
[3] Caruso LB,Silliman RA. Harrison's Principles of Internal medicine. 17th ed. USA:McGraw Hill;2008.p. 53-62.
[4] Todkar SS, Gujarathi VV, Tapare VS. Period prevalence and sociodemographic factors of hypertension in rural Maharashtra: A cross-sectional study. Indian J Community Med 2009;34(3):183-7.
[5] Gupta R, Gupta VP, Sarna M, Bhatnagar S, Thanvi J, Sharma V et al. Prevalence of coronary heart disease and risk factors in an urban Indian population: Jaipur heart watch 2. Indian Heart J 2002;54(1):59-66.
[6] World Health Organization. Integrated management of cardiovascular risk, report of a WHO meeting. Geneva; WHO:2002.p.5-9. 4. Birkenhager WH, F

[7] Holick MF. Vitamin D deficiency. N Engl J Med. 2007; 357(3): 266– 281
[8] Vasan RS, Larson MG, Leip EP, et al. Impact of high.normal blood pressure on the risk of cardiovascular disease. N Engl J Med. 2001; 345(18): 1291– 1297
[9] Zittermann A. Vitamin D and disease prevention with special reference to cardiovascular disease. Prog Biophys Mol Biol. 2006; 92(1): 39– 48.
[10] Somjen D, Weisman Y, Kohen F, et al. 25.hydroxyvitamin D3.1alpha.hydroxylase is expressed in human vascular smooth muscle cells and is upregulated by parathyroid hormone and estrogenic compounds. Circulation. 2005; 111(13): 1666– 1671.
[11] Kristal.Boneh E, Froom P, Harari G, et al. Association of calcitriol and blood pressure in normotensive men. Hypertension. 1997; 30(5): 1289– 1294.
[12] McCarty MF, Thomas CA. PTH excess may promote weight gain by impeding catecholamine.induced lipolysis.implications for the impact of calcium, vitamin D, and alcohol on body weight. Med Hypotheses. 2003; 61(5–6): 535– 542.
[13] Rostand SG. Ultraviolet light may contribute to geographic and racial blood pressure differences. Hypertension. 1997; 30(2 Pt 1): 150– 156.
[14] Schedl HP, Miller DL, Pape JM, et al. Calcium and sodium transport and vitamin D metabolism in the spontaneously hypertensive rat. J Clin Invest. 1984; 73(4): 980– 986.
[15] Li YC, Kong J, Wei M, et al. 1,25.Dihydroxyvitamin D(3) is a negative endocrine regulator of the renin.angiotensin system. J Clin Invest. 2002; 110(2): 229– 238.
[16] Chobanion AV, Bakris GL, Black HR. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure- The JNC 7 report. JAMA 2003;289:2560-72.
[17] Norman AW, Bouillon R. Vitamin D nutritional policy needs a vision for the future. Exp Biol Med. 2010;235:1034–45.
[18] Fradinger EE, Zanchetta JR.Vitamin D and bone mineral density in ambulatory women living in Buenos Aires, Argentina. Osteoporosis Int. 2001;12:24-7.
[19] Holick MF Siris E, Binkley N. Prevalence of Vitaamin D inadequacy among postmenopausal North American women recieving osteoporosis therapy. J Clin Endocrinol metab. 2005;90:3215-24.
[20] Holick MF. The Vitamin D deficiency pandemic: a forgotten hormone. Public health reviews. 2010;32:267-83. 16. Holick MF.. Vitamin D : Adelightful solution for health. J Investig Med. 2011;59(6):872-80
[21] Maclaughlin J A, Holick M F. Aging decreases the capacity of human skin to produce Vitamin D3. Journal of clinical investigation. 1985;76:1536-8.
[22] Omdahl JL. Nutritional status in a healthy elderly population:Vitamin D. The American journal of clinical nutrition. 1982;36:1225-33. 16. Munger KL, Levin LI, Hollis BW, Howard NS,
[23] Scragg R, Sowers M, Bell C. Serum 25-hydroxyvitamin D, ethnicity, and blood pressure in the Third National Health and Nutrition Examination Survey. American journal of hypertension. 2007;20:713–9
[24] Bhandari SK, Pashayan S, Liu IL, Rasgon SA, Kujubu DA, Tom TY, et al. 25-hydroxyvitamin D levels and hypertension rates. Journal of clinical hypertension. 2011;13:170–7.
[25] Forrest KY, Stuhldreher WL. Prevalence and correlates of vitamin D deficiency in US adults. Nutrition research. 2011;31:48–54
[26] Martins D, Wolf M, Pan D, Zadshir A, Tareen N, Thadhani R, et al. Prevalence of cardiovascular risk factors and the serum levels of 25-hydroxyvitamin D in the United States: data from the Third National Health and Nutrition Examination Survey. Archives of internal medicine. 2007;167:1159–65
[27] Li YC, Qiao G, Uskokovic M, Xiang W, Zheng W, Kong J. Vitamin D: a negative endocrine regulator of the renin-angiotensin system and blood pressure. Journal of Steroid Biochemistry and Molecular Biology. 2004;89-90:387–392.
[28] Kong J, Qiao G, Zhang Z, Liu SQ, Li YC. Targeted vitamin D receptor expression in juxtaglomerular cells suppresses renin expression independent of parathyroid hormone and calcium. Kidney International. 2008;74(12):1577–1581