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Research article

Determinants of Vitamin D deficiency among the adult population - An observational study

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ABSTRACT

Introduction and Aim: Vitamin D deficiency (VDD) has now become a scourge, and even in sunny areas in India, it is an increasing concern. The present study was prospective in nature and was carried over a period of two years (31st October 2019-1st November 2020) at the wellness clinic in a medical college teaching hospital and research centre and was aimed to inquire the determinants of VDD in the representative sample.

Material and Methods: The serum 25(OH) Vitamin D levels of subjects between the ages of 18 and 60 years were recorded along with their pertinent data. Statistical analysis was carried out using SPSS software v.23.0 and Microsoft Office 2007 to analyse the data. The non-parametric "Chi-square" test was applied to test any possible link between VDD and putative determinants.

Results: VDD (25(OH) D levels< 50 nmol/L) was more common in the elderly (51-60 years), with a higher prevalence among females, in rural regions, and during the winter. Even the young and those with a normal BMI, exhibited significant vitamin D deficiency. Statistically significance was espied for age and VDD.

Conclusion: VDD is very much colloquial in this locale, regardless of age, gender, BMI, seasonality, or urban/rural context. The statistics can help treating consultants understand the purview of the pandemic and develop strategy to improve gains in vitamin D levels on a community level.

Keywords: Vitamin D deficiency; VDI; VDS; tropical region; population.

INTRODUCTION

Vitamin D(25-hydroxyvitamin D) levels in the serum is considered to be the most useful marker of vitamin D status and has been an interested area of research in the recent past (1). The diagnosis of the clinical deficiency is also based on serum levels of 25-hydroxyvitamin D (2). Institute of Medicine (IOM) Committee suggests to use the serum levels of 25-hydroxyvitamin D as only an "indicator" of bone health, as the causality is fully established (3).

The vitamin D status of the population is influenced by many conditions but primarily the difference in age, seasons and increased BMI or frank obesity are important factors (4) along with genetic makeup of the population, the cloud cover of the geographic location, "clothing pattern", pollution and also skin pigmentation (5,6).

The Vijayapura district of north Karnataka receives abundant sunshine throughout the year and hence the deficiency of vitamin D, a sunshine hormone can be frequently overlooked. It also has a mixed population as in the rest of the country and is known to have cultural and social taboos which pose certain limitation for adequate sun exposure. Also, the majority of the population follows a vegetarian food pattern which could limit the vitamin D intake(7). Hence, this study aimed to document and discern the vitamin D status of the regional population and the relationship of the vitamin D status with possible determining factors such as age, gender, urban-rural divide, body mass index (BMI) and the seasons of assay in subjects attending -a tertiary care centre.

MATERIALS AND METHODS

The data was collected according to a predefined protocol and registered as demographic characteristics and diagnostic data after obtaining the Ethical clearance (BLDE (DU) IEC/329/2019-20) from the institutional review board. Details regarding living conditions, and dietary habits, clothing pattern and sun exposure were also noted. Serum 25(OH) Vitamin D levels and information on the symptoms of vitamin D deficiency like bone pains and aches were also registered.

Methodology for vitamin D estimation

The serum 25 OH Vitamin D total levels were estimated on the venous blood sample by using the VITROS 25-OH Vitamin D total reagent pack and the VITROS 25-OH Vitamin D (Total) calibrators on the Vitros ECi/ECiQ Immunodiagnostic systems by competitive immunoassay technique (8) according to the manufacturer's instruction. The method has a detection limit of 18.55 nmol/L and accuracy consistent with CSLI document EP17 and EP9 respectively(9,10).

Quality was assured by the use of Internal and external quality controls with each run. Subjects were diagnosed as vitamin D deficient (VDD), vitamin D insufficient (VDI) and vitamin D sufficient (VDS) based on serum levels of "vitamin D" and as per the latest recommendation of International Endocrine Society(2).

Statistical analysis

All characteristics were summarized descriptively. SPSS software v.23.0 and Microsoft office 2007 were used for data analysis. Continuous variables were summarised as Mean± standard deviation (SD) and the categorical data was computed using number and percentage. The association between two categorical variables was assessed by "Chi-square (χ^2)" test.

RESULTS

Our study analysed a convenience sample of 1031 subjects who availed the services of the "wellness clinic" at the hospital and were self-professed to be healthy. In total, 650 women and 381 men with a mean age of 44.1.6 ± 15.1 years were included in the analysis who were recruited from the past 2 years and were known to have mean BMI values of 23.5± 2.5 kg/m^2 (Table I).

Table 1: Baseline characteristics of the participants

Baseline characteristics	**N (%)**
Age(years)	
18-20	47 (4.6)
21-30	186 (18.0)
31-40	216 (21.0)
41-50	229 (22.2)
51-60	206 (20.0)
>60	147 (14.2
Sex	
Female	650 (63.0
Male	381(37.0)
Urban/Rural	
Rural	520(50.4)
Urban	511(49.6)
BMI	
Normal	667(64.7)
Overweight/obese	364(35.3)
SEASONS	
Winter	258 (25.0)
Summer	261(25.3)
Monsoon	374 (36.3)
Autumn	138 (13.4)

Mean Serum concentration of 25[OH] D was 44.1±15.1 for all participants. Overall, 605 participants (58.7%) had vitamin D deficiency, and 238 had vitamin D insufficiency (23.1%) and only 188(18.2%) of the study population was found to have sufficient vitamin D levels.

Table 2: Distribution of Vitamin D level according to baseline characteristics (original)

Baseline characteristics	**Vitamin D Level**			**Chi square value**	**p value**
	Deficient	**Insufficient**	**Sufficient**		
	N (%)	**N (%)**	**N (%)**		
Age(years)				31.8	<0.001*
18-20	30 (63.8)	11(23.4)	6(12.8)		
21-30	130 (69.9)	35(18.8)	21(11.3)		
31-40	138(63.9)	44(20.4)	34(15.7)		
41-50	135(59.0)	56(24.5)	38(16.6)		
51-60	99(48.1)	52(25.2)	55(26.7)		
>60	73(49.7)	40(27.2)	34(23.1)		
Sex				1.9	0.373
Female	387(59.5)	141(21.7)	122(18.8)		
Male	218(57.2)	97(25.5)	66(17.3)		
Urban/rural				0.57	0.751
Rural	311(59.8)	116(22.3)	93(17.9)		
Urban	294(57.5)	122(23.9	95(18.6)		
BMI				0.37	0.828
Normal	396(59.4v	151(22.6)	120(18.0)		
Overweight/obese	209(57.4)	87(23.9)	68(18.7)		
SEASONS				8.97	0.175
Winter	157(60.9)	54(20.9)	47(18.2)		
Summer	154(59.0)	68(26.1)	39(14.9)		
Monsoon	212(56.7)	24.9)	69(18.4)		
Autumn	82(59.4)	23(16.7)	33(23.9)		
Total	605(58.7)	238(23.1)	188(18.2)		

DISCUSSION

The prevalence of Vitamin D deficiency (VDD) among the apparently healthy populace of the Vijayapura district was as high as 58.7% and adequate levels of vitamin D were noted in only about 18.2 %. A high incidence of VDD among all age groups, independent of factors like gender, BMI and seasons is also reported previously (11).A significant difference (chi square value= 31.8; $p<0.001$) in the vitamin D status among different age groups was observed. VDD was reported in 48.1% of subjects in the age group of 21-30 yr. whereas 69.9% of subjects in the age group of 51-60 years. were found to be deficient of vitamin D. This tends to be due to fact that the 7-DHC concentration in the skin decreases with age and the cutaneous synthesis of Vitamin D is attenuated resulting in a four- fold reduction of D_3 production in 70 year old when compared with 20 year old adult (12).

Reduced intake of vitamin D rich food by the older population and the possibility of age related increase in the adiposity can also lead to increased hypovitaminosis D in them(13). The vitamin D deficient state in the young (48.1%) is also of tremendous concern of their bone health as it is a period of achieving peak bone mass. Strategies which are practical and felicitous should be directed to improve the vitamin D status in this group of population and are the need of the hour.

The higher prevalence of hypovitaminosis D was also seen in females (59.5%) in comparison with the males (57.2%). Possible factors could be lesser exposure to sunlight and less nutrition in comparison to their male counterparts and also early marriage, an early and increased number of pregnancies which are unplanned and shortly spaced (14).

Another observation of our study was that 59.8% of the rural and about 57.5% of the urban population was vitamin D deficient. Estimates are lesser than that reported by Goswami R. et al. where about 70% of the rural population had Vitamin D deficiency, but the mean level of serum 25-OH Vitamin Din them(36.4 ± 22.5 nmol/L) was higher than that found in urban dwellers(13.5 ± 3.0 nmol/L)(15). The VDD noted in rural regions may be possibly due to the high phytate and low calcium content of the diet that has predominantly consumed them. High phytate levels tend to lower the intestinal absorption of calcium as well as escalate the catabolism of 25(OH) D resulting in an increase of the inactive metabolites (16).

The deficiency in the urban population was also of concern and could be possibly due to the modernization with prolonged indoor working hours, and consumption of refined and processed foods. The "Sun-shy" nature of Indians (17) results in poor exposure to sunlight and also, fewer available options of Vitamin D fortified foods for those who are well informed about the importance of vitamin D contribute to the increased deficiency in urban population (18). Our observation of vitamin D status of the participants in relation to body mass index (BMI) was that people with normal BMI (59.4%) were more VDD compared to those with higher BMI (57.4%). The observation remains statistically insignificant but does not agree with the observations of other studies where serum 25(OH)D levels were inversely correlated with obesity with reduced levels in people who were overweight or obese(19,20). Asians Indians have lesser muscle mass and more central fatness when compared to Europeans. Adiposity or fat distribution across ethnic groups cannot be consistently reflected by the use of BMI or the waist to hip ratio (21,22). Furthermore, our study did not report any significant difference in the vitamin D status among the participants during the various seasons (summer-59.0%; winter-60.9 %; monsoon-56.7% and autumn -59.4%). Though our study did not take into account for the skin colour of the participants studied, the population of this region is comparatively dark skinned and require about three to five times longer exposure to the sun in order to synthesize the same measure of vitamin D as their counterparts of a lighter skin tone and could be possibly be one of the explanations for the widespread deficiency noted in this population in spite of the adequate sun exposure (23).

CONCLUSION

Our study concludes that the prevalence of Vitamin D deficiency and insufficiency was noted among the participants in all age groups irrespective of gender and BMI. Neither the urban setting nor the season in which the vitamin D levels were assayed had any significant association with the vitamin D status. We hope these findings shall reinforce the need to design appropriate measures that can improve the vitamin D status of the population at large.

Educating the community on the importance of vitamin D, fortification of common foods, screening and treating the populace for vitamin D deficiency are some of the measures that can be persuaded to be adopted as national policies for large scale transformation.

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CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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