Original Article

Prevalence of Vitamin D Deficiency in Northern Temperate Region of India

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Abstract

Background: Vitamin D plays an essential role in maintaining skeletal integrity and function among other health benefits. Vitamin D deficiency has a bearing not only on skeletal but also on extra-skeletal diseases. It plays a notable role in contributing to several leading causes of death including cardiovascular disease, cancers and diabetes. We sought the prevalence of vitamin D deficiency in Kashmir, a northern temperate region of India where it has been previously thought to be omnipresent.

Methods: This study was conducted across two tertiary care centers namely skims medical college hospital bemina Srinagar and Government medical college Srinagar wherein a total of 4895 patients were included among which 1936 were males and 2959 females. Samples were collected from April to November 2021.Vitamin D deficiency was defined as 25(OH) D concentration of <20 ng/ml. Vitamin D insufficiency was defined as 25(OH) D concentration of 20-30 ng/ml, sufficient Vitamin D level was defined as 25(OH) D concentration of 30 - 100 ng/ml and a risk of Vitamin D toxicity was defined as 25(OH) D concentration >100 ng/ml.

Results: Vitamin D deficiency was seen in 1635(33.4%) patients out of which 981(60%) were females and 654(40%) were males. A total of 543(11.09%) patients had severe Vitamin D deficiency out of which 370(68.1%) were females and 173(31.9%) were males. Insufficient Vitamin D levels were seen in 1364(27.86%) patients of which 797(58.4%) were females and 567(41.6%) were males.

Conclusion: Vitamin D deficiency is quiet prevalent in Kashmir valley and has been seen more commonly among the females. However it may not be as widely prevalent as has been previously observed in the region.

Keywords: Vitamin-D deficiency, calcium homeostasis, 25-hydroxy vitamin-D.

Introduction

Vitamin D plays an essential role in maintaining skeletal integrity, electrolyte reabsorption and immune system regulation among other health benefits. There are two types of physiologically important form vitamin D: cholecalciferol (D3) and

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ergocalciferol (D2). D3 is synthesized in the skin from 7-dehydrocholesterol in cell membranes upon exposure to UVB (290 – 320 nm) while D2 is plant and yeast derived exogenously by UV irradiation of ergosterol[1,2]. Vitamin D in the circulation is metabolized to 25-hydroxyvitamin D [25(OH)D] in the liver and further metabolized to the active metabolite 1,25-dihydroxyvitamin D [1,25(OH)2D] in the kidney. 25-hydroxyvitamin D [25(OH)D] is the major circulating metabolite of vitamin D. The concentration of 1,25(OH)2D is highly regulated by a variety of factors including serum parathyroid hormone and phosphorus levels [1,3].

The primary role of vitamin D has been considered to be the absorption of calcium from the intestine (i.e., calcium homeostasis in the body) and is necessary for skeletal health. Over the years it has become increasingly clear that vitamin D not only has a function in bones but it also significantly affects cell proliferation and differentiation[4]. Vitamin D deficiency has a bearing not only on skeletal but also on extra-skeletal diseases. Vitamin D deficiency has been linked with the increased risk of developing hypertension, diabetes, obesity and high triglyceride levels ultimately leading to increased cardiovascular mortality [5]. Some epidemiological evidence shows that vitamin D defieiency is associated with systemic lupus erythromatosus, rheumatoid arthritis and other autoimmune diseases [6-8]. Vitamin D deficiency plays a notable role in contributing to several leading causes of death including cardiovascular disease, cancers and diabetes.

Sun exposure alone is adequate for vitamin D sufficiency. However vitamin D deficiency is widely prevalent despite plentiful sunshine even in tropical countries like India. Low dietary vitamin D intake and poor exposure to sunlight are common causes of vitamin D deficiency in the general population. Skin pigmentation, clothing practices, latitude and season are some of the factors that influence the cutaneous photochemical synthesis of vitamin D in healthy individuals[9].

Prevalence rates of vitamin D deficiency defined as 25(OH)D <30 nmol/L (or 12 ng/ml) of 5.9% (US) [10], 7.4% (Canada) [11], and 13% (Europe) [12] have been reported. Estimates of the prevalence of 25(OH)D levels <50 nmol/L (or 20 ng/ml) have been reported as 24% (US), 37% (Canada), and 40% (Europe) [10-13]. Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinent and other south Asian countries with the prevalence of 50-97% in the general population[14-18]. It has been observed in previous studies that vitamin D deficiency has a very high prevalence (83%) in apparently healthy adults in Kashmir[19].We conducted this cross sectional study in Kashmir valley, a temperate region situated in Northern India to assess the prevalence of vitamin D.

Methods

This study was conducted in a private diagnostic laboratory based in Kashmir located in the northern Indian union territory of Jammu and Kashmir. Because of its wide catchment area the laboratory receives patients from all over the valley. The study was conducted from April 2021 - November 2021. A total of 4895 patients were included among which were 1936 males and 2959 females. Patients included in the study were apparently healthy and residents of Kashmir valley and all patients had volunteered to be a part of the study. Vitamin D levels were assessed by electrochemilumine scence binding assay using cobas e immunoassay analyzer. Severe Vitamin D deficiency was defined as 25(OH) D concentration less than 12 ng/ml, Vitamin D deficiency was defined as 25(OH) D concentration of <20 ng/ml, suboptimal Vitamin D level was defined as 25(OH) D concentration of 20-30 ng/ml, sufficient Vitamin D level was defined as 25(OH) D concentration of 30 - 100 ng/ml and a risk of Vitamin D toxicity was defined as 25(OH) D concentration >100 ng/ml. The primary aim of our study was to determine the prevalence of vitamin D deficiency as per different age groups and gender in Kashmir North India.

Statistical methods

Statistical analysis was done by using SPSS software version 23. Chi square test was used to find the association between variables and correlation statistics was used. All values were discussed at 5% level of significance i.e. p value <0.05 was taken as significant.

Results

A total of 4895 patients who were residents of Kashmir valley participated in the study which

included 1936 males and 2959 females. Table 1 and figure 1 shows the distribution of patients by age and vitamin D levels respectively. 2496(51%) patients belonged to the age group 30-59 years, 769(15.7%) patients were in 0-14 age group, 725(14.8%) patients were in 15-29 years age group, 905(18.5%) were in 60 and above age group. Vitamin D deficiency was seen in 1635(33.4%) patients out of which 981(60%) were females and 654(40%) were males as shown in Table 2. 806(49.29%) out of 1635 patients having vitamin D deficiency were in the age group of 30-59 years. A total of 543(11.09%) patients had severe Vitamin D deficiency out of which 370(68.1%) were females and 173(31.9%) were males as shown in Table 2. 234(43.10%) patients in the age group 30-59 years had severe Vitamin D deficiency. Insufficient Vitamin D levels were seen in 1364(27.86%) patients out of which 797(58.4%) were females and 567(41.6%) were males. Sufficient Vitamin D levels were seen in 1834(37.46%) patients out of which 1147(62.5%) were females and 687(37.5%) were males. Vitamin D level >100 was seen in 62 patients out of which 34(54.8%) were females and 28(45.2%) were males. Table 3 shows gender distribution about Vitamin D levels. Table 4 shows correlation of vitamin D according to age with a significant p value.

Table 1: Distribution of Patients by Age and Vitamin D Levels.

Levels of Vitamin D		AGE				Total	χ2	p-value
		0-14	15-29	30-59	60+			
<12	N	104	144	234	61	543	170.15	0.001
	%	19.20%	26.50%	43.10%	11.20%	100.00%		
12—20	N	196	169	572	155	1092		
	%	17.90%	15.50%	52.40%	14.20%	100.00%		
21-30	N	211	192	733	228	1364		
	%	15.50%	14.10%	53.70%	16.70%	100.00%		
31-100	N	238	216	937	443	1834		
	%	13.00%	11.80%	51.10%	24.20%	100.00%		
>100	N	20	4	20	18	62		
	%	32.30%	6.50%	32.30%	29.00%	100.00%		
Total	N	769	725	2496	905	4895		
	%	15.70%	14.80%	51.00%	18.50%	100.00%		

Table 2: Distribution of Patients By Gender and Vitamin D Levels.

Levels of Vitamin D		Gender		Total	χ2	p-value
		Male	Female			
<12	n	173	370	543	29.16	0.001
	%	31.90%	68.10%	100.00%		
12—20	n	481	611	1092		
	%	44.00%	56.00%	100.00%		
21-30	n	567	797	1364		
	%	41.60%	58.40%	100.00%		
31-100	n	687	1147	1834		
	%	37.50%	62.50%	100.00%		
>100	n	28	34	62		
	%	45.20%	54.80%	100.00%		
Total	n	1936	2959	4895		
	%	39.60%	60.40%	100.00%		

Table 3: Distribution of Patients By Gender about Vitamin D.

Gender	N	Mean	Standard Deviation	Median	Minimum	Maximum
Female	2959	31	20	27	3	161
Male	1936	31	20	26	3	161
Total	4895	30.75	20.22	26	3	161

Table 4: Correlation of Vitamin D According to Age.

		Vitamin D
Age	ρ	.160**
	p	0.001
	n	4895

**** ρ: Spearman's rank correlation coefficient. n, total number of patients.**

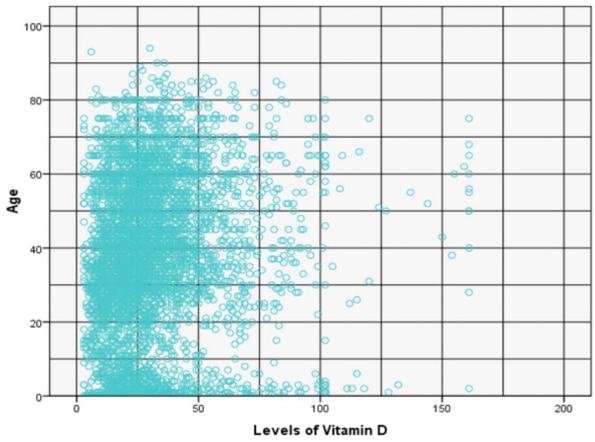

Fig. 1: Vitamin D Levels According to Age.

Discussion

Vitamin D is important for normal development and protection of bone. It has negative effects on calcium metabolism, osteoblastic activity, matrix ossification, bone remodeling and bone density [20]. Vitamin D deficiency is a common condition associated with many diseases including osteoporosis in the elderly, rickets in children, some cancers, cardiovascular diseases and diabetes mellitus [21, 22]. There is no consensus on the optimal serum 25(OH) D levels for bone health. The American Institute of Medicine (IOM) and American Geriatric Society recommend that serum 25(OH)D levels should be above 20 ng/mL and 30 ng/mL respectively to minimize the risk of falls and fractures [23-27].

It is estimated that approximately one billion people in the world suffer from vitamin D deficiency [28]. In the literature vitamin D status differs in several countries even in various regions of the same country. In America and Europe vitamin D deficiency was reported to be found in 40–100% of elderly men and women[28]. Prevalence rates of severe vitamin D deficiency defined as 25(OH)D <30 nmol/L (or 12 ng/ml), of 5.9% (US) [10], 7.4% (Canada) [11], and 13% (Europe) [12] have been reported. Prevalence of vitamin D deficiency is also much higher in Asia. A total of 30–50% of people in India, Lebanon, and Turkey [2] and also 45.2% of women in China were vitamin D deficient. Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinent with the prevalence of 70-100% in the general population.

In our study Vitamin D deficiency was seen in 1635(33.4%) patients out of which 981(60%) were females and 654(40%) were males. 806(49.29%) out of 1635 patients having vitamin D deficiency were in the age group of 30-59 years. A total of 543(11.09%) patients had severe Vitamin D deficiency (Vitamin D <12 ng/ml) out of which 370(68.1%) were females and 173(31.9%) patients were males. Zargar et al[19] had previously in a hospital based study found a very high prevalence (83%) of vitamin D deficiency (defined as a serum 25 (OH) D concentration of <50 nmol/l) in apparently healthy adults from different walks of life. Our study included 4895 patients compared to their study which included 92 patients which may actually be the reason of the disparity in results between the two studies. Our study may actually represent the true prevalence of vitamin D deficiency in our population since it has much higher patient number.

In our study 654 (33.7%) out of total 1936 males and 981 (33.15%) out of total 2959 females had vitamin D deficiency which is again in contrast to that of the earlier study by Zargar et al. who found vitamin D deficiency in 76.6% males and 94.4% females. As prevalent as the deficiency of vitamin D may be the main source of vitamin D is sunlight to which our population is adequately exposed there may actually be no reason for a significant difference in vitamin d levels between the two genders.

In our study 33.4 % patients had vitamin D deficiency (<20 ng/ml) which included 60% females and 40% males. 11.09% of patients had severe vitamin D deficiency (<12 ng/ml) of which 68.1% were women and 31.9% were men. As for vitamin D insufficiency (20–30 ng/mL) it was found in 58.4% of women and 41.6% of men respectively.

Contrary to previous studies which have shown a predilection for vitamin D deficiency in elderly we found vitamin D deficiency more commonly in the adult age group (30-59 years) which may be due to the fact that there were a lesser number of patients enrolled in our study above the age of 60 years. Adding to it is the lack of exposure to sun in the predominantly indoor working class of subjects.

Conclusion

Vitamin D deficiency is quiet prevalent in our valley. However it may not be as widely prevalent as has been previously observed. Physician awareness is important and investigating patients before starting treatment is the ideal way forward.

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