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Original Research Article

To Determine the Sufficient Level of Vitamin D [25 Hydroxy Vitamin D, 25(OH)D] in Relation to Intact Parathormone (IPTH)

Pankaj Kumar[1], Abilesh Kumar[2]

[1]SMO (Specialist Medical Officer) Department of Medicine, Sadar Hospital, Bhagalpur, Bihar, India

[2]Professor and HOD, Department of Medicine, JLNMCH, Bhagalpur, Bihar, India

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Corresponding Author: Dr. Pankaj Kumar
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Abstract

Aim: The aim of the present study was aimed to determine the sufficient level of vitamin D [25 hydroxyvitamin D, 25(OH)D] in relation to intact parathormone (iPTH) in apparently healthy adult volunteers.

Methods: This observational cross-sectional study was conducted in the Department of Medicine, JLNMCH, Bhagalpur, Bihar, India for the period of one year. Informed written consent was taken from the participants. After exclusion, a total of 100 apparently healthy adults were enrolled in the study.

Results: Most individuals were 30-39 years old and male. 75% were urban and 30% had elementary schooling. 48% were middle-class and 68% non-smokers. 33% were obese, 85% normotensive. The vitamin D levels (ng/ml) of patients with insufficient sunshine exposure duration, body surface area, and sunscreen usage were considerably lower than those without sunscreen use. Under all three criteria, persons with enough sunshine exposure had substantially greater vitamin D (ng/ml). The quantity of milk, eggs, and big fish consumed did not affect vitamin D levels.

Conclusion: At least 30 ng/ml of serum 25(OH)D is ideal for healthy persons. Large-scale studies including individuals from diverse parts of our nation and monitoring blood vitamin D year-round may provide higher levels. We can better determine the appropriate vitamin D level for the general population by measuring BMD, biochemical markers (osteocalcin, N-telopeptides, etc.), and calcium absorption simultaneously.

Keywords: healthy adults, intact parathormone; vitamin D, 25(OH)

Introduction

The primary method by which vitamin D, a prohormone, is produced is by the photolysis of 7-dehydrocholesterol, which is found in human skin, by ultraviolet B radiation from the sun, which has a wavelength ranging from 290 to 320 nanometers. A little amount of vitamin D may be obtained via dietary sources such as cod liver oil, beef, eggs, milk products, and mushrooms. Also included in this category are mushrooms. [1] It has been shown that vitamin D has pleiotropic properties, meaning that it may act as an anti-inflammatory, antiapoptotic, and antifibrotic agent. This is in addition to the fact that it plays a significant part in the maintenance of bone mineral homeostasis. Furthermore, it has been shown to play a significant part in the control of activities related to the heart, kidneys, and immune system. A lack of vitamin D has been linked to an increased chance of developing illnesses such as diabetes, schizophrenia, and cancer. This association has been shown via research. [2-6] The amount of blood 25-hydroxy (25-OH) vitamin D, which is one of the most important circulating metabolites of vitamin D, is used to determine an individual's vitamin D status. An evaluation of the biological effects of vitamin D on calcium homeostasis was carried out by Hollis. The findings of this research indicate that a blood 25-OH vitamin D level that is more than 32 ng/ml is necessary for the preservation of bone health. [7] According to the findings of another research conducted by Heaney, the optimal level of calcium absorption in the gastrointestinal tract is reached when blood 25-OH vitamin D levels are more than 30 ng/ml. [8] In light of these results, it is recommended that an individual's blood 25-OH vitamin D level be more than 30 ng/ml in order to get the best possible biological effects of vitamin D. According to the criteria established by the Endocrine Society, the current classification of vitamin D status is as follows: deficiency, insufficiency, and adequacy, on the basis of serum 25-OH. Under 20 ng/ml (50 nmol/L), 21–29 ng/ml (52.5–72.5 nmol/L), and 30–100 ng/ml (75–250 nmol/L) are the amounts of vitamin D that are considered to be below the threshold. [9] Despite the fact that this categorization is generally acknowledged, a significant amount of work is being

put out to interpret the foundation of this criterion. This is due to the fact that the majority of the people around the world have been discovered to be lacking in vitamin D.[10]
The purpose of the current investigation was aiming to identify the necessary amount of vitamin D [25 hydroxyvitamin D, 25(OH)D] in relation to intact parathormone (iPTH) in apparently healthy adult volunteers.

Materials and Methods

This observational cross-sectional study was conducted in the Department of Medicine, JLNMCH, Bhagalpur, Bihar, India for the period of one year. Informed written consent was taken from the participants. After exclusion, a total of 100 apparently healthy adults were enrolled in the study. Initially, apparently healthy adults were consecutively recruited by purposive sampling to screen with clinical features and biochemical tests [serum alanine amino transferase (ALT) and creatinine]. Participants who were taking or had received vitamin D or calcium supplements within last 120 days of sample collection, or took medications that might affect calcium, vitamin D metabolism, and bone, or who had any known diseases (chronic heart failure, renal failure, cancer, etc.) along with pregnant or lactating mothers were excluded from study. Prior to enrollment, it was established that all of the participants had normal liver (serum ALT £40 U/L) and kidney function (eGFR 60 ml/minute/1.73 m2 body surface area).

Demographic profile along with sunlight exposure and dietary history were taken. Sunlight exposure of more than one hour between 11 am to 2 pm at least three days a week with exposure of at least 18% body surface area without use of sunscreen (sun protecting factor ³8) was considered as adequate.8 Food frequency questionnaire was used to collect dietary history.9 Height, weight, waist circumference (WC) and blood pressure were measured by standard procedures. Body mass index (BMI= weight in kg ÷ height in meter2) ³25 kg/m2, WC ³90 cm for male and ³80 cm for female and blood pressure ³140/90 mm-Hg were considered as general obesity, central obesity and hypertension respectively.10,11 About 10 ml of venous blood was drawn from each participant in the fasting state. Serum was separated by centrifugation and stored in -200 C until assay. Assay of the collected samples were done for 25(OH)D by high performance liquid chromatography method (HPLC) in SIL 20 series prominence HPLC analyzer with a coefficient of variability 2.6 – 4.9%. Serum iPTH, calcium, albumin along with phosphate were analyzed by chemiluminescent enzyme-labeled immunometric assay with Immulite 2000 systems Siemens, USA analyzer. Corrected calcium was calculated from fasting calcium and albumin by using correction formula {corrected calcium (mg/dl) = measured calcium (mg/dl) + 0.8 × (4 – measured albumin in gm/ dl)}.

All data were processed by the SPSS program (version 22.0). Data were expressed in frequencies or percentages for qualitative values and mean (±SD) or median (interquartile range) for quantitative values. To compare the mean value of subgroups, independent-samples T test, one way ANOVA were used as appropriate. Spearman's correlation test was used to correlate between vitamin D, iPTH and other variables. The association between 25(OH)D and iPTH concentrations was studied both by linear and non-linear regression models. A quadratic model with plateau was fitted to see the relationship between serum iPTH and serum 25(OH)D levels to objectively identify the 25(OH)D level where the iPTH reaches a plateau. P values <0.05 were considered as statistically significant.

Results

Table 1: The characteristics of the study population

Variables	Categories	Number	25(OH)D (ng/ml) mean±SD	p value
Age group	20 – 39 years	66	16.82±7.86	0.002
	40 – 59 years	24	14.00±8.29	
	□60 years	10	24.31±9.83	
Sex	Male	52	16.27±8.20	0.482
	Female	48	17.32±8.78	
Residence	Urban	75	16.33±8.44	0.307
	Rural	25	18.08±8.55	
Occupation	House wife	24	16.85±8.80	0.064
	Service holder	30	18.72±8.17	
	Student	25	13.63±7.90	
	Others	21	17.92±8.51	
Educational status	Primary	30	19.43±8.15	0.068
	Higher secondary	35	15.43±8.22	

	Graduate and above	35	15.96±8.68	
Socio-economic status	Lower	40	16.91±8.46	0.966
	Middle	48	16.59±8.55	
	Higher	12	17.13±8.77	
Physical activity level	Low	15	18.55±10.95	0.136
	Moderate	65	15.66±8.04	
	High	20	18.86±8.47	
Smoking status	Smoker	32	15.89±5.87	0.267
	Nonsmoker	68	17.41±8.55	
Blood pressure	Hypertensive	15	19.69±6.65	0.079
	Normotensive	85	16.38±8.81	
BMI category(kg/m^2)	Underweight (<18.5)	3	14.21±3.33	0.644
	Normal (18.5 – 22.9)	42	16.40±9.32	
	Overweight (23 – 24.9)	22	18.40±7.68	
	Obese (□25)	33	16.25±8.17	
WC category	Centrally obese	55	16.29±7.71	0.445
	Nonobese	45	17.44±9.42	

There were male predominance and most of the subjects belonged to 30-39 years of age. 75% belonged to urban area and 30% had primary educational qualification. 48% belonged to middle socioeconomic status and 68% were non-smoker. 33% were obese and 85% were normotensive.

Table 2: Dietary and sunlight exposure history in the study population

Variables	Category	No.	Vitamin D (ng/ml) mean±SD	p
Number of cups of milk consumption/ week	None	35	17.83 ±7.89	0.100
	1 to 3	55	15.47±8.45	
	4 to 6	9	22.43±10.56	
	7 and above	1	23.35	
Number of egg consumption/ week	None	10	19.21±8.37	0.378
	1 to 3	18	15.00±6.95	
	4 to 6	26	18.11±8.66	
	7 to 10	46	16.25±8.90	
Number of pieces of large fish consumption/ week	None	16	17.85±8.04	0.749
	1 to 5	6	15.23±6.20	
	6 to 10	48	17.03±8.68	
	11 to 15	5	19.40±6.65	
	15 and above	25	15.48±9.16	
Sunlight exposure time	Adequate	28	19.76±7.61	0.013
	Inadequate	72	15.64±8.55	
Sunlight exposure of body surface	Adequate	20	20.32±5.80	0.023
	Inadequate	80	15.98±8.80	
Sunscreen use	Yes	5	9.28±5.93	0.026
	No	95	17.14±8.43	
Overall sunlight exposure	Adequate	20	20.32±5.80	0.005
	Inadequate	80	15.98±8.80	

Patients with inadequate sunlight exposure time, exposure of inadequate body surface area to sunlight and use of sunscreen had significantly lower vitamin D level (ng/ml) than adequate sunlight exposure time, body surface area and without history of use of sunscreen respectively. Considering all the three factors, participants with adequate sunlight exposure had significantly higher vitamin D (ng/ml) than inadequate sunlight exposure. Vitamin D levels had no significant associations with consumption of different amount of milk, egg and large fish.

Discussion

Vitamin D deficiency is currently recognized as a worldwide epidemic and its potential health implications are currently the subject of significant interest and controversy. [11] The major circulating form of vitamin D is 25- hydroxyvitamin D {25(OH)D}. It is widely considered as the best indicator of vitamin D status because of its stability, better co-relation with clinical features, and accurate reflection of body storage. [12]

There were male predominance and most of the subjects belonged to 30-39 years of age. 75% belonged to urban area and 30% had primary educational qualification. 48% belonged to middle socioeconomic status and 68% were non-smoker. 33% were obese and 85% were normotensive. A systematic review consisting of 40 studies conducted among 19,761 apparently healthy Indians found a population mean of vitamin D of 14.16±0.89 (13.27 – 15.05) ng/ml. The level is lower than our study result. [13] This may be due to use of predominantly older methods (radioimmunoassay, chemiluminescent immuno-assay, enzyme-linked immunosorbent assay etc.) in most studies rather than HPLC method.

Patients with inadequate sunlight exposure time, exposure of inadequate body surface area to sunlight and use of sunscreen had significantly lower vitamin D level (ng/ml) than adequate sunlight exposure time, body surface area and without history of use of sunscreen respectively. Considering all the three factors, participants with adequate sunlight exposure had significantly higher vitamin D (ng/ml) than inadequate sunlight exposure. Vitamin D levels had no significant associations with consumption of different amount of milk, egg and large fish. The timing and proper skin exposures are also important for vitamin D photosynthesis. [14] We presume and agree with the authors who indicated that low intensity of the sun in the morning, shaded sun shines, shadows of tall buildings and trees, upright position of the subjects, high pollution in the air, covered- up-dressing style as well as the dark skin necessitate the need for prolonged exposure for adequate synthesis of vitamin D in the skin. [15]

Substantial studies found that 25(OH)D concentrations from 12 – 50 ng/ml (30 – 125 nmol/L) were required to maintain a normal iPTH level. [16,17] In the Israeli population, serum 25(OH)D levels <20 ng/ml were associated with a steep increase in iPTH levels, which lessen with increasing 25(OH)D levels and reached a plateau at 25(OH)D levels of 30 to 34 ng/ml. It was appraised that iPTH began to increase when serum 25(OH)D level was < 31.56 ng/ml. This point corresponded to a serum iPTH level of 62.5 pg/ml in all cases tested. [18] In French population, iPTH levels began to plateau at their nadir when 25(OH)D levels were between 30 and 40 ng/ml. [19]

Conclusion

The optimal level of serum 25(OH)D for apparently healthy adults is above 30 ng/ml. Large scale study encompassing people from different regions of our country and measuring serum vitamin D round the year, may yield more robust level of serum vitamin D. Simultaneous measurement of BMD, biochemical markers (osteocalcin, N- telopeptides etc.) and calcium absorption will further help us to precise the optimal level of vitamin D in general population.

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