Vitamin D status in a sample population representing urban youth

Chandrika N[1,*], Usha SMR[2], HV Shetty[3]

[1]Assistant Professor, Chamarajanagar Institute of Medical Sciences, Chamarajanagar, [2]Professor & HOD, [3]Dean & Professor, Dept. of Biochemistry, Rajarajeswari Medical College & Hospital, Bengaluru

***Corresponding Author:**
Email: dr.chandrika@gmail.com

Abstract

Background: Vitamin D deficiency is clinically silent and affected individuals are at high risk for the consequences of unrecognized and untreated hypovitaminosis D.The cut off value to define low vitamin D status remains controversial. The objective of this study is to assess and interpret the vitamin D status based on the two different 'cut off 'recommended by US Endocrine society and Institute of Medicine(IOM) respectively in a sample population of young adults in urban area.

Methodology: Fifty five apparently healthy young adults of 18 to 23 years age group were recruited in this study and their 25 hydroxycholecalciferol(25OHD), serum calcium, serum phosphorus and serum alkaline phosphatase levels were estimated. The study subjects were asked to furnish information regarding their dietary habits, lifestyle and daily sun exposure duration.

Result: The mean±standard deviation(SD) value of vitamin Dfor the whole group in our study is11.03±4.96 ng/ml. Based on US Endocrine society classification, 94.54% of the subjects had vitamin D deficiency (VDD), 5.45% had vitamin D insufficiency and none were vitamin D sufficient. IOM classification based distribution showed that 78.18% had VDD, 16.4% had sub optimal levels and 5.45% of the whole group had optimum D levels.

Conclusion: Based on our findings, we conclude that reference ranges to define vitamin D levels should be established for our population. Also Government should take initiative to bring awareness among the public about vitamin D supplementation and food fortification as a preventive measure against hypovitaminosis D epidemic.

Key words: 25 hydroxycholecalciferol(25OH D), Vitamin D deficiency(VDD),vitamin D insufficiency, US Endocrine Society, Institute of Medicine(IOM).

Access this article online	
Quick Response Code:	**Website:** www.innovativepublication.com
	DOI: 10.5958/2394-6377.2016.00044.7

Introduction

Malnutrition is one the major health problems prevailing in India as 21.9% of our population are still below poverty line[1]. Vitamin D is a micro-nutrient which is affordable even by the poorest of the poor, as ample sunshine is all that is required for its synthesis. India is a tropical country extending from 8.4° N to 37.4°N lattitude[2] and majority of our population reside in areas where there is adequate sunlight. In spite, recent data suggest that 50 to 90% of Indian population have low levels of vitamin D.

In response to UV-B radiation of the skin, a photochemical cleavage results in the formation of vitamin D from 7-dehydrocholesterol in our body. The dietary source of vitamin D suffice only one fifth of the total requirement[4]. The plant source is in the form of vitamin D_2, whereas that from animal source is vitamin D_3. These two forms have equivalent biologic activity and are activated equally well by the hydroxylases in humans. The biologic effects of both dietary and endogenously synthesized vitamin D are mediated by vitamin D receptors which are found in most tissues: binding with these receptors potentially expands vitamin D actions on nearly all cell systems and organs(e.g. Immune system, brain, breast, colon and prostate) as well as exerting classic endocrine effects on calcium metabolism and bone health.

Vitamin D status is determined by the measurement of the circulating concentration 25-hydroxy cholecalciferol (25-OH D). 25-OH Dis the major circulating and the storage form of vitamin D. The half-life of 25-OH D is approximately 2-3 weeks.

It's now a well-established fact that vitamin D deficiency causes rickets in children and osteomalacia in adults. Recent studies have shown that sub optimal vitamin D levels defined as vitamin D insufficiency is associated with an elevated risk of a number of chronic disorders including malignancy, inflammation and autoimmune diseases as well as metabolic disorders[5].

The cut off value to define low vitamin D status remains controversial due to variability of vitamin D concentration by geographic location and differences in assay methodology. The publication of the two most authoritative reports on these issues, one released from the US Endocrine Society and the other from the Institute of medicine (IOM) has led to more confusion among clinicians, researchers and the public with regard to data interpretation of vitamin D levels. The US endocrine society reported 25-OH D, ≤20 ng/ml as the 'cut off' to define vitamin D deficiency, a 25-OH D between 21 and 29 ng/ml as vitamin D insufficiency

and a 25-OH D≥30 ng/ml as optimal level. In contrast, the IOM conclude that 25-OH D levels above 20 ng/ml are needed for good bone health for almost all the individuals (97.5% of the population), while a level of 16 ng/ml meets the need of approximately half the population, suggesting that higher levels of vitamin D may not necessarily confer greater benefits[6].

With this background, we set out to assess and interpret the vitamin D status based on the two different 'cut off' recommended by the above mentioned societies in a sample population of young adults.

Methodology

Fifty five apparently healthy students from Rajarajeswari Medical College and Hospital, Bengaluru, of 18 to 23 years age group, hailing from upper socioeconomic status volunteered to be the part of this study. This group consisted of thirty two girls and twenty three boys. The study was conducted between January 2014 and March 2014. An informed and written consent was taken from the participants, also they were asked to furnish details relevant to our study in a proforma provided to them. Based on general physical examination and the medical history elicitation all the students recruited were validated of being healthy at the time of the study.

Fasting blood sample of 5 ml was collected in clot activator containing vacuum evacuated tubes. Serum calcium, serum phosphorus and serum alkaline phosphatase was estimated on the same day from the serum derived from the respective blood samples. The remaining serum was aliquoted, labelled and preserved at -20°C for estimation of vitamin D, which was run in a single batch when all fifty five blood samples were obtained.

Serum calcium, phosphorus and alkaline phosphatase were estimated photometrically on Mindray BS 300 fully automated analyser by arsenazo III, UV test with end point determination and IFCC (with AMP buffer) methods respectively. Vitamin D was estimated by chemiluminescence immunoassay method on Maglumi 1000 analyser.

The proforma was mainly intended to provide us information regarding the amount sun light each individual was exposed to and if they were regularly using sun blocks/purdah.

The study was approved by the Institutional Ethics committee.

Statistical analysis: The biochemical profile constituting the above mentioned parameters and the information from proforma of these fifty five students were compiled and analyzed. The vitamin D values were classified according to specifications of two different societies and value under each category was expressed in numerical and percentages for comparison. Data was also expressed as mean and Standard deviation(SD). Correlations were done by calculating Pearson's correlation. All statistical analysis was done at 5% level of significance using statistical software SAS 9.2 and SPSS 15.0.

Results

In the current study apart from vitamin D(25 OH D), the biochemical parameters we have studied are serum calcium, phosphorus and alkaline phosphatase. We chose the two minerals calcium and phosphorus, as the their metabolism is regulated by vitamin D. Serum alkaline phosphatase for long is known to be a surrogate marker of bone activity and the levels of the bone isoenzyme of this enzyme is increased in vitamin D deficiency.

Table1 depicts the reference ranges and mean±standard deviation values of the four analytes in our study. The table also gives the mean±SD values for the whole group and separately for girls and boys. Except for vitamin D, the rest of the biochemical parameters are within the reference ranges.

The primary focus of this study is to compare vitamin D levels based on two different cut offs given by US Endocrine society and Institute of Medicine respectively. This is compiled in Table 2. The percentages of subjects in deficient class vary grossly between the two classifications. More numbers of subjects are categorized as deficient when classified according to US Endocrine society. The same pattern of distribution of vitamin D levels are observed in girls and boys when compared in a similar fashion as in the whole group, the same is tabulated in Table 3 & 4. No significant correlation was seen between vitamin D and rest of the parameters in our study.

Table 1: Reference ranges and descriptive statistics of Biochemical parameters of students studied

Sl no.	Parameter	Reference range	Mean±Standard Deviation	
1	Vitamin D (ng/ml)	≥ 30	Whole group (n=55)	11.03±4.96
			Girls (n=32)	10.74±5.49
			Boys (n=23)	11.43±4.17
2	Serum Calcium(mg/dl)	8.4 to 10.7	Whole group (n=55)	11.49±13.27
			Girls (n=32)	9.56±0.66
			Boys (n=23)	14.17±20.47
3	Serum Alkaline phosphatase (U/L)	47 to 147	Whole group (n=55)	97±29.25
			Girls (n=32)	84.34±20.10
			Boys (n=23)	114.60±31.21
4	Serum phosphorus (mg/dl)	2.5 to 3.5	Whole group (n=55)	3.35±0.47
			Girls (n=32)	3.35±0.36
			Boys (n=23)	3.34±0.59

Table 2: Comparison between Vitamin D levels based on US Endocrine society and Institute Of Medicine cut offs in the whole group (n=55)

US Endo Soc	No. of students(%)	IOM	No. of students(%)
≥30 ng/ml(Sufficiency)	Nil	≥ 20 ng/ml covers the requirements of ≥97.5% of the population	03(5.45%)
21-29 ng/ml(Insufficiency)	03(5.45%)	>16ng/ml covers the requirements of approximately half the population	09(16.4%)
≤ 20ng/ml(Deficiency)	52(94.54%)	<16 ng/ml	43(78.18%)

Table 3: Comparison between Vitamin D levels based on US Endocrine society and Institute Of Medicine cut offs among girls (n=32)

US Endo Soc	No. of students(%)	IOM	No. of students(%)
≥30 ng/ml(Sufficiency)	Nil	≥ 20 ng/ml covers the requirements of ≥97.5% of the population	02(6.25%)
21-29 ng/ml(Insufficiency)	02(6.25%)	>16 ng/ml covers the requirements of approximately half the population	06(18.75%)
≤ 20ng/ml(Deficiency)	30(93.75%)	<16 ng/ml	24(75%)

Table 4: Comparison between Vitamin D levels based on US Endocrine society and Institute Of Medicine cut offs among boys (n=23)

US Endo Soc	No. of students(%)	IOM	No. of students(%)
≥30 ng/ml(Sufficiency)	Nil	≥ 20 ng/ml covers the requirements of ≥97.5% of the population	01(4.35%)
21-29 ng/ml(Insufficiency)	01(4.35%)	>16 ng/ml covers the requirements of approximately half the population	03(13%)
≤ 20 ng/ml(Deficiency)	22(95.65%)	<16 ng/ml	19(82.6 %)

Table 5: Comparison of different aspects of US endocrine society and IOM studies

S. No	Study description	US Endocrine Society	IOM
1	Population	At risk for vitamin D deficiency	General population
2	Tools	Based both on Randomized control trials and observational studies	Based more on Randomized control trials than observational studies
3	Calcium absorption	Optimal absorption at 25OH D level of 30 ng/ml	Calcium absorption reaches threshold at a range of 5-10ng/ml of 25OHD
4	Osteomalacia	Seen in 8.5% of cases with 25OH D>20ng/ml	Seen in 1% of cases with 25OH D>20ng/ml
5	Vitamin supplementation for adults	1500 to 2000 IU/day	600 IU/day

Discussion

With over one billion population in the world having either vitamin D deficiency or insufficiency[7], researchers have been trying to analyze the cause for the same, but the answers are as eluding as a mirage in the desert. It is quite surprising to note that more than half the Indian populations have low vitamin D levels and this data clearly suggests the deficiency/insufficiency is prevailing among the ostensibly healthy population. This finding sets off two thought processes, one whether the situation needs us to be on guard with constant monitoring of this population and two, is there a need for re-establishment of cut off values of vitamin D for our population? Ours is a pilot study and a small step in addressing these two concerns.

When we focus on the findings of our study we see that the mean±SD value of serum 25 hydroxycholecalciferol for the whole group is 11.03±4.96 ng/ml and for that of girls and boys are 10.75±5.49 ng/ml and 11.43±4.17 ng/ml respectively. This is consistent with findings of study by Zarger et al which also involved fifty urban subjects and the mean±SD 25OHD level was 11.26±9.65 ng/ml[8]. Puri et al who conducted study among higher income group adolescents also observed 25OHD to be 11.75±5.07 ng/ml (Mean±SD) which is very similar to our findings[9]. We have supportive findings by Marwaha et al who have reported 12.96±9.84 ng/ml vitamin D value among young adults[10].

The US Endocrine society reported 25-OH D, ≤20 ng/ml as the 'cut off' to define vitamin D deficiency, a 25-OH D between 21 and 29 ng/ml as vitamin D insufficiency and a 25-OH D≥30 ng/ml as optimal level. According to this classification, of the fifty five students in our study, none of them had sufficient or optimal vitamin D levels. Three students comprising 5.45% of the total had sub-optimal or insufficient vitamin D levels. Fifty two students i.e., 94.54% of the study population were vitamin D deficient. The scenario remained almost the same as seen in table 3 & 4 when we segregated the whole group into girls and boys sub groups. Our findings are akin to observations made by Vipputuri et al who reported vitamin D deficiency of 94.3% in urban adults in their study[11]. 94.4 and 91.9 are percentages of vitamin D deficiency as declared by Zarger and Puri et al respectively in their articles[8,9].

The Institute of Medicine in their Dietary reference intakes for calcium and vitamin D, November 2010 report suggests that nearly all individuals meet their needs at intake levels (RDAs) provided in this report and, for vitamin D, at 25OHD levels of at least 20 ng/ml (50 nml/liter) even under conditions of minimal sun exposure. Furthermore, higher levels have not been shown consistently to confer greater benefits, challenging the concept that "more is better." Serum concentrations of 25OHD above 30 ng/ml (75nmol/liter) are not consistently associated with increased benefit, and risks have been identified for some outcomes at 25OHD levels above 50 ng/ml (125 nmol/liter).So we categorized the 25OH D values in our study based on IOM recommendation. Now, we had 5.45% of the whole group who had IOM certified optimum D levels, i.e. >20 ng/ml, 16.4% had levels between 16 and 20 ng/ml- a sub optimal level according to IOM as this range covers the requirements of approximately half the population and 78.18% were deficient as per IOM norms. The girls and boys sub groups also show similar distribution. Jayshree et al in their study have disclosed that 62.5% had vitamin D deficiency(VDD) considering 16ng/ml as cut off[12]. Tiwari and Puliyel et al also have recorded VDD ranging between 82 to 84% with <14ng/ml as VDD[13].

When we compare percentage of students who get classified under VDD it varies. According to US Endocrine Society classifications 94.5% come under VDD category, where as 78.18% fall under VDD when classified according to IOM.

In Table 5, we have compared the major differences observed in the US Endocrine society and IOM studies. The IOM studies have more pitfalls when compared to US Endocrine study. Also with IOM based classification we have at least 5.45% who are with vitamin D sufficiency, which is encouraging as the populations we have selected are healthy young adults. With US endocrine society study, the recommendations are evidence based and with few loopholes, but based on this classification nobody in our study population is vitamin D sufficient!

Eventually both authorities conclude that that existing data in their research work are not sufficient to support the recommendation of vitamin D supplementation to reduce the risk of extra skeletal acute and/or chronic diseases[14,15]. So the confusion with respect to adoption of which professional organizational recommendation continues.

12.96° N latitude runs across Bengaluru, a geographical location receiving good amount of sunshine all-round the year. There is no study so far that has evaluated vitamin D levels in the population of this region in South India. Amount of sun exposure required for adequate vitamin D synthesis in this region is thirty minutes of exposure to arms, neck and face every day. In our study all fifty five subjects revealed that they were sufficiently exposed to sun so as to meet the daily vitamin D synthesis requirement. None were practicing purdah and few used sunscreen with SPF(sun protection factor) of <30. There was no significant correlation between dietary habits and vitamin D levels in the study.

Finally, in our study we did not observe statistically significant correlation between serum calcium and 25OH D, serum alkaline phosphatase and 25OHD, serum phosphorus and 25OH D as well. The same result was reported in a study by Jayashree Vasudevanet al[12].

Maintenance of optimal vitamin D levels in the blood has hogged the spotlight after recent studies have correlated sub-optimal vitamin D levels with chronic diseases like malignancy, autoimmune and metabolic disorders. Just as serum creatinine levels becomes abnormal only when the kidneys have lost fifty percent of its functional capacity, there is a possibility that the adverse effects of a chronically low vitamin D manifests when the damage has become irreversible. So the need of the hour is establish a reliable cut off to define sufficiency, insufficiency and deficiency of vitamin D levels in our population. Meanwhile Government should take steps to educate the public regarding consumption vitamin D rich diet and food fortification with vitamin D as sunlight alone seems not to suffice the recommended daily requirement of so called 'sunshine vitamin'.

Acknowledgements

We thank Dr. H.V. Shetty, Dean and Professor, Rajarajeswari Medical College and Hospital, Bengaluru for his encouragement in accomplishing this study. Our sincere thanks to Dr. Manjula H.S., Dr. Victoriakshetrimayum and Dr. Vijayalakshmi, Post Graduate students, Department of Biochemistry, Rajarajeswari Medical College and Hospital, Bengaluru, India for their help during this research work. We also thank the medical students for willing to be a part of this study.

References

1. Devi R, Dixit S. India's Chronic Religion" "POVERTISM". International Journal of Technology Innovations and Research (IJTIR). April 2015;Volume 14.
2. Lodhey V. Vitamin D deficiency: Indian scenario. JAPI.Nov 2011;Vol 59, Editorial.
3. Harinarayan CV, Joshi SR. Vitamin D status in India-Its implications and Remedial Measures. J Assoc Physicians India 2009;57:40-484.
4. Romagnoli E, Pepe J, Piemonte S, Cipriani C and Minisola S. Value and limitations of assessing vitamin D nutritional status and advised levels of vitamin D supplementation. European Journal of Endocrinology. 2013;169:R59–R69.
5. Whiting SJ & Calvo MS. Vitamin D insufficiency: a significant risk factor in chronic diseases and potential disease specific biomarkers of vitamin D sufficiency. J Nutr 2005;135:301–303.
6. Aloia JF. The 2011 report on dietary reference intake for vitamin D: where do we go from here? Journal of Clinical Endocrinology andMetabolism.2011;96:2987–2996.
7. Hollick MF. Vitamin D deficiency. N Engl J Med. 2007;357: 266-281.
8. Zargar AH, Ahmad S, Masoodi SR, Wani AI, Bashir MI, Laway BA, Shah ZA. Vitamin D status in apparently healthy adults in Kashmir Valley of Indian subcontinent. Postgrad. Med. J. 2007;83:713–716.
9. Puri S, Marwaha R.K, Agarwal N, Tandon N, Agarwal R, Grewal K, Reddy DH, Singh S. Vitamin D status of apparently healthy schoolgirls from two different socioeconomic strata in Delhi: Relation to nutrition and lifestyle. Br. J. Nutr. 2008; 99:876–882.
10. Marwaha RK, Tandon N, Garg MK, Kanwar R, Narang A, Sastry A, Saberwal A, Bandra K. Vitamin D status in healthy Indians aged 50 years and above. J. Assoc. Physicians India 2011;59:706–709.
11. Vipputuri MR, Goswami R, Gupta N, Ray D, Tandon N, Kumar N. Prevalence and functional significance of 25-hydroxyvitamin D deficiency and vitamin D receptor gene polymorphisms in Asian Indians. Am. J. Clin. Nutr. 2006;83:1411–1419.
12. Vasudevan J, Reddy GMM, Jenifer A, Thayumanavan S, Uma Devi, Rathinasamy M. Prevalence and Factors Associated with Vitamin D Deficiency in Indian Children: A Hospital Based Cross Sectional Study. Pediatric On call Journal. July-.September 2014; Vol 11, issue 3.
13. Tiwari L and Pulilyel J. Vitamin D Level in Slum Children of Delhi. Indian Pediatrics.2004;41:1076-1077.
14. Institute of Medicine (IOM). Dietary Reference Intakes for Calcium and Vitamin D. November 30,2010.
15. Endocrine Society clinical practice guideline. J Clin Endocrinol Metab. 2011;96(7):1911-1930.