

Prevalence of vitamin D deficiency in adults in the coastal regions of Odisha, India

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Abstract

Background and objectives: Vitamin D is a fat-soluble vitamin belonging to secosteroids. It is responsible for intestinal absorption and bioavailability of calcium and phosphorus. Synthesis of vitamin D in response to ultraviolet rays in skin depends on latitude, atmospheric pollution, clothing, skin pigmentation, sunscreen usage, duration and time of exposure to sunlight. Deficiency causes rickets, defective bone mineralization, osteomalacia and various non skeletal diseases such as rheumatoid arthritis, diabetes mellitus, coronary artery disease and cancer. Recent studies have suggested a deficiency state in Indian population in spite of ample sunshine. Hence, this study was designed to estimate the prevalence of vitamin D deficiency in adults in the coastal regions of Odisha, India

Material and methods: This cross-sectional study included 3056 conducted among healthy population of Cuttack, a coastal district of Odisha. All the individuals were tested for serum 25(OH)D level by electrochemiluminescence immunoassay method using automated analyzer Cobas e411, Roche diagnostics.

Results: We observed a vast majority of individuals (48.2%), were deficient and many were moderately (36.7%) deficient. Among the study population almost 84.9% were deficient in vitamin D. The deficiency was more in females (78.7%) as compared to males in this study population.

Conclusion: We conclude by suggesting that regular serum vitamin D status must be assessed to review the nutritional status in apparently healthy population and in musculoskeletal diseases. Vitamin D supplementation may be introduced along with regular monitoring may be included in the health care management.

Keywords: Cholecalciferol, vitamin D3, 25(OH)D, Deficiency

I. Introduction

Vitamin D is a fat soluble vitamin involved in the calcium and phosphorus metabolism. The synthesis of vitamin in the skin depends on various factors such as latitude, clothing, skin colour, sunscreen usage, duration and time of exposure to sunlight. In spite of abundant sun exposure Vitamin D deficiency is common in all age groups of India (1-4). As per the FAO/WHO expert Consultation report, thirty minutes of exposure of skin to sunlight without the application of sunscreen is optimum for the synthesis of vitamin in the subcutaneous fat (5). Vitamin D is crucial for maintain bone mineralization, prevention of Rickets in children and osteoporosis and osteomalacia in adults (6, 7). In human, the vitamin D related compounds include D2 (ergocalciferol) and vitamin D3 (cholecalciferol). While D2 is mainly found in plant kingdom, synthesized in mushrooms and yeast, D3 is synthesized in the skin when exposed to ultraviolet rays. Hence, the name "sunshine vitamin" (8,9). Vitamin D is obtained from sunlight or from food rich in vitamin D such as mushrooms, dairy products and fish. In the body vitamin D is metabolized in the liver to 25 hydroxy vitamin D [25(OH)D] or calcidiol. This is found in the blood circulation and is measured in the serum to assess deficiency states. The renal enzymes metabolize calcidiol to calcitriol, the physiologically active form of vitamin D called 1,25-dihydroxy vitamin D. This form regulates the calcium and phosphorus metabolism (9). Other than skeletal system vitamin D is associated with cardiovascular disease, type 2 diabetes mellitus, multiple sclerosis, preeclampsia, tuberculosis, cancer (9, 10, 11). Vitamin D deficiency causes demineralization of bones, rickets in children and osteomalacia in adults. Hence, vitamin D is usually prescribed in both children and adults. Excessive intake of the vitamin causes hypervitaminosis and hypercalcemia, leading to loss of appetite, irritability, over calcification of bones, soft tissues, renal stones and even induce hypertension (12, 13). The recommended daily dietary allowances of vitamin D are as follows: upto 1 year of age-400IU, 1 year to 70 years- 600IU and >70 years-800IU (14, 15,16). This dietary allowances complements the naturally synthesized vitamin D on exposure to sunlight (14, 15, 16,17). Hence, this study was designed to evaluate the serum vitamin D levels in apparently healthy adults.

II. Material and method:

This study was carried out among adults of various age group in the city of Cuttack during March 2015 to September 2016. The study included 3056 individuals. Informed consent was obtained from all the participants. Individuals on vitamin supplements, pregnant and lactating ladies were excluded. The individuals suffering from chronic diseases such as Diabetes, hypertension and other illness were excluded. Fasting venous blood samples were collected from all the individuals. Serum Vitamin D estimation was done by electrochemiluminescence immunoassay (ECLIA) by commercial kits from Roche diagnostics adapted to automated analyzer Cobas e411, Roche diagnostics. We followed the recommendations of Mayo medical laboratory for assessing the biological reference range for serum vitamin D (15). As per the recommendation, the normal range of serum vitamin D is 29-80ng/ml. Vitamin D deficiency is classified as severe deficiency (less than 10ng/ml), mild to moderate deficiency (10-28ng/ml). Vitamin D toxicity is indicated when the serum levels are more than 80ng/ml (18). In this study we included the following classification: less than 10ng/ml was considered severely deficient; 11-20ng/ml as moderately deficient; 21-28 as mildly deficient and the normal range was 30-80ng/ml. Vitamin D level more than 80 was considered as toxicity

III. Results

This cross-sectional study included 3056 (1627 males and 1429 females) individuals conducted among healthy population of Cuttack, a coastal district of Odisha (figure 1). The age of the study population ranged from 30 to 65 years. Among the study population almost 2595 individuals out of the total study population (84.9%) were deficient in vitamin D. The deficiency was more in females 1124 out of 1429 females (78.7%) as compared to 804 males out of 1627 (49.4%) males in this study population (Table 1). In our study we observed 1,473 out of the total number of participants (48.2%) were mildly deficient; 1,122 individuals (36.7%) were moderately deficient and 278 individuals are severely deficient (9.1%) (Table 2). The deficiency of serum vitamin D level also varied with age (Table 3). We found only 461 individuals (15%) of the total study population had normal range of serum vitamin D.

Figure 1

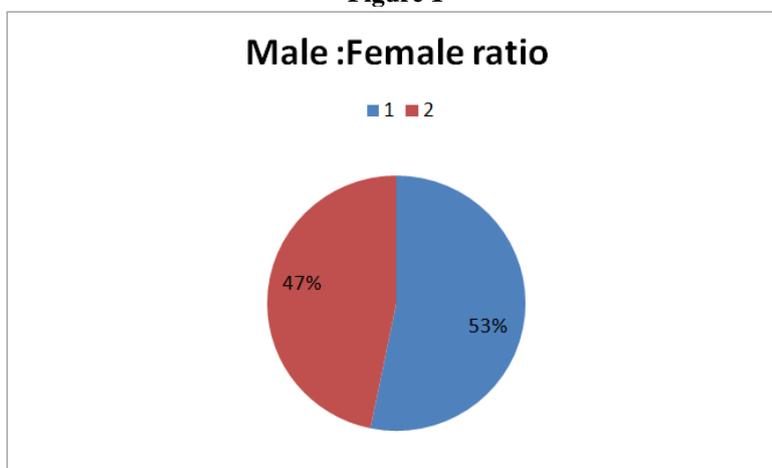


Table 1 Serum Vitamin D status among the study population

Total number of individuals	Number of individuals with deficiency	Percentage deficiency
3056	2595	84.9%
Males 1627	804	49.1%
Females 1429	1124	78.7%

The deficiency was more in females

Table 2 Severity of deficiency

Deficiency stage	Vitamin D level (ng/ml)	Number of individuals	Percentage (%)
Mildly deficient	21-28	1122	36.7
Moderate deficiency	11-20	1473	48.2
Severely deficient	Less than 10	278	9.1
Toxicity	More than 80	nil	nil

Majority of the study population exhibited moderate deficiency of Vitamin D

Table 3 Serum Vitamin D deficiency variation with Age

Age in years	Percentage
30-45	11.3%
46-55	32.5%
56-65	56.5%

The deficiency increased with age.

IV. Discussion

Vitamin D is required for healthy bones in all age groups, including fetal life. The normal development of fetal bones and tooth requires adequate maternal vitamin D status. Vitamin D is directly related to the bone and immunity in both men and women (18, 19). The deficiency of Vitamin D is associated with increased prevalence of Cancer, Diabetes Mellitus, cardiovascular diseases, infectious diseases like tuberculosis, autoimmune diseases like multiple sclerosis, Psoriasis, Systemic lupus erythematosus (19-24). The geriatric population also requires sufficient amount of vitamin D to prevent osteoporotic bone lesions and improve immunity as they spend less time under sunlight, their photo production under the skin is less (25). Various studies have recently suggested Vitamin D deficiency in the Indian population (1-17). The deficiency is widespread in all age groups and sexes (3-17). In our study, a preliminary survey, we also observed a similar deficiency status of the vitamin, among all the adults and the deficiency was more marked in the females as per the current biological reference ranges. We observed that the deficiency of vitamin D increased with age of the patients and was more prevalent in the females. This is in concurrence with the previous studies Harinarayan et al (19, 20 and 21). Our study population was healthy and the coastal region has abundant sunshine. A low Serum level of Vitamin D reduces the immunity and leads to osteomaletic symptoms such as back ache, joint pain, body ache and even obesity (26). Hence, in conclusion we suggest a vast population study should be done to evaluate the serum vitamin D level and establish the normal biological reference range for the Indian population. The current range is based on western data and international standards which may not hold true in the Indian senerio. Further, if the deficiency is widely prevalent, then supplementation and food fortification should be done.

Conflict of interest None

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References

- [1]. Hodgkin P, Kay GH, Hine PM, et al. Vitamin D deficiency in Asians at home and in Britain. *Lancet* 1973; 167-171.
- [2]. Harinarayan Cv, Joshi Sr. vitamin D status in India-Its implications and remedial measures. *J Assoc Physicians India* 2009;57:40-48.
- [3]. Marwaha rK, Sripathy G. vitamin D and bone mineral density of healthy school children in northern India. *Indian J Med Res* 2008;127:239-244.
- [4]. Harinarayan Cv. Prevalence of vitamin D insufficiency in postmenopausal South Indian women. *Osteoporos Int* 2005;16:397-402.
- [5]. Report of Joint FAO/ WHO expert Consultation on vitamin and mineral requirement in human nutrition: Bangkok 1998. Second Edition FAO Rome, 2004. Available at <http://whqlibdoc.who.int/publications/2004/9241546123.pdf>.
- [6]. Reginster JY. The high prevalence of inadequate serum vitamin D levels and implications for bone health. *Curr Med Res Opin* 2005;21:579-586.
- [7]. Riggs bL. role of vitamin D- endocrine system in the pathophysiology of postmenopausal osteoporosis. *J Cell Biochem* 2003;88:209-215.
- [8]. Holick MF. Sunlight and vitamin D for bone health and prevention of autoimmune diseases, cancers, and cardiovascular disease. *Am J Clin Nutr* 2004;80(6 Suppl): 1678S-88S.
- [9]. Holick MF. Vitamin D deficiency. *N Engl J Med* 2007;357(3): 266-81.
- [10]. McGreevy C, Williams D. New insights about vitamin D and cardiovascular disease: a narrative review. *Ann Intern Med* 2011;155(12):820-6.
- [11]. Ascherio A, Munger, KL, Simon, KC. Vitamin D and multiple sclerosis. *Lancet Neurol* 2010;9:599-612.
- [12]. Aghajafari F, Nagulesapillai T, Ronksley PE, Tough SC, O'Beirne M, Rabi DM. Association between maternal serum 25-hydroxyvitamin D level and pregnancy and neonatal outcomes: systematic review and meta-analysis of observational studies. *BMJ* 2013;346:f1169.
- [13]. Luong K, Nguyen LT. Impact of vitamin D in the treatment of tuberculosis. *Am J Med Sci* 2011;341(6):493-8.
- [14]. Ross AC, Taylor CL, Yaktine AL, Del Valle HB. Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: National Academies Press, 2011. p. 435.
- [15]. Glerup H, Mikkelsen K, Poulsen L, Hass E, Overbeck S, Thomsen J, et al. Commonly recommended daily intake of vitamin D is not sufficient if sunlight exposure is limited. *J Intern Med*. 2000;247(2):260-8.
- [16]. Patel et al.: Vitamin D deficiency in Ahmedabad, India
- [17]. International Journal of Medical Science and Public Health | 2015 | Vol 4 | Issue 5 620
- [18]. Categorization of Vitamin D Levels: Mayo Medical Laboratories: Vitamin D testing (article online). Available at: <http://www.mayomedicallaboratoires.com/articles/vitamind/index.html> (last accessed March 25, 2011).

- [19]. Harinarayan CV, Ramalakshmi T, Prasad UV, Sudhakar D, Srinivasarao PV, Sarma KV, et al. High prevalence of low dietary calcium, high phytate consumption, and vitamin D deficiency in healthy south Indians. *Am J Clin Nutr.*2007;85:1062-1067
- [20]. Harinarayan CV, Joshi SR. Vitamin D status in India-Its implications and Remedial measures. *J Assoc Physicians India.*2009;57:40-48.
- [21]. Babu US, Calvo MS. Modern India and the vitamin D dilemma:evidence for the need of a national food fortification program. *Mol Nutr Food Res.*2010;54:1134-1147.
- [22]. Holick MF. Vitamin D and bone health. *J Nutr.*1996;126:1159S-1164S.
- [23]. Marwaha RK, Tandon N, Garg MK et al. Vitamin D status in healthy Indians aged 50 years and above. *J Assoc Physicians India.*2011;59:703-707.
- [24]. Vishwanath P, Kulkarni P, Prashant A. Editorial: Vitamin D deficiency in India: Are we overconcerned? *Int J Health Allied Sci.*2014;3:77-78.
- [25]. Harinarayan CV. The multiple roles of vitamin D. *NFI Bulletin.*2014;35(3):1-8.
- [26]. Dawson-Hughes B, Heaney RP, Holick MF, Lips P, Meunier PJ, Vieth R. Estimates of optimal vitamin D status. *Osteoporos Int.*2005;16(7):713-6.