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A REVIEW OFVITAMIN D DEFICIENCY IN INDIA-CURRENT GUIDELINES ON DIAGNOSIS AND MANAGEMENT

Orthopaedics

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ABSTRACT

Vitamin D deficiency prevails in epidemic proportions all over the Indian subcontinent, with a prevalence of 70%–100% in the general population. In India, widely consumed food items such as dairy products are rarely fortified with vitamin D. Indian socioreligious and cultural practices do not facilitate adequate sun exposure, thereby negating potential benefits of plentiful sunshine. Consequently, subclinical vitamin D deficiency is highly prevalent in both urban and rural settings, and across all socioeconomic and geographic strata. Vitamin D deficiency is likely to play an important role in the very high prevalence of rickets, osteoporosis, cardiovascular diseases, diabetes, cancer and infections such as tuberculosis in India. The prevalence of Vitamin D deficiency ranged from 40% to 99%, with most of the studies reporting a prevalence of 80%–90%. It was prevalent in all the age groups and high-risk groups alike. With the consequences of Vitamin D deficiency, namely, autoimmune diseases, cardiovascular diseases, cancer, and tuberculosis being explored, we can imagine the burden it would cause in our country. We need to create awareness among the public and healthcare providers about the importance of Vitamin D and the consequences of deficiency. Our Indian diet generally fails to satisfy the daily requirement of Vitamin D for a normal adult. This stresses on the need for fortifying various food with Vitamin D, through the national programs. This silent epidemic should be addressed appropriately with concrete public health action.

KEYWORDS

Vitamin D Deficiency, India, Prevalence, Rickets, Sunlight, Supplementation.

INTRODUCTION:

Vitamin D deficiency is pandemic, yet it is the most under-diagnosed and under-treated nutritional deficiency in the world [1–3]. Vitamin D deficiency is widespread in individuals irrespective of their age, gender, race and geography. Vitamin D is photosynthesized in the skin on exposure to UVB rays. Sun exposure alone ought to suffice for vitamin D sufficiency. However, vitamin D deficiency is widely prevalent despite plentiful sunshine even in tropical countries like India. Rickets is a disease of growing bones that results from a failure of or delay in the calcification of newly formed cartilage at the growth plates of long bones, and the disease is associated with a failure of mineralization of newly formed osteoid (this feature is termed osteomalacia) at the trabecular bone surfaces and the endosteal and periosteal surfaces of cortical bone. These osseous changes result in the long bones in particular no longer being able to maintain their normal shapes in response to physical forces, such as produced by weight bearing or muscle insertions.

The global prevalence of rickets is not known as many of the community surveys that have been conducted rely on the finding of bony deformities that are not specific to rickets for the diagnosis of the disease. Furthermore, these deformities do not necessarily imply the presence of active rickets because deformities that develop during the active stage of the disease may persist for months or years after the disease has been treated. Despite the lack of accurate information, it is clear that rickets and vitamin D deficiency are common in many countries throughout the world, including Middle Eastern countries [1-2] and a number of developing countries.

Vitamin D is endogenously synthesized in human beings from photo conversion of 7-dehydrocholestrol in the skin to cholecalciferol on exposure to ultraviolet radiation of sun. In a tropical country like India, where sunlight exposure is abundant, vitamin D deficiency seems unlikely. However, as opposed to this, various studies have highlighted that 70-100% Indians in different age groups vitamin D insufficient or deficient.

It is needed for the maintenance of normal blood levels of calcium and phosphate that are required for normal mineralization of bone, muscle contraction, nerve conduction, and general cellular function in all cells of the body. It is also found to be important for immune function, for inflammation, cell proliferation, and differentiation.[4-5].The active form of Vitamin D stimulates the absorption of calcium in the duodenum and increases calcium influx in distal tubules of kidney through nuclear Vitamin D receptor (VDR); latter is specifically regulated by parathormone level.[6]

This review discusses the need and feasibility of fortification of staple foods with vitamin D deficiency consequences,in children and adults,Rickets,Calcium deficiency and Reasons of the wide spread vitamin D deficiency in India. Steps to be taken by the policymakers in India are also mentioned. Data, when available, from other countries of the Indian subcontinent are also compiled and presented for comparison.

DISCUSSION:

The prevalence of Vitamin D deficiency is reported worldwide, both in sunshine deficient and sunshine sufficient countries. Still, it is the most underdiagnosed and undertreated nutritional deficiency in the world. However, various studies showed poor Vitamin D status irrespective of age, sex, and geography. As there is no standard guideline which is followed all over the world for classifying the Vitamin D status, these studies had different cutoff values for the deficiency. The vast majority of these studies used serum 25(OH) D level of <20 ng/ml as Vitamin D deficiency. Studies which used other cutoffs have been so indicated in footnotes [6].

Consequences Of Vitamin D Deficiency:

Vitamin D deficiency results in a variety of skeletal and extraskeletal manifestations. Very few Indian studies have been published on the consequences of Vitamin D deficiency. Hence, overseas studies on this issue are cited.Skeletal manifestations, Depression, Parkinson's disease, Suicide, Infectious disease, Autoimmune diseases, Cancer, Type 2 diabetes mellitus,Heart disease, Obesity [5-6].

Although we are aware of the causes of Vitamin D deficiency, we are not able to prevent it to a large extent. India being a tropical country has adequate sunshine. Most of the Indian population live in areas with adequate sunlight throughout the year and are expected to have adequate Vitamin D. Indians are mostly vegetarians and Vitamin D rich foods are of animal origin. All the above-mentioned factors can be a cause in urban population. However, the rural population, who by the virtue of their occupation have sufficient sunlight exposure, too have low Vitamin D levels. This can be due to the high phytate and low calcium diet they consume. Phytate rich diet is known to reduce the intestinal absorption of calcium. Hence, low dietary calcium increases the catabolism of 25(OH) D and

increases the inactive metabolites with the resultant reduction in 25(OH)D concentrations.[7-8].

Vitamin D deficiency is common in infancy due to several factors such as – decreased dietary intake, decreased cutaneous synthesis (because of cultural and religious practices, seasonal variation, fear of cancer, and practice of not taking the child out, increase in pigmentation), increasing rate of exclusive breast feeding, and low maternal vitamin D.

Preterm infants should be supplemented from birth with 400-800 IU/day because of inadequate transfer of maternal vitamin D stores and issues associated with prematurity such as poor feeding, gastrointestinal difficulties impairing absorption and sometimes liver and kidney impairment. Consideration for universal supplementation particularly in breastfed infants has been suggested.The preparations available in India are; Vitamin D3 – as oral drops 400 IU/mL; Syrup 400 IU/5mL; and Tablets as 1000 and 2000 IU in blister packing and also as sachet in powder form with each sachet containing 60000 IU of vitamin D3.For infants who are exclusively breastfed a minimum daily intake of 400 IU/ day should be initiated within a few days after birth. Since most of the infant formulas contain 400 IU/L, infants who are on formula feeds also need supplementation unless they consume more than 1000 mL of formula per day.Children who are dark skinned, veiled, exposed to reduced sun light or who have underlying medical condition should receive 400 IU daily to prevent vitamin D deficiency [8].

Rickets:

The diagnosis of rickets is made clinically by the presence of the typical bony deformities [3]; however, these do not necessarily indicate active disease as they may persist for months or years following the correction of dietary calcium or vitamin D deficiencies. Craniotabes also may occur in young normal infants, especially in those born prematurely [9].Biochemically, active rickets manifests classically with hypocalcaemia, hypophosphataemia, and elevated alkaline phosphatase and parathyroid hormone concentrations. In the early stages of vitamin D deficiency, hypocalcaemia may be the only biochemical finding, but as the disease progresses and hyperparathyroidism becomes manifest, hypocalcaemia may partially correct, and hypophosphataemia and elevated alkaline phosphatase levels become apparent. In the severe stages of the disease, calcium levels once again fall as the homeostatic mechanisms fail to maintain normocalcaemia. Confirmation of vitamin D deficiency is dependent on the finding of low 25(OH)D concentrations. It is generally considered that values below 10–12 ng/mL (25–30 nmol/L) are indicative of vitamin D deficiency; however, children with vitamin D deficiency rickets typically have values below 5 ng/mL (12.5 nmol/L) [10]. The measurement of 1,25-(OH)2D concentrations is not helpful in the diagnosis of vitamin D deficiency as levels have been found to be low, normal, or elevated [10-12].

In most developing countries and in certain situations in industrialised countries, vitamin D deficiency is frequently associated with low dietary calcium intake; thus, it is prudent to provide calcium supplements at the same time as correcting vitamin D deficiency as response to therapy is more rapid [13-14]. A daily supplement of 50 mg/kg of elemental calcium for several months is recommended.

The prevalence of vitamin D deficiency is 50-90 % in the Indian subcontinent and is attributed to low dietary calcium along with skin color and changing lifestyle.Some postulate that a deficiency of dietary calcium rather than vitamin D deficiency is responsible for rickets after infancy, supported by the fact that they have a better response to treatment with calcium alone or in combination with vitamin D rather than vitamin D alone . Vitamin D deficiency is observed among breastfed infants at one end with dietary calcium deficiency in older children at the other end. Between these two extremes, it is likely that vitamin D insufficiency and decreased calcium intake or high phytate intake combine to induce vitamin D deficiency and rickets, which may be the most frequent cause of rickets globally.

Calcium Deficiency:

If dietary calcium deficiency is suspected to be the primary aetiological factor in the pathogenesis of the disease, as in Nigeria, in Bangladesh, or in older children in South Africa, children have been shown to respond rapidly to calcium supplements alone (1,000 mg/day) [13]; however, unless the measurement of 25(OH)D concentrations is readily available, it is appropriate to combine the calcium supplements with vitamin D therapy [14]. Vitamin D alone is less effective than either calcium alone or a combination of calcium and vitamin D in these situations [15].Most dietary sources of vitamin D have very low vitamin D content. Most of the food items rich in vitamin D are of animal origin. Most Indians are vegetarians. Commonly, a dietary source of vitamin D for vegetarians is milk, provided milk has been fortified with vitamin D. Milk is rarely fortified with vitamin D in India. The vitamin D content of unfortified milk is very low (2 IU/100 mL). Additionally, milk and milk products are unaffordable to the socioeconomically underprivileged. Another concern in India is the rampant dilution and/or adulteration of milk and milk products.

Definitions of vitamin D status have been intensely debated by clinicians and researchers alike. Vitamin D deficiency is defined as serum levels of 25(OH)D less than 20 ng/dL whereas 21- 29 ng/dL is considered to be insufficient by US Endocrine Society. This has been done to utilize full advantage of all the health benefits of vitamin D .The control of rickets in developing countries is dependent on the control of poverty and overcrowding and the development of effective primary health care facilities and programmes. Further, dietary diversification is an important aspect of the improvement of calcium intake. In areas where social or religious customs militate against adequate sunlight exposure in young infants, attention must be paid to ensuring the adequate vitamin D status of pregnant women through the provision of vitamin D supplements during antenatal care. Health promotion and education programmes should highlight the ease of combating vitamin D deficiency and the prevention of long-term morbidity through ensuring adequate sunlight exposure or vitamin D supplementation.

Indian Academy of Pediatrics published practice guidelines for Pediatricians for the prevention and treatment of vitamin D and calcium deficiency in children and adolescents.[15] In view of high prevalence of VDD in India and the important effects of vitamin D on skeletal and extraskeletal health, there is need to study the effect of routine supplementation of vitamin D in Indian children taking into account cost–benefit ratio.

Reasons Of The Wide Spread Vitamin D Deficiency:

The probable reasons of the wide spread vitamin D deficiency in Indians could be because of low dietary vitamin D intake, high fiber and phytate intake that depletes vitamin D levels [16], reduced exposure to sunlight [17], pollution [18] or reduced exposure of skin to sun light because of cultural and traditional habits like “burkha” or “parda”. However, what is really alarming is that despite the wide spread vitamin D deficiency, Indian Council of Medical Research (ICMR) has not given specific recommendations for daily vitamin D consumption except in specific medical conditions

Where it recommends a daily supplement of 400 IU [19]. For normal healthy children and adults, ICMR only recommends outdoor activities in sun as a means to acquire adequate vitamin D levels [19] which really doesn't seem to be sufficient in the current Indian scenario to achieve optimum levels of vitamin D given the wide spread prevalence of deficiency in India.Few studies from north India also demonstrated that the prevalence of VDD in apparently healthy children is as high as 90%.[4-6] In a study involving 338 apparently healthy children in the age group of 3 months to 12 years belonging to the upper socioeconomic group in Chandigarh, the prevalence of VDD was 40.3%. On univariate analysis, VDD was associated with relatively younger age group, female sex, failure to thrive, exclusive breast-feeding, inadequate sun exposure, and no vitamin D supplements.[6] The differences observed in the prevalence of VDD among healthy children in different studies could be due to different populations studied, latitude of residence, sunlight exposure, skin color, environmental pollution and weather, vitamin D intake (diet and supplementation), different methods used to measure 25(OH) D, and different cut-off values.[6]

Despite cheap and effective means of both treating and preventing nutritional rickets, the disease remains a major cause of infant and

young child morbidity and mortality in a number of developing countries. Rickets continues as a public health problem in developing countries lying at high latitude in the temperate zones, while in the Middle East and some other countries, religious customs often prevent adequate sunlight exposure not only in young infants but also in adolescent children and pregnant women. In other tropical countries, increasing evidence is accumulating that indicates that low dietary calcium intake by itself or in synergy with relative vitamin D deficiency exacerbates and promotes the development of the disease [18].

The prevalence in most studies is alarmingly very high. Long term vitamin D deficiency has severe consequences. Food fortification, educational programs and public health policies soon need to be formulated to reduce the prevalence of vitamin D deficiency in India.Educational programs are a must to create awareness about Vitamin D deficiency as it is the most underdiagnosed and undertreated nutritional disease. Both physicians and the public should be made aware of its implications. To develop, launch and sustain such a program, adequate investment in the form of time, money, and effort is required,Vitamin D supplements of good quality should be made available at PHC level for the population at risk, i.e., pregnant women, lactating women, children, and elderly, Revision of RDA for Vitamin D by ICMR is needed as it is less compared to other guidelines,Government should support research groups to study and monitor the impact of supplementation programs and fortification strategies [19].

The need for improvement in vitamin status of the Indian population is both important and urgent. The Indian government needs to take substantive measures in this direction. Revision of RDA for calcium and vitamin D is required. Better facilities and technologies should be made available countrywide to enable timely diagnosis of clinical manifestations of vitamin D deficiency in individuals who need attention by the clinicians. Population-based programs at the national level must be developed to increase awareness of the problem at hand, to provide affordable vitamin D supplements and also to provide vitamin D fortified foods to the Indian populace at large. Research in this field needs continued support to provide a comprehensive picture of the ongoing vitamin D problem and also to study and monitor the effect(s) of a partnership between the government, healthcare system, industry and consumers, aimed at improving the vitamin D status in India.

CONCLUSION:

Vitamin D deficiency is widespread. However, the clinically diagnosed cases represent only the tip of the iceberg. With the knowledge of the multiple consequences, it can lead to; we can imagine the burden, this silent epidemic would cause the development of the country. Vitamin D deficiency needs to be addressed with due attention and strong action.Fortified foods are being recognised as an important source of vitamin D [19-20]. Fortification of milk has been found to be a safe, effective and acceptable method [20]. However, in a setting like India, where the per capita milk consumption is very low, consideration for other methods of fortification such as fortification of oil, cereal powders and even salt needs consideration. The need for a national food fortification program for vitamin D has been highlighted in an earlier review [21]. Since adequate sunlight exposure at solar noon is difficult to achieve because of modernisation and existing cultural practices, supplementation and fortification may help in preventing vitamin D deficiency and such public health interventions need serious consideration in the Indian context.

REFERENCES:

1. Lubani MM, Al-Shab TS, Al-Saleh QA et al. Vitamin-D-deficiency rickets in Kuwait: the prevalence of a preventable disease. Ann Trop Paediatr 1989;3:134–139.
2. Fida NM. Assessment of nutritional rickets in western Saudi Arabia. Saudi Med J 2003;24(4): 337–340.
3. Thacher TD, Fischer PR, Pettifor JM. The usefulness of clinical features to identify active rickets. Ann Trop Paediatr 2002;22(3):229–237.
4. Marwaha RK, Tandon N, Reddy DR, Aggarwal R, Singh R, Sawhney RC, et al. Vitamin D and bone mineral density status of healthy schoolchildren in northern India. Am J ClinNutr 2005;82:477-82.
5. Puri S, Marwaha RK, Agarwal N, Tandon N, Agarwal R, Grewal K, et al. Vitamin D statusof apparently healthy schoolgirls from two different socioeconomic strata in Delhi: Relation to nutrition and lifestyle. Br J Nutr 2008;99:876-82.
6. Angurana SK, Angurana RS, Mahajan G, Kumar N, Mahajan V. Prevalence of vitamin D deficiency in apparently healthy children in north India. J PediatrEndocrinolMetab 2014;27:1151-6.
7. 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 ClinNutr 2007;85:1062-7.
8. Clements MR, Johnson L, Fraser DR. A new mechanism for induced Vitamin D deficiency in calcium deprivation. Nature 1987;325:62-5.
9. P ettifor JM, Pentopoulos M, Moodley GP, Isdale JM, Ross FP. Is craniotabes a pathognomonic sign of rickets in 3-month-old infants? S Afr Med J 1984;65:549–551.
10. Kruse K. Pathophysiology of calcium metabolism in children with vitamin D-deficiency rickets. J Pediatr 1995;126(5 pt 1):736–741.
11. Markestad T, Halvorsen S, Seeger Halvorsen K, Aksnes L, Aarskog D. Plasma concentrations of vitamin D metabolites before and during treatment of vitamin D deficiency rickets in children. ActaPaediatrScand 1984;73:225–231.
12. Chesney RW, Zimmerman J, Hamstra A, DeLuca HF, Mazess RB. Vitamin D metabolite concentrations in vitamin D deficiency. Am J Dis Child 1981;135:1025–1028.
13. Thacher TD, Fischer PR, Pettifor JM, et al. A comparison of calcium, vitamin D, or both for nutritional rickets in Nigerian children. N Engl J Med 1999;341(8):563–568.
14. K utluk G, Cetinkaya F, Basak M. Comparisons of oral calcium, high dose vitamin D and a combination of these in the treatment of nutritional rickets in children. J Trop Pediatr 2002;48(6):351–353.
15. Balasubramanian K, Rajeswari J, Gulab, et al. Varying role of vitamin D deficiency in the etiology of rickets in young children vs. adolescents in northern India. J Trop Pediatr 2003;49(4):201–206.
16. Khadilkar AV. (2010) Vitamin D deficiency in Indian Adolescents. Indian Paediatr 47:756-757.
17. Ekbote VH, Khadilkar AV, Mughal MZ, Hanumante N, Sanwalka N, Khadilkar VV, Chiplonkar SA, Kant S, Ganacharya R et al. (2010) Sunlight exposure and development of rickets in Indian toddlers. Indian J Pediatr. 77:61-5.
18. Agarwal KS, Mughal MZ, Upadhyay P, Berry JL, Mawer EB, Puliyel JM et al. (2002) The impact of atmospheric pollution on vitamin D status of infants and toddlers in Delhi, India. Arch Dis Child. 87:111-3.
19. Nutrient Requirement and Recommended Dietary Allowances for Indians - A report of the expert group of the Indian Council of Medical (2009) Indian Council of Medical Research, National Institute of Nutrition. [accessed on 1st August 2010] 132, 163 – 172, 332.
20. Natri AM, Salo P, Vikstedt T, Palssa A, Huttunen M, Kärkkäinen MU, et al. Bread fortified with cholecalciferol increases the serum 25-hydroxyvitamin D concentration in women as effectively as a cholecalciferol supplement. J. Nutr. 2006;136:123-7.
21. Babu US, Calvo MS. Modern India and the vitamin D dilemma: evidence for the need of a national food fortification program. MolNutr Food Res. 2010;54: 1134-47.