



ORIGINAL RESEARCH PAPER

Biochemistry

VITAMIN D: NO MORE A DELIGHT FOR THE POPULATION OF WEST BENGAL, INDIA - AN INTROSPECTION

KEY WORDS:

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Introduction :

The extra skeletal importance of vitamin D apart from its regulatory role in bone mineral homeostasis has been evidenced by epidemiological studies worldwide (1,2). Vitamin D deficiency (VDD) has been linked to various immunological diseases, autoimmunity, cancer, hepatic, cardiac and renal diseases (3,4). The endogenous synthesis of vitamin D in skin from secosterol on exposure to UV-B (290-315 nm) is the primary source of vitamin D (5). In addition to it, intestinal absorption of vitamin D depends on the dietary consumption, intake of fortified food and supplementation.

located in the tropics (22°30'N) and receives ample amount of sunlight throughout the year, but the zenith angle of the sun over Kolkata varies from 8° in winter to around 40° in summer, which might influence the absorption of uv rays. More over an increased amount of air pollution is reported in the urban areas of the state where Kolkata tops the list, which does not allow UV rays to pass through the atmosphere and be absorbed by the skin, thus reducing endogenous synthesis of vitamin D (18,19) and causes vitamin D deficiency in the inhabitants of West Bengal inspite of living in a sunny state.

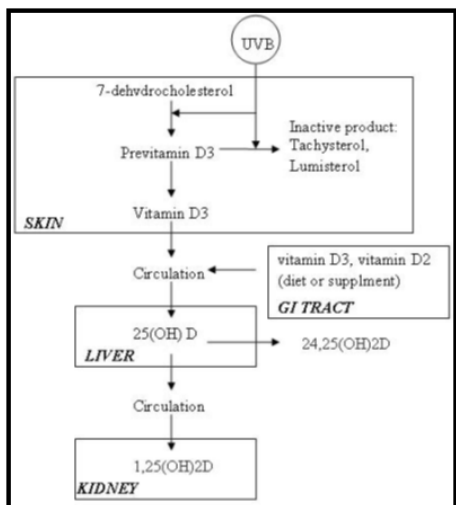


Fig 1: Synthesis and complete processing of Vitamin D metabolites

[ref: Zhang and Naughton. Vitamin D in health and disease: Current perspectives Nutrition Journal 2010, 9:65]

Incidentally vitamin D deficiency is prevalent all over the world (6,7) irrespective of caste, creed and religion which is in accordance with our early study that reported 82.3% vitamin D deficiency among the Bengalee population (8). Several factors like latitudinal location, season, age, sex, duration of exposure to sunlight, skin color & use of sunscreen contribute to the persistent predominance of VDD (9-15)

The fact that vitamin D levels decreases with age is well known (16). But now a days vitamin D deficiency is observed across all age groups due to the genetic, environmental, social-economic factors which is thought to be aggravated the deficiency of vitamin D. Multiple factors which might attribute to the increased prevalence of vitamin D deficiency are as follows.

Latitudnal location: The prevalence of VDD increases across the world during winter months due to less amount of sunlight received owing to its position and 23.5° inclination of earth's axis (4,17). Depending on the geographical location, UV exposure is maximum at the equator and minimum at the poles. Kolkata is

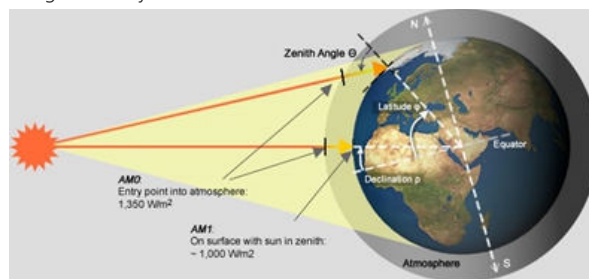


Fig 2: Zenith angle of the sun on the earth at any place

Sex: Vitamin D deficiency is found to be more severe in women than men although pathophysiologically there should not be any difference of vitamin D levels among the sexes but noticeable variance is observed due to their differences in socio cultural life.. In a country like India where responsibility of livelihood mainly lies on the shoulder of men comparing to women who engage themselves in indoor activities which deprive them of getting ample sunlight to synthesize vitamin D. In addition to that covered clothings may also play a hindrance to absorb UV rays of the sun. But Indian men are also reported to be severe vitamin D deficient now a days due to their change of lifestyle which prevents them to spend significant portion of the day time into offices or school or colleges rather than field areas (20).

Age group: Age plays a casual role in vitamin D deficiency. The elderly population is known to be vitamin D deficient due to the decreased amount of 7-dehydrocholesterol which is the precursor of endogenous vitamin D synthesis on interaction with UV-B rays. With increased institutionalization and reduced mobility, exposure to sunlight decreases in older persons which reduce the synthesis of vitamin D on the skin. Additionally poor kidney function hinders to synthesize 1,25 (OH)₂ vitamin D₃ in kidney ultimately causing deficiency of vitamin D (21,22). VDD is quite expected in the middle age group persons as they lead a sedentary life style, where they are even less exposed to sunlight as they work at indoors (in offices) mostly but shockingly, an increased prevalence of vitamin D deficiency has also been observed among the school going children in recent years (23). The children of this generation is heavily burdened with academic pressure which shortens their time to play in the outdoors along with that easy access to computer games, mobile etc make them busy at their leisure time eventually deprive them from the exposure to sunlight. Ultimately sedentary lifestyle & unhealthy eating habits are the main contributor of VDD among children.

Skin color: Studies suggest that melanin competes with 7-dehydrocholesterol for absorption of UV-B photons and thus decreases the rate of UV-B absorption by 95% (24). Brown skinned Indians are observed to be more vitamin D deficient preclinically due to their high melanin content on skin compared to others (25).

Sunscreen: UV-B is efficiently absorbed by sunscreen but it prevents 7-dehydrocholesterol to interact with UV-B thus ceasing production of previtamin D3. Evidential proofs state that sunscreen with SPF (sun protection factor) 8 and 15 reduces previtamin D synthesis by 95 and 98% respectively (26,27). Rampant use of sunscreen in the Indian women at a very young age make them vit D deficient.

Materials and Method:

A large cohort of 2636 patients from Kolkata and adjacent areas of West Bengal (Geographical location: 22°82 N 88°20 E) who visited Ramakrishna Mission Seva Pratishthan outdoor from Jan 2014 to May 2015 were recruited for this study. Questionnaires including their clinical and medication histories, diet, exposure time to the sunlight, vit D supplementation filled by the participants were evaluated meticulously and analyzed retrospectively.

All study participants provided written informed consent. The study was approved by the Institutional Ethics Committee of RKMSP.

Results:

A total of 90.41% (2383/2686) vitamin D deficiency was observed in this study population. The vitamin D deficient population was classified according to gender, age group and their location (Table 1)

| Variable | Sub groups | Number | Percentage | Mean Vitamin D |
|-------------------|------------|--------|------------|----------------|
| Gender | Male | 908 | 34.4% | 17.6±1.9 |
| | Female | 1778 | 66.6% | 15.9±2.3 |
| Age Groups | 0-10yrs | 170 | 6.4% | 19.7±3.6 |
| | 10-20 yrs | 313 | 11.8% | 18.9±3.3 |
| | 20-40 yrs | 624 | 23.6% | 17.7±2.8 |
| | 40-60 yrs | 970 | 36.6% | 16.9±3.7 |
| Location | Urban | 1429 | 54.2% | 16.1±3.1 |
| | Rural | 1186 | 44.9% | 18.2±2.5 |

Table 1: Percentage of Vitamin D deficiency

Female subjects showed 66.6% vitamin D deficiency as compared to their male counterpart with 34.4% deficiency. Middle aged group (40-60 years) was found to be most deficient among all age groups. As expected the urban population was found to be more deficient than the rural population (Table 1).

The influence of seasonal variation on vitamin D deficiency has been reflected in our study which indicated highest percentage of severe vitamin D deficiency (25%) in winter as predicted and vitamin D deficiency was found to be very low in summer season. The pie chart shows the percentage of deficiency in each season (Fig.1). Also the mean vitamin D was lowest in spring (15.73±2.2) whereas rainy season had the highest mean vitamin D (20.2±3.9) (Table 2)

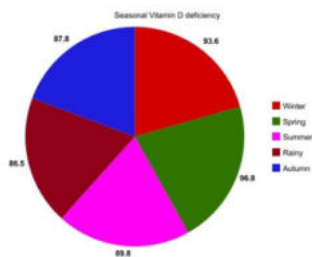


Fig 1: Percentages of Vitamin D deficiency in different seasons during the study period

| Month | Mean 25(OH)D | <10 ng/ml | 10-20 ng/ml | 20-30 ng/ml | >30 ng/ml |
|--------|--------------|-----------|-------------|-------------|-----------|
| Winter | 15.73±2.2 | (25.3%) | (44.8%) | (24%) | (3.2%) |
| Spring | 16.25±3.2 | (21.5%) | (53%) | (22.5%) | (6.4%) |
| Summer | 20.2±3.9 | (14.5%) | (45.3%) | (27.1%) | (13.5%) |
| Rainy | 19.06±4.1 | (14.1%) | (36.7%) | (29%) | (10.2%) |

Table 2: Seasonal variation of mean vitamin D

Also the severity of vitamin D deficiency in percentage for each season have been depicted in Fig.2, this explains that most of the population had insufficient vitamin D levels in the range of 10-20ng/ml.

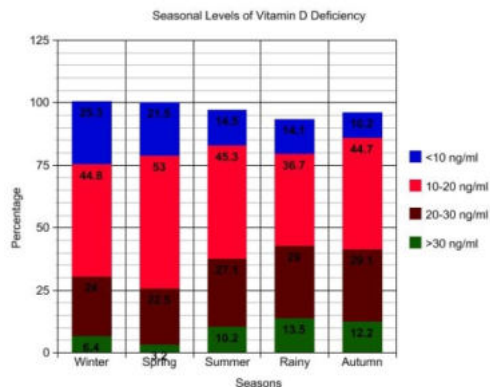


Fig 2: Levels of Seasonal Vitamin D deficiency

The mean vitamin D levels were calculated for each age group. Maximum VDD was observed to be among the older section of the society as reflected in their mean vitamin D level (16.81±1.9) followed by the children less than ten years (17.1±1.2) and the adults (18.2±1.3. No such noticeable difference was observed in the mean vitamin D levels between the adults and the adolescents. Age wise distribution of vitamin D deficiency is represented in Table 3.

| Age Group | Mean Age | Mean Vitamin D |
|-----------|----------|----------------|
| <10 yrs | 7.2±0.8 | 17.1±1.2 |
| 10-20 yrs | 16.7±2.1 | 18.1±1.7 |
| 20-40 yrs | 32.6±3.8 | 18.2±1.3 |
| 40-60 yrs | 53.7±5.5 | 17.02±1.6 |
| 60-80 yrs | 67.2±3.8 | 16.81±1.9 |

Table 3: Variation of mean vitamin D in all age groups throughout the year

Discussion :

The present study reflects a wild increase of vitamin D deficiency among the population of West Bengal, India inspite of being a sunny state. The important factors attributing to this raising incidence of vitamin D deficiency are being evaluated in this current study. It was observed that 90.4% of the population (2383/2636) was found to be vitamin D deficient.

A significant difference of vitamin D deficiency was noticed among men and women. Women (66.6%) were found to be almost twice vitamin D deficient than their men (34.4%) counterpart which is also indicated in their mean 25(OH)vitamin D levels (15.9±2.3 vs 17.6±1.9). With growing age, a trend of gaining weight is observed among the women than men due to their increased physical inactivities. Decreased bioavailability of vitamin D was reported in obese persons (28, 29) due to the sequestration of vitamin D receptors into the adipose tissues as its fat soluble nature. It might explain the lower vitamin D status in women. Other extraneous factors like the increased use of sunscreen and clothing patterns especially among the women preventing UV-rays to get absorbed in to skin causing deficiency of vitamin D.(30). This study demonstrated a overall vitamin D deficiency in all age groups. Elderly group of people (60-80years) showed a maximum deficiency as compared to other groups. It is evident from the results that with age synthesis of vitamin D decreases) due to

reduced intake of vitamin D fortified milk products, fish, eggs, increased confinement at home & decreased ability of the kidney to synthesize active vitamin D metabolites but the issue remains controversial yet (31). A noticeable percentage of vitamin D deficiency observed among the children is quite surprising. VDD in the neonates might be explained by maternal vitamin D deficiency but the deficiency among the children and adolescents (0-18 years) is really worrisome which might be triggered by juvenile obesity. Obesity, a quite common feature of this age group plays a detrimental role in the metabolism of vitamin D and makes them high candidates for future metabolic syndrome which ultimately leads to diabetes and other chronic illness.

Our result is in accordance with the findings of other countries which demonstrated increased prevalence of vitamin D deficiency in the urban population (54.2%) than the rural population (44.9%). Sedentary lifestyle and reduced exposure to sunlight are thought to be primarily responsible for the wide difference of vitamin D deficiency in the rural vs. urban population of West Bengal.

Seasonal variation of vitamin D deficiency has been demonstrated in numerous studies across the world (32,33,34). Our study shows similar picture of change of mean 25(OH)vitamin D level with the change of seasons. As expected serum 25(OH) vitamin D reached its peak value in the summer (20.2±3.9) due to maximum absorption of UV rays and nadir values in winter (15.73±2.2). The first three seasons showed high vitamin D levels closer to range of vitamin D sufficiency (20-30ng/ml) but a gradual fall was observed in the winter and early spring. This can be explained by low absorbance of UV light, a primary requisite for vitamin D synthesis due to steeper angle of sun's irradiation in the winter. Along with these woolen and covered clothing in winter prevents endogenous synthesis of vitamin D. On the other hand, vitamin D already synthesized in the summer starts to fall down gradually in the subsequent months and declines to a very low level in the winter and early spring. Depletion of stored vitamin D and lack of synthesis of serum 25(OH)vitamin D contribute to the major deficiency of vitamin D in winter.

A significant percentage of vitamin D deficiency was observed in Kolkata, West Bengal which is quite alarming. In addition to various attributable factors including age, sex, seasons and location, dietary habits might also contribute to this severe deficiency. Moreover consumption of vitamin D fortified foods are not in practice in the developing country like India which might be a possible reason of the vitamin D deficiency in our country.

Limitations: Details of all patients' dietary intake of vitamin D rich food, life style, BMI, use of sunscreen were not possible to take into account due to lack of coherent data. Although a high level of vitamin D deficiency is reported over the time period of study, but might not be a true reflection of the society as the data procured from the record section of a tertiary care hospital.

Conclusion: Our study reflects a very high prevalence of vitamin D deficiency in the local population of Kolkata, West Bengal especially among the age group of 40-80 years, in female genders and in the inhabitants of the urban areas of West Bengal. Seasonal variation was observed where the spring recorded highest deficiency and the rainy season had the lowest. Overall the total population was at high risk to predispose chronic metabolic diseases due to severe vitamin D deficiency as vitamin D is reported to play a very crucial role in the pathogenesis of these non-communicable diseases. The effectiveness of vitamin D in context of various diseases with a special emphasis on non-skeletal diseases still remains a novel area in a country like India, so in most of the cases vitamin D deficiency does not get clinical attention. It is high time for the Government to initiate random screening of vitamin D deficiency starting from the school-going children to all age groups and implement some necessary measures for vitamin D supplementation and food fortification with vitamin D wherever required. At the same time Government should launch some educational/awareness programmes to create a mass awareness

of the importance of vitamin D and the serious consequences of its deficiency to get rid of this silent epidemic of vitamin D deficiency.

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