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 despite 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 access 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 deficiency is usually prescribed in both children and adults. Excessive intake of the vitamin causes hypercalcitoninosis 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.

![Male : Female ratio](image)

Table 1: Serum Vitamin D status among the study population

<table>
<thead>
<tr>
<th>Total number of individuals</th>
<th>Number of individuals with deficiency</th>
<th>Percentage deficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>3056</td>
<td>2595</td>
<td>84.9%</td>
</tr>
<tr>
<td>Males 1627</td>
<td>804</td>
<td>49.1%</td>
</tr>
<tr>
<td>Females 1429</td>
<td>1124</td>
<td>78.7%</td>
</tr>
</tbody>
</table>

The deficiency was more in females

Table 2: Severity of deficiency

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

Majority of the study population exhibited moderate deficiency of Vitamin D
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Table 3 Serum Vitamin D deficiency variation with Age

<table>
<thead>
<tr>
<th>Age in years</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-45</td>
<td>11.3%</td>
</tr>
<tr>
<td>46-55</td>
<td>32.5%</td>
</tr>
<tr>
<td>56-65</td>
<td>56.5%</td>
</tr>
</tbody>
</table>

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 osteomalacic 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 scenario. Further, if the deficiency is widely prevalent, then supplementation and food fortification should be done.

Conflict of interest
None

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