

Original research article

Study of Vitamin D Deficiency Status and its Significance in Adults.

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Abstract

Vitamin D deficiency is now recognized as a worldwide health disease. The major cause of vitamin D deficiency is the lack of appreciation that sun exposure in moderation is the major source of vitamin D for most humans. Very few foods naturally contain vitamin D, and foods that are fortified with vitamin D are often inadequate to satisfy either a child's or an adult's vitamin D requirement. Vitamin D deficiency causes rickets in children and will precipitate and exacerbate osteopenia, osteoporosis, and fractures in adults. Vitamin D deficiency has been associated with increased risk of common cancers, autoimmune diseases, hypertension, and infectious diseases. Vitamin D can be easily assessed in patients by measuring serum 25-hydroxyvitamin D. The aim of this study was to estimate vitamin D3 levels in patients coming to medicine and orthopaedic OPD with various symptoms related to vit D deficiency such as tiredness and fatigue, muscle pain, bone and joint pain, mood changes, low immunity (recurrent respiratory infections), hypertension. Both male and females 70 adult subjects were included in this study. Serum Vitamin D3 levels were estimated in all subjects. 35.71% subjects had severely deficient vit D3 levels. 42.85% were deficient. 14.28% had inadequate vitamin D3 levels. 4.28% had adequate levels of Vitamin D3. Vitamin D deficiency can be managed with pharmacological or non-pharmacological approaches depending on the severity. The goal of the treatment is to raise serum vitamin D to normal levels to relieve the symptoms and reduce the adverse health outcomes such as rickettsia among infants, osteomalacia among adults, and osteoporosis among the elderly.

Key word : Vitamin D, Deficiency, Significance.

Introduction

Vitamin D, 25-hydroxyvitamin D (25(OH) D), is a vital fat-soluble vitamin that regulates calcium homeostasis and is essential for bone and muscle health in people of all ages [1]. Vitamin D is naturally present in some foods and dietary supplements and is produced endogenously when sunlight strikes the skin and stimulates vitamin D synthesis. Serum concentration of 25(OH) D is the best indicator of vitamin D status in humans, with values of less than 30 nmol/L (nmol/L = 0.4 ng/mL) considered to be inadequate for the general health and wellbeing of adults [2]. A plethora of epidemiological and observational studies have demonstrated the correlation between vitamin D and overall human health [3–5]. Studies

suggest that sufficient serum vitamin D of more than 30 nmol/L is implicated in preventing cardiovascular disease [6]. An adequate vitamin D serum level has also been reported to enhance the immune system, prevent cancer, and limit its progression [7]. In addition, vitamin D plays a role in the prevention and control of diabetes through improving glycemic index [8], enhancing beta cell function, increasing insulin secretion, and decreasing insulin resistance [9–12]. Vitamin D is a steroid hormone that has a major role in bone mineralization through the regulation of calcium and phosphorus metabolism. The main sources of vitamin D are cutaneous synthesis and the ingestion of food, especially fish oil, eggs, and liver [13]. Vitamin D has a substantial function in the maintenance of bone health. A deficiency of vitamin D has been associated with the increased risk of a number of chronic conditions, including cardiovascular disease, diabetes, hypertension, some cancers, autoimmune diseases, neuropsychiatric disorders, metabolic disorders and infectious diseases associated with decreased immunity [14,15]. The deficiency of vitamin D is a significant problem of public health in both the developed world and developing countries, with a reported prevalence of 30% to 80% of children and adults worldwide [16, 17]

Sources of vitamin D : The main source of vitamin D comes from exposure of the skin to sunlight. Hence there is considerable seasonal variation with concentrations higher at the end of summer compared to other seasons. Vitamin D₃ is found in fatty fish such as herring, salmon and mackerel. Other sources include eggs, meat and fortified foods such as margarine.

Recommending sun exposure : Recommended exposure of 5–15 minutes of sunlight 4–6 times a week outside the hours of 10 am–2 pm seems prudent . Certainly, avoidance of the most dangerous ultraviolet exposure in the middle of the day is appropriate, especially in summer, with responsible use of ultraviolet blocking agents. Guidelines on exposure to sunshine need to be tailored to the individual – one size does not fit all. Many factors need to be considered including geographical location such as latitude, season, time of day, skin colour, age and particularly clothing.

Causes of vitamin D deficiency : Reduced synthesis of cholecalciferol in the skin, Disorders of malabsorption, Enhanced degradation of 25-hydroxyvitamin D.

Diagnosing vitamin D deficiency : Vitamin D deficiency is usually asymptomatic, but signs and symptoms can include muscle aches and particularly weakness (proximal limb girdle). It is often seen in older people with osteoporosis. While there is debate about the benefit of vitamin D supplementation in preventing osteoporotic fractures, there is evidence that it may reduce falls risk. Also, virtually all of the currently approved osteoporosis treatments have been evaluated in the presence of adequate vitamin D concentrations so these should be achieved as part of the approach to osteoporosis treatment. Vitamin D deficiency can be detected using the 25-hydroxyvitamin D radioimmunoassay. While there is debate as to ideal concentrations, the following could be used to guide a clinical approach:

vitamin D sufficiency => 75 nmol/L

sub-optimal levels= 50–75 nmol/L

vitamin D insufficiency =25–50 nmol/L

vitamin D deficiency =15–25 nmol/L

severe vitamin D deficiency = < 15 nmol/L.

Daily requirements : Daily requirements for vitamin D are around 800–1000 IU, but larger doses are needed for patients who are already deficient. For moderate deficiency, that is 15–25 nmol/L, oral supplementation with 3000–5000 IU daily for 6–12 weeks can be used to replete

stores followed by a maintenance dose of 1000–2000 IU per day. Vitamin D status should be assessed 3–4 months after commencing treatment as vitamin D is stored in fat and muscle and there is a lag time before normalisation of serum concentrations. For severe vitamin D deficiency, that is 25-hydroxyvitamin D less than 15 nmol/L, the intramuscular form of cholecalciferol 100 000 IU (megadose therapy) may be more suitable to replenish stores more quickly and effectively. This is especially pertinent for patients with malabsorption, acute medical illnesses and poor dietary compliance. Currently, such formulations are only available for specialists under a special access scheme.

The aim of this study was to estimate vitamin D3 levels in patients coming to medicine and orthopaedic OPD with various symptoms related to vit D deficiency.

Material and methods

This study was conducted in year 2021. Patients coming to medicine and orthopaedic OPD with symptoms such as tiredness and fatigue, muscle pain, bone and joint pain, mood changes, low immunity (recurrent respiratory infections), hypertension were included in study. Both male and females 70 adult subjects were included in this study. Informed consent was taken from subjects. Blood pressure was recorded of all subjects, general examination was done. Serum Vitamin D3 levels were estimated in all subjects. History was asked regarding type of diet, daily sun exposure, daily physical activity. Any changes in mood or depression was asked. Height and weight was recorded and Body mass index was calculated. X ray of long bones and joints was done in suspected patients of bone loss. Data collected was analysed and tabulated in form of frequency and percentage.

Results

21.42% subjects had normal BMI, 35.71% were overweight, 42.85% were obese.

Table 1 : Body mass index of study Subjects

BMI	Number of subjects n=70	Percentage
<24.9 -Normal	15	21.42%
25-29.5-Overweight	25	35.71%
>30-Obese	30	42.85%

Table 2 shows 64.28% subjects had less than 30 minutes of sun exposure daily. 21.42% subjects had vegetarian diet. 57.14% subjects had inadequate daily physical activity.

Table2: Features of study subjects

Average duration of sun exposure per day	Number of subjects n=70	Percentage
>30 minutes	25	35.71%
<30 minutes	45	64.28%
Diet	Number of subjects n=70	Percentage
Veg	15	21.42%
Non Veg	55	78.57%
Physical activity daily	Number of subjects n=70	Percentage
yes	30	42.85%
No	40	57.14%

Table 3 : Presenting symptoms of subjects

Symptoms	Number of subjects n=70	Percentage
Tiredness and Fatigue	60	85.71%
Muscle pain	55	78.57%
Hair loss	15	21.42%
Bone loss	40	57.14%
Bone and joint pain	60	85.71%
Hypertension	10	14.28%
Mood changes	12	17.14%
Low immunity	25	35.71%

Table 3 shows the various symptoms patients presented with in OPD. These symptoms were related to vit D deficiency. 85.71% subjects had Tiredness and Fatigue , 78.57% subjects had Muscle pain, 57.14% subjects showed bone loss in X ray. 85.71% subjects had Bone and joint pain. 14.28% subjects had hypertension . 17.14% had mood changes mainly depression. 35.71% had recurrent infections which shows low immunity.

Table 4 shows Serum vitamin D3 levels of subjects. 35.71% had Severely deficient vit D3 levels. 42.85% were deficient. 14.28% had inadequate vitamin D3 levels. 4.28% had adequate levels of Vitamin D3.

Table 4 : Total Vitamin D3 levels in subjects.

Vitamin D3 levels (nmol/L)	Number of subjects n=70	Percentage	
Severely deficient	<15	25	35.71%
Deficient	15-30	30	42.85%
Inadequate	30-50	10	14.28%
Adequate	>50	03	4.28%
Optimal	>100-125	02	2.85%

Discussion

Vitamin D deficiency is a widespread condition that is said to affect about 1 billion people worldwide . A previous review of vitamin D deficiency in Turkey revealed a wide rate of severe deficiency of 8% to 84% [18]. Over the past 2 decades, several national population-based epidemiological studies in the United States, Canada, the United Kingdom, and New Zealand have reported a deficiency rate of 18% to 36%. It was reported that the vitamin D deficiency rate among the Australian population was 39% for women and 22% for men [19]. Vitamin D is unique because it can be made in the skin from exposure to sunlight.[20]

Vitamin D exists in two forms. Vitamin D2 is obtained from the UV irradiation of the yeast sterol ergosterol and is found naturally in sun-exposed mushrooms. UVB light from the sun strikes the skin, and humans synthesize vitamin D3 , so it is the most “natural” form. Human beings do not make vitamin D2 , and most oil-rich fish such as salmon, mackerel, and herring contain vitamin D3 . Vitamin D (D represents D2 , or D3 , or both) that is ingested is incorporated into chylomicrons, which are absorbed into the lymphatic system and enter the venous blood. Vitamin D that comes from the skin or diet is biologically inert and requires its first hydroxylation in the liver by the vitamin D-25-hydroxylase (25-OHase) to 25(OH)D. However, 25(OH)D requires a further hydroxylation in the kidneys by the 25(OH)D-1-OHase (CYP27B1) to form the biologically active form of vitamin D 1,25(OH)2D. 1,25(OH)2D stimulates intestinal calcium absorption. Without vitamin D, only 10–15% of dietary calcium and about 60% of phosphorus are absorbed. Vitamin D sufficiency enhances calcium and phosphorus absorption by 30–40% and 80%, respectively.[21]

Vitamin D deficiency: Prevalence VDD has been historically defined and recently recommended by the Institute of Medicine (IOM) as a 25(OH)D of less than 0.8 IU. Vitamin D insufficiency has been defined as a 25(OH) D of 21–29 ng/mL. Children and young- and middleaged adults are at equally high risk for VDD and insufficiency worldwide. VDD is common in Australia, the Middle East, India, Africa, and South America.[22] Pregnant and lactating women who take a prenatal vitamin and a calcium supplement with vitamin D remain at high risk for VDD.[23]

Vitamin D deficiency, why it happens? :The major source of vitamin D for children and adults is exposure to natural sunlight.[24] Thus, the major cause of VDD is inadequate exposure to sunlight. Wearing a sunscreen with a sun protection factor of 30 reduces vitamin D synthesis in the skin by more than 95%. People with a naturally dark skin tone have natural sun protection and require at least three to five times longer exposure to make the same amount of vitamin D as a person with a white skin tone.[25] There is an inverse association of serum 25(OH)D and body mass index (BMI) greater than 30 kg/m² , and thus, obesity is associated with VDD.[26] Patients with one of the fat malabsorption syndromes and bariatric patients are often unable to absorb the fatsoluble vitamin D, and patients with nephritic syndrome lose 25(OH)D bound to the vitamin D-binding protein in the urine.[27]

Vitamin D deficiency Consequences VDD results in abnormalities in calcium, phosphorus, and bone metabolism. VDD causes a decrease in the absorption of dietary calcium and phosphorus, resulting in an increase in PTH levels. The PTH-mediated increase in osteoclastic activity creates local foci of bone weakness and causes a generalized decrease in bone mineral density (BMD), resulting in osteopenia and osteoporosis. An inadequate calcium–phosphorus product causes a mineralization defect in the skeleton.[28] In young children who have little mineral in their skeleton, this defect results in a variety of skeletal deformities classically known as rickets. VDD also causes muscle weakness; affected children have difficulty in standing and walking, whereas the elderly have increasing sway and more frequent falls, thereby increasing their risk of fracture. Vitamin D is known to help the body absorb calcium, and it plays a role in bone health. In addition, VDRs are located on the fast-twitch muscle fibers, which are the first to respond in a fall. It is theorized that vitamin D may increase muscle strength, thereby preventing falls.[29] Many studies have shown an association between low vitamin D concentrations and an increased risk of fractures and falls in older adults.

In our study 35.71% had Severely deficient vit D3 levels. 42.85% were deficient. 14.28% had inadequate vitamin D3 levels. 4.28% had adequate levels of Vitamin D3. 85.71% subjects had Tiredness and Fatigue , 78.57% subjects had Muscle pain, 57.14% subjects showed bone loss in X ray. 85.71% subjects had Bone and joint pain. 14.28% subjects had hypertension . 17.14% had mood changes mainly depression. 35.71% had recurrent infections which shows low immunity. 64.28% subjects had less than 30 minutes of sun exposure daily. 21.42% subjects had vegetarian diet. 57.14% subjects had inadequate daily physical activity. 21.42% subjects had normal BMI, 35.71% were overweight, 42.85% were obese.

Vitamin D deficiency can be managed with pharmacological or non-pharmacological approaches depending on the severity. The goal of the treatment is to raise serum vitamin D to normal levels to relieve the symptoms and reduce the adverse health outcomes such as rickettsia among infants, osteomalacia among adults, and osteoporosis among the elderly. To date, there are no clear guidelines in treating vitamin D deficiency . According to the American Family Physician, ergocalciferol at 60,000 IU given orally is the medication of choice that should be given every week for eight weeks as an effective regiment to normalize the level of serum 25-hydroxyvitamin D.

Conclusion

Numbers of people with Vitamin D deficiency are continuously increasing; the importance of this hormone in overall health and the prevention of chronic diseases are at the forefront of research. VDD is very common in all age groups. Very few foods contain vitamin D therefore guidelines recommended supplementation of vitamin D at tolerable UL levels. It is also suggested to measure the serum 25-hydroxyvitamin D level as the initial diagnostic test in patients at risk for deficiency. Treatment with either vitamin D2 or vitamin D3 is recommended for the deficient patients.

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