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Why vitamin D is important and how to access the important resources?

Hassanat E. Mustafa

Ph.D. Medical-Surgical Nursing Khartoum, Sudan | Nursing Practice Department, Umm Al-Qura University, Mecca, Makkah, Saudi Arabia

Corresponding author email: hemustafa@uqu.edu.sa

Abstract--Background: Vitamin D was important for health. It regulated calcium and phosphate absorption, strengthens bones; muscles, and improved the body's immunity. There were multiple resources for it, but its deficiency led to various health problems. Aim: The study aimed to review literature to understand the nature and optimal time for exposure to sunrays for gaining vitamin D. Method: The searcher conducted the literature through health organizations such as Up-To-Date, Medline, Pro-Quest–Medline Index, Clinical Key, CDC, WHO, Google Scholar, and PubMed. Result: Vitamin D had various benefits for vital body function as well as its reduction led to serious problems, so the recommended daily oral dose was 600 IU which increased among the population with vitamin D deficiency. Exposed of the face, arms, legs, or back to sun rays for an average of 15 minutes between 10 a.m. to 3 p.m. two to three times per week was enough for cholecalciferol production. Conclusion: Vitamin D was important for the body function. The skin had the ability to synthesize vitamin D₃ when exposed to sunlight during the day, especially in the summer; the peak time was 11:00 am to 2 pm. There were factors that influenced vitamin D production such as time through the day and seasons.

Keywords--important, vitamin D, insufficiency, natural resources.

Background

Vitamin D is a fat-soluble vitamin that regulates calcium and phosphate absorption and the strength of bone, muscle, improves immunity, and supports mental health. Also, it prevents the risk of osteoporosis, rickets in children, heart disease. cancer, type 2 diabetes, multiple sclerosis, and covid 19. It is produced during skin exposure to sunlight rays in addition to animal and plant sources.^{1,2,3,4} Vitamin D₂ is found in plant-based sources like exposed mushrooms to sunlight and yeast in addition to animal-based sources of vitamin

D3 or cholecalciferol; from oil-rich fish in salmon, milk, eggs, mackerel, and herring are equally effective in enhancing Vitamin D levels.^{1,2,5}

The inert biological form of vitamin D needs to be hydroxylated in the liver by the vitamin D-25-hydroxylase to 25(OH)D requires further hydroxylation in the kidneys by the 25(OH)D-1-OHase to form the biologically active form of vitamin D which enhance absorption of intestinal calcium and phosphorus in high percentage.² A study in the United Kingdom of 120 white people found that exposure to summer sunlight for 13 minutes three times a week keeps the health range of vitamin D; in addition, vitamin D-rich foods are helpful, especially in darker skin. Also, The National Institute of Health recommended a daily amount of vitamin D for healthy human bodies 400 IU per day for infants aged up to one year, 600 IU for 1 up to 70 years, and 800 IU for adults more than 70 years.^{1,2}

Vitamin D deficiency is wide world problem in Australia the Middle East, India, Africa, and South America. It leads to different health problems such as rickets in children, osteomalacia, and osteoporosis.^{1,2} Vitamin D directly interacts with the cells that are responsible for addressing infections. Several large observational studies have shown a link between a deficiency and respiratory tract infections such as colds, bronchitis, and pneumonia.³ Studies in 2020 linked a deficiency of vitamin D high risk to develop COVID-19.¹

Vitamin D sufficiency is estimated between 20 and 40 ng/mL (50 to 100 nmol/L), are based on evidence related to bone health according to the National and International Osteoporosis Foundation.⁵ There are several factors that lead to insufficient vitamin D including inadequate exposure to sunlight, such as people wearing sunscreen with sun protection reduces its synthesis by 95%., people with dark skin tones require five times longer exposure compared with white ones, obesity, patients with fat malabsorption, bariatric, and nephritic syndrome, Crohn's disease, chronic, granuloma-forming disorders and some lymphomas such as sarcoidosis, tuberculosis, chronic fungal infections and primary hyperparathyroidism. ². certain medications that affect vitamin D metabolism, such as statins and steroids ³. as well as pregnancy and Lactation ² American Association of Pediatricians (AAP) recommended vitamin supplements for high-risk populations such as infants, elders, fat malabsorption, obese, and dark skin people. ² other Observational studies suggest an association between poor vitamin D status and muscle weakness in children and older individuals. The greatest benefit of vitamin D supplementation for patients with vitamin D below 10 ng/mL (25 nmol/L).⁶

Vitamin D deficiency is associated with many symptoms such as aches, bone and muscle pain, weakness, and stress fractures, especially in the legs, pelvis, and hips.⁴ Fatigue and tiredness are approved one study included 480 older adults, and in other observational studies, 89% of female nurses self-reported fatigue due to vitamin D deficiency. Plus, a study of 39 children has poor sleep linked to low vitamin D levels.³ Also, one study in 98 adults with lower back pain; another similar. A review of 81 studies found that people with arthritis, muscle, and chronic widespread pain, Depression, and impaired wound healing. results from a test-tube study suggest that vitamin D increases the production of compounds that are crucial for forming new skin as part of the wound-healing process, one

study in 221 people, 112 of whom had diabetes-related foot infections, found that those with severe vitamin D deficiency were more likely to have higher levels of inflammatory markers that can jeopardize healing. In a 12-week study involving 60 people with diabetes-related foot ulcers, those who took a vitamin D supplement experienced significant improvements in wound healing compared with the placebo group.³ In a large observational study of more than 1,100 middle-aged menopausal women, researchers found a strong link between low vitamin D levels and low bone mineral density, hair loss, stress, and autoimmune disease. In another study of 48 people with alopecia, applying a synthetic form of vitamin D topically for 12 weeks significantly increased hair regrowth.³

In an older study, 71% of people with chronic pain were found to have a deficiency. The vitamin D receptor is present in nerve cells called nociceptors, which sense pain. A separate study in pregnant women found that having adequate vitamin D levels may help reduce anxiety symptoms, improve sleep quality, and even help prevent postpartum depression.³ Lacking in vitamin D are common in patients with Chronic Obstructive Pulmonary Disease (COPD). According to the recent data on vitamin D status in representative COPD cohorts in Scandinavia in the Southwestern Sweden clinic during two periods, 2017-2018 and 2021 a total of 667 patients were included, and 33% had vitamin D insufficiency.⁷ On the other hand, magnesium helps activate vitamin D.³ However, calcium and vitamin D supplementation is typically suggested as part of the treatment of osteoporosis, particularly for patients who are receiving osteoporosis medications.^{8, 9,10}

Melanoma is a worldwide public health concern in light-skinned populations due to exposure to ultraviolet (UV) radiation. To decrease this hazard an Australian skin cancer prevention program and the United States Centers for Disease Control and Prevention (CDC) estimated that a comprehensive national skin cancer prevention program could avert 230,000 melanoma cases and USD \$2.7 billion in initial year treatment costs from 2020 to 2030. In the period 2005 to 2014 a similar reduction in melanoma incidence in both gender populations aged ≤45 years.¹¹ The National Health and Nutrition Examination Survey (NHANES) in America, recommended 600 IU daily intake and increasing the dose among a population with vitamin D deficiency.^{12,13} Many factors influence the skin to synthesize Vitamin D from the sun's rays and increase the risk of deficiency. So exposure of the skin directly to UVB rays at specific time and duration per day produce the body needs from vitamin D3, or cholecalciferol.¹⁴

As well as the time during the day and seasons are important because the sun's rays enter the Earth's atmosphere at a steep angle which leads to blocked UVB rays during the early and later parts of the day and most of the day during the winter, so levels of vitamin D have been shown lowest during the winter months and highest in the summer.¹⁴ However, the right choice for the reduction of the risk of skin cancer there are available two forms of D2 and D3 supplements of vitamin D.¹¹ Some studies proved that the maximal period of vitamin D production was exposure to solar radiation wavelengths UVB photons 290–315 nm resulting in the cutaneous production of vitamin D3 between 11 a.m. to 2 p.m.¹⁵ This time agreed with the finding of the studies conducted in south India.^{16,17}

Another study conducted in the Central region of Riyadh, Saudi Arabia in 2013 aimed to determine the optimum time for sun exposure; results demonstrated that the time of the day has a major influence on vitamin D production was observed to occur between 8:00 AM to 4:00 PM with peak hours between 10:00 AM to 12 noon and in summer is from 9:00 AM until 3:00 PM, while during winter it's from 10:00 AM until 2:00 PM.¹⁸ Also, study was conducted in the southern part of Argentina which has a high prevalence of rickets, the result showed the maximal time of vitamin D production from 10:30 a.m. to 2:30 p.m. were similar for each month.¹⁹ In South Africa, Cape Town, and Johannesburg; found that maximum production of Vitamin D3 at midday at 1:30 pm during summer, while formed little amount during the winter months.²⁰ Using a model, the ability of sunlight to synthesize vitamin D3 in skin is affected by the seasonal and latitudinal vary in summer and winter.²¹ people need vitamin D supplement 400 IU daily for infants and 600 IU daily for children and adult.^{22,23} Generally, serum 25-Hydroxyvitamin D [25(OH)D] Concentrations ≥ 50 nmol/L or ≥ 20 considered adequate for bone and overall health in healthy individuals.²⁴

Interactions Vitamin D supplements with Medications: there are several types of medications interact with Vitamin D, included orlistat weight-loss drug can reduce the absorption of vitamin D from food and supplements, Statin medications reduce of cholesterol synthesis which endogenous resources of vitamin D. In addition to Corticosteroid medications were prescribed to reduce inflammation' can reduce calcium absorption and impair metabolism of vitamin D as well as combination of Thiazide with vitamin D supplements lead to hypercalcemia related to increase intestinal calcium absorption, especially among older adults and individuals with compromised renal function or hyperparathyroidism.²⁴.

Conclusions

Vitamin D is important for health, but its deficiency leads to various health problems. There are different resources for vitamin D through oral intake of special food and exposure to the sun's rays as a natural resource. The recommended oral daily dose was 600 IU and increasing the dose among a population with vitamin D deficiency. There are different factors influence vitamin D production. According to the National Institutes of Health, exposure of unprotected face, arms, legs, or back to the sun rays for 5 - 30 minutes at a time between 10 a.m. to 3 p.m. two to three times per week is getting more than 90 percent enough for the body to produce its needs from cholecalciferol. In general vitamin D production occurred between 8:00 AM to 4:00 PM with peak average hours between 11:00 AM to 2 PM. .there was normal concentration level of vitamin D adequate for bone and overall health in healthy individuals.

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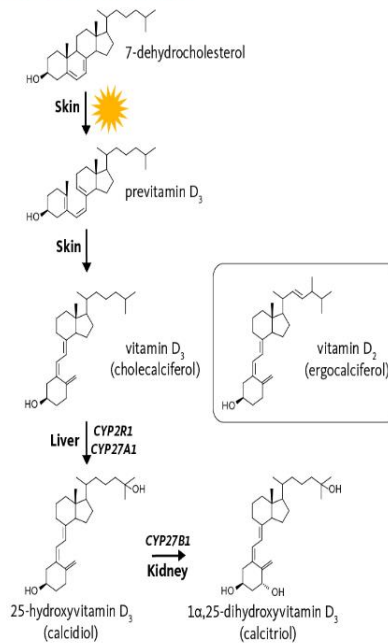
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Annexes

Figure 1. Chemical Structures of Vitamin D



Vitamin D synthesis. Previtamin D₃ is synthesized in the upper layers of the skin from 7-dehydrocholesterol by the action of ultraviolet light (UVB). A nonenzymatic conversion of previtamin D₃ into vitamin D₃ (cholecalciferol) then occurs in lower layers of the skin. Vitamin D₃ is quickly transported to adipose tissue for storage or liver for activation. In liver cells, several cytochrome P450 (CYP) enzymes can catalyze the 25-hydroxylation of vitamin D₃ (or plant-based vitamin D₂ or ergocalciferol). The product of this step, 25-hydroxyvitamin D₃, is converted into the active form of vitamin D₃, 1,25-dihydroxyvitamin D₃, in a reaction catalyzed by CYP27B1. This 1 α -hydroxylation takes place primarily in the kidney.

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