

REVIEW ARTICLE

SUNSHINE VITAMIN

Virendra Kr. Goyal¹

HOW TO CITE THIS ARTICLE:

Virendra Kr. Goyal. "Sunshine Vitamin". Journal of Evidence Based Medicine and Healthcare; Volume 1, Issue 7, September 2014; Page: 503-508.

ABSTRACT: Vitamin is an organic chemical compound which can't be synthesized in sufficient quantities by an organism and must be obtained from diet. Vitamin D is not essential dietary vitamin in strict sense.⁸ It is synthesized in adequate amounts by most mammals exposed to sun. Surprisingly, cats and dogs can't synthesize vitamin D and must receive it in diet. As with other compounds called vitamins, vitamin-D was discovered as to find the dietary substance that was lacking in a disease, namely, rickets.¹

Vitamin D (Sunshine Vitamin) is a group of fat soluble seco-steroids responsible for intestinal absorption of calcium and phosphate¹. Two forms of vitamin D are:-

D2 – Ergocalciferol and

D3 – Cholecalciferol

Regular sources are:-

1. Diet
2. Supplements / Fortified foods: e.g. margarine, some cereals, infant formula milk.
3. Sunshine

Vitamin D₃ (cholecalciferol) is produced by UVB irradiation of precursor 7-dehydrocholesterol. Our skin makes Vitamin D₃ and supplies about 90% of our Vitamin D. Vitamin D₃ is richly found in oily fish and cod liver oil.

Vitamin D₂ (Ergocalciferol) is a derivative of ergosterol, produced by fungi e.g. mushrooms. It is produced from ergosterol by UVI. The fate for producing 25 (OH) D₂ from D₂ is same as for 25(OH) D₃.

Vit-D sources are oily fishes (such as sardines, pilchards, herring, trout, tuna, salmon and mackerel), fortified foods (this means they have vitamin D added to them) such as margarine, some cereals, infant formula milk, cod liver oil, egg yolk, liver and mushrooms (contain small quantities of vitamin D). However, UVB remains the richest & biggest source³.

Symptoms of hypovitaminosis-D: -Bone pain and muscle weakness are commonly seen. Low blood levels of the Vitamin have been associated with increased risk of death from CVD, cognitive impairment in elderly, severe asthma in children and a wide variety of cancers.

Vitamin D deficiency can occur for a number of reasons: -

One doesn't consume the recommended levels of the vitamin over time.

Strict vegetarian diet, because most of the natural sources are animal based, including fish and fish oils, egg yolks, cheese, fortified milk and beef liver. Hypovitaminosis D is a risk factor for the development of depressive symptoms in older persons.

REVIEW ARTICLE

The body makes vitamin D when our skin is exposed to sunlight. One may be at risk of deficiency if: -homebound, live in northern latitudes, wear long robes or head coverings (naqab, burka) for religious reasons, or occupation that prevents sun exposure.

For a fair skinned person, 20-30 minutes of sunlight on the face and forearms around the middle of the day 2-3 times a week is sufficient to make enough vitamin D in the summer months. For people with darker skin and elderly, the amount of time needed to get exposed to sunlight is much more.²

It is nothing the same as sunbath. The skin simply needs to be exposed to sunlight. The sunlight has to fall directly on the bare skin. Sunlight through a window is not enough.

LIMITATIONS:

One has dark skin.

The pigment melanin reduces the skin's ability to make vitamin D in response to sunlight exposure. Elder adults with darker skin are at high risk of vitamin D deficiency.

Kidneys cannot convert vitamin D to its active form.

With aging, kidneys are less able to convert vitamin D to its active form, thus increasing their risk of Vitamin D deficiency.

Digestive tract cannot adequately absorb vitamin D.

Certain medical problems, including Crohn's disease, cystic fibrosis, and celiac disease, affect intestine's ability to absorb vitamin D from the food.

Obesity.

Vitamin D is extracted from the blood by fat cells, altering its release into the circulation. People with a body mass index of 30 or greater have low blood levels of vitamin D.

Certain medicines which interfere with Vitamin D include: -

- Carbamazepine
- Phenytoin,
- Primidone,
- Barbiturates and,
- Antivirals for HIV infection etc.

SERUM LEVELS: Serum concentration of 25 hydroxy vitamin D (Calcidiol) is used to determine Vitamin D status. It reflects Vitamin D produced in the skin & acquired from the diet. (Half-life of 15 days). It does not reveal the amount of vitamin D stored in body tissues. The level of serum 1, 25 dihydroxy vitamin D is not used to determine vitamin D status⁷. (half-life of 15 hours) and is regulated by parathyroid hormone, calcium & phosphate, so it is not decreased significantly until vitamin D deficiency is well advanced³.

2, 5 Hydroxy vitamin D blood test.

20 nanograms / milliliter to 50ng/mL – adequate for healthy people

REVIEW ARTICLE

Less than 15ng/mL – vitamin D deficiency (mild to severe)

10-15 ng/mL - mild

5-10 ng/mL - moderate

<5 ng /mL - severe

TREATMENT: It aims getting more vitamin D through diet and supplements. A concentration of less than 20nanograms per milliliter is considered inadequate, requiring treatment. The safe upper limit is 4000 IUs to optimize bone health. If one don't spend time in the sun or always covering the skin (sunscreen inhibits vitamin D production), vitamin D supplement may be required⁴.

Inadequate nutritional intake of Vitamin D coupled with inadequate sunlight exposure (inadequate UVB rays). Disorders that limit Vitamin D absorption and conditions that impair the conversion of Vitamin D into active metabolites includes certain liver, kidney and hereditary disorders. Deficiency results in impaired bone mineralization and leads to bone softening disease including rickets in children and osteomalacia and osteoporosis in adults⁴.

DEFICIENCY – BONE DISEASES:

- Rickets, a childhood disease characterized by impeded growth and deformity of the long bones.
- The earliest sign of subclinical Vitamin D deficiency is craniotabes i.e. abnormal softening or thinning of the skull.
- Osteomalacia (bone – thinning disorder) exclusively in adults. There is proximal muscle weakness and bone fragility.
- Osteoporosis, a condition characterized by reduced bone mineral density and increased bone fragility.
- Muscle aches and weakness (in particular proximal limb girdle)⁶
- Muscle twitching (fasciculations)

REQUIREMENT: To prevent rickets and possibly also a wide range of chronic non skeletal disease.

600 IU of Vitamin D/day for those 1-70 years.

800 IU for those above 70 years of age.

1 IU vitamin D is the biological equivalent of 0.025µg cholecalciferol / ergocalciferol. Pregnant or breast feeding women consider taking 2000 IU / day. All babies who are exclusively breastfed receive a supplement of 400 IU/day. Obese individuals have lower levels of Vitamin D, because of reduced bioavailability & are at risk of deficiency. To maintain blood levels of calcium, therapeutic vitamin D doses are administered (up to 100,000 IU or 2.5 mg daily) to patients who have had their parathyroid glands removed (renal dialysis, primary hyperparathyroidism) or with hypoparathyroidism.²

Patients with chronic liver disease or intestinal malabsorption disorders also require larger doses of vitamin D (up to 40,000 IU or 1mg daily)⁴.

REVIEW ARTICLE

The use of sunscreen with a sun protection factor (SPF) of 8, inhibit more than 95% of vitamin D production in the skin. Wearing full clothing prevents skin exposure to UVB and reducing vitamin D synthesis. The clothing worn on a consistent and regular basis, such as the naqab, burqa is correlated with lower vitamin D levels and increased prevalence of hypovitaminosis D.

Reduced pigmentation of light skinned individuals results in higher vitamin D levels, because melanin acts like a sun-block. Dark skinned individuals may require extra vitamin D to avoid deficiency at higher latitudes. The natural selection hypothesis suggests that lighter skin color evolved to optimize vitamin D production in extreme northern latitudes.

Vitamin D deficiency causes osteomalacia (rickets in children). Low serum vitamin D levels cause falls, and low bone mineral density. There is not enough evidence to indicate that healthy postmenopausal women should use supplemental doses of calcium or vitamin D to prevent fractures. Supplementation with Vitamin D and calcium may improve bone mineral density slightly, as well as decreasing the risk of fractures in people, older than 65 years.

No benefit to bone health from Vitamin D without sufficient calcium.⁴

MULTIPLE SCLEROSIS:

Hypovitaminosis D is associated with multiple sclerosis (MS).^{9,10}

Supplementation with Vitamin D has a protective effect. Reasons are as follows:

1. MS frequency increases with increasing latitude, which is inversely correlated with duration and intensity of UVB from sunlight and vitamin D concentration.
2. Prevalence of MS is lower than at high latitudes in populations with high consumption of Vitamin D rich fatty fish.
3. MS risk seems to decrease with migration from high to low latitudes.

Hypovitaminosis D is associated with some cancers (prostatic) and has worse outcomes in other cancers⁶. Low levels of Vitamin D in pregnancy are associated with gestational diabetes, pre-eclampsia and LBW. Pregnant women who take an adequate amount of vitamin D during gestation experience positive immune effects.

OTHERS⁶:

Influenza: high rates for influenza infection during the winter.

Viral Infections: factors include low relative humidity produced by indoor heating and low temperatures that favor virus spread.

Low levels of Vitamin is a risk factor for tuberculosis.

Asthma – low levels of vitamin D.

Supplemental Vitamin D is recommended in promotion of human hair growth.

RICKETS (A CHILDHOOD DISEASE):

Rickets is characterized by impeded growth, soft, weak, deformity of the long bones that bend and bow under their weight as they start to walk. This condition is characterized by bow

REVIEW ARTICLE

legs, which can be caused by calcium or phosphorus deficiency as well as a lack of vitamin D. It is found in low income countries in Africa, Asia or the Middle East and in those with age.

OSTEOMALACIA:

Adults with Chronic musculoskeletal pain

Softening of the bones, leading to

1. bending of the spine,
2. bowing of the legs,
3. proximal muscle weakness,
4. Bone fragility and increased risk for fractures. Osteomalacia reduces calcium absorption and increases calcium loss from bone, which increases the risk for bone fractures (25-hydroxyvitamin D levels < 10 ng/mL).

OSTEOPOROSIS: It is defined as decrease in bone mineral density and the appearance of small holes in bones due to loss of minerals. There is vitamin D inadequacy (<10 ng/ml). Osteoporosis and osteomalacia are closely associated. There is higher risk of fractures and bone loss. Supplementing with Vitamin D increases bone density and can significantly improve the reduction in risk of osteoporotic fractures (especially hip fractures).

TOXICITY: Vitamin D overdose causes hypercalcemia, and so are the symptoms, e.g. anorexia, nausea and vomiting polyuria, polydipsia, weakness, insomnia, nervousness, pruritus & renal failure.

- Proteinuria, urinary casts, azotemia and metastatic calcification (especially in the kidneys).
- Mental retardation in young children
- Abnormal bone growth and formation
- Diarrhea, irritability, weight loss & severe depression.

SUMMARY: It is important for good health, growth and strong bones. Vitamin D is mostly made in the skin by exposure to sunlight. Most foods contain very little vitamin D naturally, though some are fortified with added Vitamin D.

A mild lack of Vitamin D may not cause symptoms but can cause tiredness and general aches and pains. A more severe lack can cause problems such as rickets (in children) and osteomalacia (in adults).

Treatment is with Vitamin D supplements.

SPECIAL CARE FOR:

Some people are more at risk of Vitamin D deficiency and so are recommended to take Vitamin D supplements routinely. These include:-

All pregnant and breast feeding women, infants and young children aged 6 months to 5 years, People above 65 years, those who are not exposed to sun much⁸. A Doctor may also recommend routine supplements for certain people with darker skin and for people with certain gut, liver or kidney diseases.

REVIEW ARTICLE

REFERENCES:

1. Holick MF "High prevalence of vitamin D inadequacy and implications for health". Mayo Clin. Proc. March 2006; 81 (3): 353–73.
2. Calvo MS, Whiting SJ, Barton CN. "Vitamin D intake: a global perspective of current status". J. Nutr. February 2005; 135 (2): 310–6.
3. Norman AW. "From vitamin D to hormone D: fundamentals of the vitamin D endocrine system essential for good health". Am. J. Clin. Nutr. August 2008; 88 (2): 491–499.
4. Bjelakovic G, Gluud LL, Nikolova D, et al. "Vitamin D supplementation for prevention of mortality in adults". Cochrane Database Syst Rev (Systematic review): 2014.
5. Bolland MJ, Grey A, Gamble GD, Reid IR. "The effect of vitamin D supplementation on skeletal, vascular, or cancer outcomes: a trial sequential meta-analysis. Lancet Diabetes Endocrinol 2014.
6. Theodoratou, E; Tzoulaki, I; Zgaga, L; Ioannidis, JP. "Vitamin D and multiple health outcomes: umbrella review of systematic reviews and meta-analyses of observational studies and randomised trials." BMJ. 2014; 348.
7. Autier P, Boniol M, Pizot C, Mullie P. "Vitamin D status and ill health: a systematic review". The Lancet Diabetes & Endocrinology, 6 December 2013.
8. Maxmen A. "Nutrition advice: the vitamin D-lemma". Nature; 2011:475 , 23–5.
9. Tuohimaa P. "Vitamin D and aging". The Journal of Steroid Biochemistry and Molecular Biology March 2009 114 (1–2): 78–84
10. Tuohimaa P, Keisala T, Minasyan A, Cachat J, Kalueff A "Vitamin D, nervous system and aging". Psychoneuroendocrinology.2009Dec; 34:1.

AUTHORS:

1. Virendra Kr. Goyal

PARTICULARS OF CONTRIBUTORS:

1. Senior Consultant, Department of Internal Medicine, Jeevan Rekha CCTH.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. V. K. Goyal,
142-A, Taruchaya Nagar,
Tonk Road, Jaipur,
Rajasthan – 302018.
E-mail: virendra601@yahoo.co.in

Date of Submission: 01/08/2014.
Date of Peer Review: 02/08/2014.
Date of Acceptance: 04/08/2014.
Date of Publishing: 02/09/2014.