

Vitamin D

AT A GLANCE

Introduction

Vitamin D comprises a group of fat-soluble compounds that are essential for maintaining the mineral balance in the body. The vitamin D form synthesized in humans is called 'cholecalciferol' (vitamin D3). As cholecalciferol is synthesized in the skin by the action of ultraviolet light (UVB), vitamin D does not fit the classical definition of a vitamin; nevertheless, it is recognized as an essential dietary nutrient.

The sun is our major vitamin D source. However, several factors such as sunscreen with a sun protection factor above 8, age, darker skin pigmentation, northern latitude greater than 40 degrees and the winter season reduce the production of vitamin D in the skin. Most vulnerable to low vitamin D status are breast fed infants, elderly and institutionalized individuals, obese individuals and African Americans of all ages.

In addition to bone health, emerging science reveals a non-skeletal benefit of vitamin D for several other health outcomes.

Health Functions

A sufficient intake of vitamin D (calciferol) is important as it helps the body to

- maintain healthy calcium and phosphate blood levels
- build and maintain healthy bones
- control cell division and specialization
- modulate the immune system.

The European Food Safety Authority (EFSA), which provides scientific advice to assist policy makers, has confirmed that clear health benefits have been established for the dietary intake of vitamin D in contributing to:

- the maintenance of normal bones and teeth;
- the normal function of the immune system and healthy inflammatory response;
- the maintenance of normal muscle function;
- normal absorption/utilization of calcium and phosphate and the maintenance of normal blood calcium concentrations;
- normal cell division.

In addition, vitamin D plus calcium are needed for the maintenance of normal bone.

Disease Risk Reduction

Bone disorders

Adequate amounts of vitamin D throughout one's life - in combination with exercise, proper nutrition, calcium, and magnesium - are necessary for building up and maintaining bones and preventing bone loss. Vitamin D is needed to properly absorb calcium.

Studies have shown that low levels of vitamin D and insufficient sunlight exposure (fewer than 20 minutes per day) are associated with osteoporosis.

Calcium, together with vitamin D, has been shown to help heal bone fractures from osteoporosis and decrease the risk of future bone breaks.

In addition, vitamin D has demonstrated a beneficial effect on muscle function and strength and thereby reduces the risk of falling.

Moreover, vitamin D is well known to protect against 'rickets' and 'osteomalacia', diseases of severe vitamin deficiency.

Cancer

Studies in test tubes have indicated that vitamin D may have anti-cancer effects, while clinical study findings on vitamin D and specific cancers such as colorectal cancer have been inconsistent.

However, some studies have shown strong evidence that high doses of vitamin D supplements may reduce the risk of colorectal cancer.

In addition, some population studies have suggested that supplementation with vitamin D may improve survival rates in those with a history of breast cancer. Other studies indicated that vitamin D3 supplementation might be effective in treating skin cancer. However, this research is still in the experimental stages.

Autoimmune diseases

Research suggests that vitamin D deficiency or a low vitamin D status may be linked to an increased risk of developing autoimmune diseases, overactive immune responses of the body attacking its own cells and organs.

Clinical studies evaluating the use of vitamin D for some forms of arthritis (e.g. rheumatoid arthritis and osteoarthritis) have found vitamin D to have preventive effects.

Observational data has suggested that vitamin D from foods and through dermal production by sunlight may help to protect against multiple sclerosis (MS), a disease in which the body's immune response attacks a person's brain and spinal cord.

Research has shown that supplementing infants and children with sufficient doses of vitamin D may protect against the development of type 1 diabetes, a disease in which the body's immune system destroys the insulin-producing cells.

Cardiovascular disease and High blood pressure

Data from clinical studies have suggested a link between low levels of vitamin D and high blood pressure. Moreover, low vitamin D status as measured by the 25(OH)D plasma levels is thought to be

independently associated with all-cause and cardiovascular mortality or a higher risk of a heart attack.

Intake Recommendations

Health authorities in the European Union and the U.S. have set adequate intake levels between 200 and 800 IU per day (5–20 micrograms) for adults. For the elderly (> 75 years), higher intakes of 400 – 800 IU (10–20 micrograms) were recommended to maintain normal calcium metabolism and maximize bone health. However, emerging scientific data suggest that this may be insufficient for chronic diseases associated with vitamin D.

A sun-deprived lifestyle resulting in low vitamin D synthesis in the body is the major factor for an insufficient vitamin D status. During late spring and summer healthy people regularly exposed to the sun have no dietary requirement for vitamin D, under appropriate conditions. As this is rarely the case in temperate zones, however, a dietary supply is needed especially in late fall and wintertime living in northern latitudes above 35 degree when no vitamin D is synthesized in the body.

Experts recommend that people in northern climates and those who do not receive direct sunlight for at least 30 to 45 minutes per week should make sure they are getting enough vitamin D through diet or supplementation, especially during winter time when less ultraviolet light (UVB) is available for vitamin D synthesis in the body. Furthermore, dark skinned people and the elderly have diminished capacity to produce vitamin D by sunlight radiation.

Expert panels in vitamin D research have proposed an optimal 25(OH)D blood plasma level above 30 nanograms/ milliliter (75 nanomoles/liter). To achieve this level a vitamin D intake of at least 800–1,000 IU/day (20–25 micrograms) is required by adults and elderly as shown by supplementation studies.

In October 2014, the American Academy of Pediatrics doubled the vitamin D intake recommendation to 400 IU/day (10 micrograms) for all infants, and to 600 IU/day (15 micrograms) for all children and adolescents.

Supply Situation

Surveys in several countries indicate that a large part of the population has a vitamin D intake below the recommended levels. A recent survey in Germany indicated that 91% of women and 82% of men do not meet the recommended daily intake of vitamin D. Furthermore, a U.S. survey showed a marked decrease in vitamin D blood levels over the last decade in the population.

Severe vitamin D deficiency in children (rickets) is still being reported in cities throughout the world. Studies have shown that many elderly and institutionalized adults are not sufficiently supplemented with vitamin D.

In addition, many immigrants, such as dark-skinned people living far from the equator, and people who cover all of their skin for religious or cultural reasons, have been identified to be vitamin D deficient.

Deficiency

Reports from across the world indicate that vitamin D insufficiency is widespread and is re-emerging as a major health problem globally.

In vitamin D deficiency, calcium absorption cannot be increased enough to satisfy the body's calcium needs. Consequently, calcium is mobilized from the skeleton to maintain normal serum calcium levels, resulting in bone loss.

One of the most frequent childhood diseases in many developing countries is 'rickets', a softening of bones, caused by severe vitamin D deficiency and thus potentially leading to bowed legs and arms and other deformities.

Osteoporosis ('brittle bones') is a disease in which the quality and density of the bone is reduced, thus increasing the risk of fractures. It usually occurs in people of older age, but can happen to anyone at any age. Osteoporosis is a silent disease. Often there are no symptoms until the first fracture occurs.

Osteoporosis has been associated with less obvious states of vitamin D deficiency, called vitamin D 'insufficiency'. Groups at risk of deficiency include:

- infants who are exclusively breast fed (human milk is a poor source of vitamin D)
- premature and low-birth-weight infants
- elderly people (reduced capacity to synthesize vitamin D in the skin by exposure to sunlight)
- people with diseases affecting the liver, kidneys or have impaired fat absorption
- vegetarians
- alcoholics
- overweight or obese people (reduced ability to produce vitamin D in the skin and to absorb it through the intestines)
- people who are housebound (lack of sunshine exposure).

Dark-skinned people produce less vitamin D from sunlight and are at risk of deficiency when living far from the equator.

Populations living at latitudes of around 40 degrees north or south are exposed to insufficient levels of sunlight especially during winter months to cover vitamin D requirements through body's own production.

Sources

The sun is our major vitamin D source. However, several factors such as sunscreen with a sun protection factor above 8, age, darker skin pigmentation, northern latitude greater than 40 degrees and winter season reduce the production of vitamin D in the skin.

Vitamin D found in food is rare. The richest natural sources of vitamin D are fish liver oils and saltwater fish such as sardines, herring, salmon and mackerel. Eggs, meat, milk and butter contain marginal amounts.

Plants are poor sources, with fruit and nuts containing no vitamin D at all. The amount of vitamin D in human milk is insufficient to cover infant needs, if the lactating mother is not supplemented sufficiently.

Vitamin D supplements are a reliable source of vitamin D especially during wintertime when there is no vitamin D production in the skin. Also people at increased risk of vitamin D deficiency (see Deficiency) should consider taking supplements.

Safety

Vitamin D toxicity has only been associated with excessive supplemental intake of daily doses greater than 50,000 IU of vitamin D over a longer period of time, which is far higher than those necessary to achieve the health benefits. Vitamin D blood levels consistently above 375 nanomoles/liter or higher can induce abnormally high blood calcium levels, which may be associated with increased bone resorption, kidney stones, and calcification of organs like the heart and kidneys, should the accidental overdosing should not be stopped. Mild symptoms of intoxication are nausea, weakness, constipation and irritability.

These symptoms are not associated with overexposure to the sun because a regulating mechanism prevents overproduction of vitamin D in the skin.

Tolerable upper intake level

Health authorities in Europe and the U.S. have set the tolerable upper intake level for vitamin D at 4,000 IU (100 micrograms) per day for adolescents and adults.

Drug interactions

Please note:

Because of the potential for interactions, dietary supplements should not be taken with medication without first talking to an experienced healthcare provider.

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