Vitamin D Ergocalciferol, Cholecalciferol, Ercalcitriol & Calcitriol

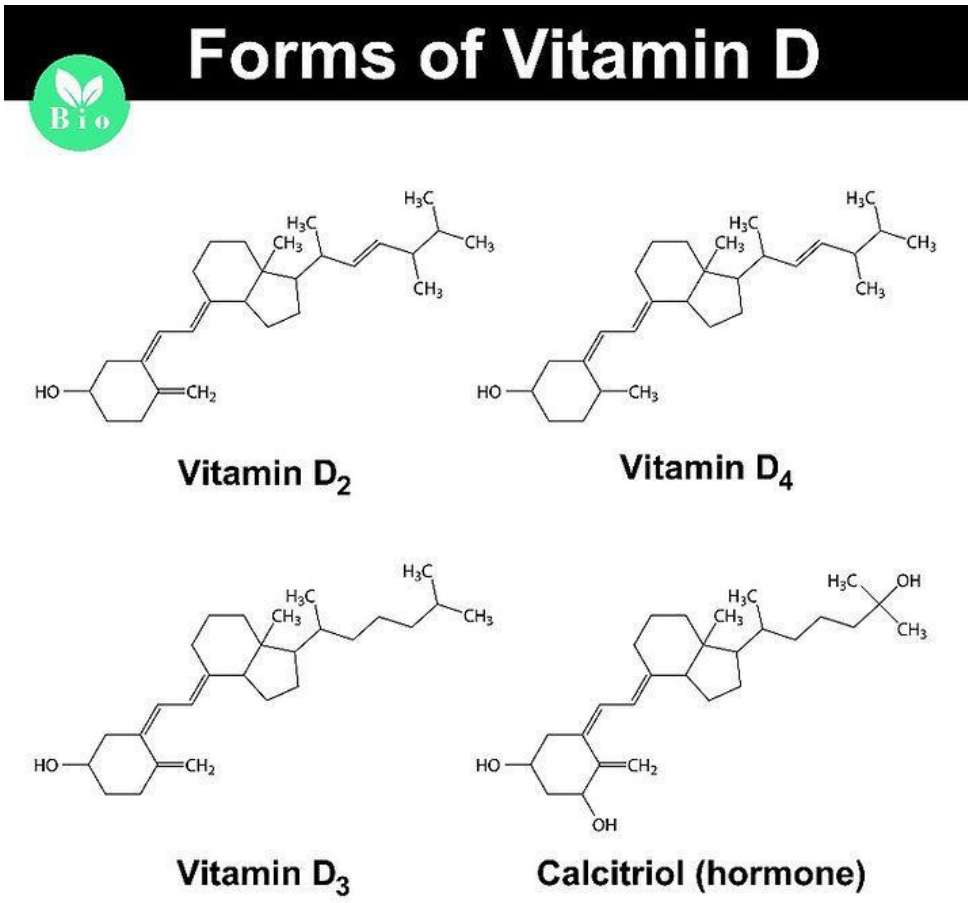
Vitamin D, the sunlight vitamin. How do we get it, what does it do, and what happens if we get too much or too little?

by Stefanie Schwartz MS, RD, CDN, Richard Strongwater MD, and Stuart M Caplen MD

Cholecalciferol (Vitamin D3) is produced in the body when ultraviolet rays from the sun hit the skin and trigger vitamin D synthesis from 7-dehydrocholesterol. This is the primary source of vitamin D in humans.

Ergocalciferol (Vitamin D2) is produced from the UV irradiation of ergosterol, which the body obtains from yeast and other ingested fungi/mushrooms.

Vitamin D (prohormones) is actually a group of fat-soluble vitamins but only two, vitamin D2 and vitamin D3 are present in humans. Vitamin D4 is present in certain mushrooms and the benefits of it in humans is uncertain.



Sources of Vitamin D (in route to the active hormones)

Cholecalciferol (Vitamin D3) is produced in the body when ultraviolet rays from the sun hit the skin and trigger vitamin-D synthesis from cholesterol. The liver then converts vitamin D3 to calcidiol (25-hydroxy vitamin D3) , and then the kidneys convert calcidiol to **the active form, calcitriol** (1,25-dihydroxy vitamin D3).

In food, **Vitamin D2 (ergocalciferol)** is generally plant and fungus based. Vitamin D2, (produced from the UV irradiation of ergosterol) is then converted in the liver to ercalcidiol (prehormone), **and then to ercalcitriol (hormone), the active metabolite of Vitamin D2**. Ercalcitriol may have less efficacy than calcitriol in reducing human health risks.

Most of our Vitamin D3 and Vitamin D2 comes from the precursors as mentioned above. These precursor molecules in our skin are then irradiated by the sun and form Vitamin D3 and Vitamin D2.

Some of our Vitamin D3 (cholecalciferol) is found naturally in fish and fish oils such as salmon, sardines, tuna, mackerel, trout, and cod liver oil. There is a smaller amount of D3 in eggs and beef liver. Some mushrooms and yeast contain D2 (ergocalciferol). Other sources of vitamin D2 and D3 include vitamin fortified cereals and either dairy or non-dairy milk products.

Some Vitamin D Rich Foods

Risk Factors for Vitamin D Deficiency

Vitamin D deficiency is common, with one study reporting that vitamin D inadequacy occurred in approximately 36% of healthy young adults and up to 57% of general medicine inpatients in the United States. People with very dark skin may be more susceptible to vitamin D deficiency due to decreased skin absorption of ultraviolet sunlight due to the pigment melanin blocking the UV absorption. Sunscreen with a sun protection factor of 30 reduces vitamin D skin synthesis by more than 95%. Wintertime in cold climate regions may increase the risk of vitamin D deficiency due to less body sun and ultraviolet light exposure. There are also a number of medical conditions and medications that can increase the chance of developing vitamin D deficiency.

Why Vitamin D?

Vitamin D promotes calcium absorption in the gut and maintains serum calcium and phosphate levels to enable bone mineralization. It is also needed for osteoblast (bone producing cells) and osteoclast (bone degrading cells) formation. Osteoblasts and osteoclasts are needed for bone remodeling which is an ongoing process in the body. Vitamin D deficiency may cause a softening and weakening of bones, which in children is called rickets and in adults osteomalacia.

Low vitamin D levels can also worsen osteoporosis (porous bones that are thin, weakened and susceptible to fracture) by reducing calcium absorption. Calcium and vitamin D supplementation may result in some increase in bone mineral density, and reduce fracture risk, but vitamin D alone appears to have no effect on fracture risk.

Vitamin D also plays a role in cell growth, neuromuscular and immune function, and reduction of inflammation.

A study of vitamin D levels and COVID-19 found that vitamin D levels less than 20 ng/ml were more common in patients with severe COVID-19 infections than in patients with mild or moderate disease. They also found that patients with vitamin D levels less than 20 ng/ml were 14 times more likely to have severe or critical disease than patients with Vitamin D levels equal to or greater than 40 ng/ml.

A review of 25 studies concluded that vitamin D supplementation reduced the chances of getting an upper respiratory infection by 12%.

Sufficient vitamin D status may help to prevent colon, prostate, and breast cancer.

Vitamin D Deficiency Defined

The total 25-hydroxy vitamin D level of both vitamin D2 and vitamin D3, (*AKA* the prehormones) is the most accurate way to measure your vitamin D level. These prehormones, the storage/circulating forms of vitamin D, are the molecular compounds that are currently used to measure your vitamin D status.

- Vitamin D3 (cholecalciferol) is the form of vitamin D that your body has either synthesized or that you have absorbed from an animal source (such as fatty fish or liver) or from a cholecalciferol vitamin supplement. The storage form,

25-hydroxy vitamin D3 (calcidiol), is synthesized in the liver from cholecalciferol.

- Vitamin D2 (ergocalciferol) is the other form of vitamin D that you have either absorbed from some mushrooms or from foods fortified with plant vitamin D or from an ergocalciferol supplement. The storage form, 25-hydroxy vitamin D2 (ercalcidiol), is synthesized in the liver from ergocalciferol.
- Ergo- and cholecalciferol work similarly in the body. The important value is the total serum 25 hydroxy vitamin D. This level measures both D2 and D3 together and is reported as a total 25-hydroxy vitamin D level.

Vitamin D deficiency is defined as a blood level below 20 ng/ml (nanograms per milliliter), and vitamin D insufficiency when blood levels are between 21–29 ng/ml, although some sources feel that in normal individuals 20 ng/ml or greater is an adequate vitamin D level. Serious effects from vitamin D deficiency are seen when the level is below 12 ng/ml. Current guidelines put adequate vitamin D levels at between 20ng/ml (or 30ng/ml depending on the source) to 40 ng/mL, but up to 50 ng/mL might be warranted in cancer patients or other populations. **Over 50 ng/ml can be toxic.**

Too Much Vitamin D ?

Too much vitamin D may be a health hazard and may lead to elevated blood calcium levels which can cause nausea, vomiting, muscle weakness, bone fractures, heart arrhythmias, high blood pressure, abnormal calcium deposition in places like the kidneys, blood vessels or eyes, and possibly an increased risk of pancreatic cancer.

Current Vitamin D Recommendations

Recommendations of supplement dosage vary in the literature. The Endocrine Society Clinical Practice Guidelines suggests that adults aged 19–70 years old require at least 600 IU/day (international units per day) of vitamin D to maximize bone health and muscle function. The guidelines also suggest that adults over 70 years of age may need 800 IU/day of vitamin D. However, in all adult age groups they note that to raise the blood vitamin D level above 30 ng/ml may require at least 1500–2000 IU/day of supplemental vitamin D. Anyone with a medical issue should consult with their physician before adding any new medication including vitamin D.

Conclusion

Supplementation with vitamin D prohormones, cholecalciferol and/or ergocalciferol may be required to enable the maintenance of a normal vitamin D level. This supplementation should be given in appropriate doses over a treatment period as determined by the patient and their clinician.

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