

The content on the *UpToDate* website is not intended nor recommended as a substitute for medical advice, diagnosis, or treatment. Always seek the advice of your own physician or other qualified health care professional regarding any medical questions or conditions. The use of this website is governed by the [UpToDate Terms of Use \(click here\)](#) ©2010 UpToDate, Inc.

## Patient information: Vitamin D deficiency

### Author

Marc K Drezner, MD

### Section Editor

Clifford J Rosen, MD

### Deputy Editors

Leah K Moynihan, RNC, MSN  
Jean E Mulder, MD

**Last literature review for version 17.3:** September 30, 2009 | **This topic last updated:** November 3, 2008

**INTRODUCTION** — [Vitamin D](#) plays an important role in many places throughout the body, including the development and calcification of the bones.

Adequate exposure to sunlight and the use of dairy products with [vitamin D](#) have significantly reduced the incidence of vitamin D deficiency. However, vitamin D deficiency is still a common problem in many populations, particularly older adults.

This topic reviews the major causes of [vitamin D](#) deficiency, including how it is diagnosed and treated, and safe ways to prevent vitamin D deficiency.

**WHAT IS VITAMIN D?** — [Vitamin D](#) is an oil-soluble vitamin that has several important functions in the body:

- It helps to absorb dietary calcium and phosphorus from the intestines.
- It suppresses the release of parathyroid hormone, a hormone that causes bone resorption.

Through these actions, [vitamin D](#) keeps the calcium and phosphate levels in the blood normal, thereby promoting bone health. Vitamin D may have other benefits, such as improving muscle and immune function, but these areas require more research.

**Natural sources of vitamin D** — [Vitamin D](#) is made in the skin under the influence of sunlight. The amount of sunlight needed to synthesize adequate amounts of vitamin D varies, depending upon the person's age, skin color, sun exposure, and any underlying medical problems. The production of vitamin D from the skin decreases with age. In addition, people who have darker skin need more sun exposure to produce adequate amounts of vitamin D, especially during the winter months.

Another important source of [vitamin D](#) is foods, where it may occur naturally (in fatty fish, cod-liver oil, and [to a lesser extent] eggs). In the United States, commercially fortified cow's milk is the largest source of dietary vitamin D, containing approximately 100 international units of vitamin D per 8 ounces. Vitamin D intake can be estimated by multiplying the number of cups of milk consumed per day by 100 (2 cups milk=200 international units vitamin D). In other parts of the world, cereals and bread products are often fortified with vitamin D.

Although [vitamin D](#) is found in cod liver oil, some fish oils also contain high doses of [vitamin A](#). Excessive vitamin A intake can be associated with side effects, including liver damage and fractures.

**CAUSES OF VITAMIN D DEFICIENCY** — The main reasons for low levels of [vitamin D](#) are:

- Lack of [vitamin D](#) in the diet, often in conjunction with inadequate sun exposure
- Inability to absorb [vitamin D](#) from the intestines
- Inability to process [vitamin D](#) due to kidney or liver disease

**Inadequate intake** — Infants, children, and elderly adults are at risk for low [vitamin D](#) levels because of inadequate vitamin D intake. Human breast milk contains low levels of vitamin D and most infant formulas do not contain adequate vitamin D. Elderly adults often do not consume enough vitamin D rich foods, and even when they do, absorption may be limited.

**Inadequate sun exposure** — Parents of infants and children are often advised to keep their child out of the sun, which reduces [vitamin D](#) synthesis from the skin. Exposure to the sun is not recommended as a source of vitamin D for infants and children due to the potential longterm risks of skin cancer. (See "[Patient information: Sunburn](#)".)

Adults who have limited sun exposure are also at increased risk of [vitamin D](#) deficiency, especially if their skin is dark. In addition, reduced amounts of vitamin D are made in the skin and stored in the body as we age. This is especially true in the winter months in some areas, such as Boston, Massachusetts and Edmonton, Alberta, where the skin virtually ceases to produce vitamin D between October and April. In the summer months, the use of sunscreen blocks vitamin D synthesis.

**Diseases or surgery that affect fat absorption** — Certain diseases affect the body's ability to absorb adequate amounts of [vitamin D](#) through the intestinal tract. Examples of these include celiac disease, Crohn's disease, and cystic fibrosis.

Surgery that removes or bypasses portions of the stomach or intestines can also lead to low [vitamin D](#) levels. An example of this type of surgery is gastric bypass. (See "[Patient information: Weight loss surgery](#)".)

**Kidney and liver disease** — The liver and kidney have important enzymes that change [vitamin D](#) from the sun or food to the biologically active form of vitamin D. People with chronic kidney and liver disease are at increased risk of low vitamin D because they lack these enzymes.

Less common causes of [vitamin D](#) deficiency include familial diseases that impair the enzymes in liver or kidney that create the biologically active form of vitamin. This results in inadequate amounts of active vitamin D.

**POTENTIAL COMPLICATIONS OF VITAMIN D DEFICIENCY** — The most serious complications of [vitamin D](#) deficiency are low blood calcium (hypocalcemia), low blood phosphate (hypophosphatemia), rickets (softening of the bones during childhood), and osteomalacia (softening of the bones in adults). However, these complications have become less common over time because many foods and drinks have added vitamin D.

"Subclinical" [vitamin D](#) deficiency or vitamin D insufficiency is common, and is defined as a lower than normal vitamin D level that has no visible signs or symptoms. However, vitamin D insufficiency is associated with reduced bone density (osteopenia or osteoporosis), a mild decrease of the blood calcium level, an increased risk of falls, and possibly fractures, all of which can seriously affect a person's quality of life.

Thus, identifying and treating [vitamin D](#) insufficiency or deficiency is important to maintain bone strength.

Treatment may even improve the health of other body systems, such as the immune, muscular, and cardiovascular systems, although more research is needed in these areas.

**DIAGNOSIS OF VITAMIN D DEFICIENCY** — A low [vitamin D](#) level can be diagnosed with a blood test called 25 hydroxyvitamin D or 25OHD (OH=hydroxy, D=vitamin D). Although there is no formal definition of vitamin D deficiency, some groups use the following values in adults:

- A normal level of [vitamin D](#) is defined as a 25OHD concentration greater than 30 ng/mL (75 nmol/L).
- [Vitamin D](#) insufficiency is defined as a 25OHD concentration of 20 to 30 ng/mL (50 to 75 nmol/L).
- [Vitamin D](#) deficiency is defined as a 25OHD level less than 20 ng/mL (50 nmol/L).

**Who needs testing for vitamin D?** — Testing for [vitamin D](#) deficiency or insufficiency is not recommended for everyone, but may be advised for people who are home-bound or in a long term care facility (eg, nursing home), if the person has a medical condition that increases the risk of vitamin D deficiency or insufficiency, and for anyone with osteoporosis or a past history of a low-trauma fracture (eg, fracture after fall from standing), low blood calcium (hypocalcemia) or phosphate (hypophosphatemia). (See "[Patient information: Bone density testing](#)" and "[Patient information: Osteoporosis prevention and treatment](#)".)

## TREATMENT OF VITAMIN D DEFICIENCY

**Vitamin D supplements** — There are many types of [vitamin D](#) preparations available for the treatment of vitamin D deficiency or insufficiency. The two commonly available forms of vitamin D supplements are ergocalciferol ([vitamin D2](#)) and cholecalciferol ([vitamin D3](#)). We suggest vitamin D3 when possible, rather than vitamin D2, because vitamin D3 is the naturally occurring form of the vitamin and it may raise vitamin D levels more effectively.

**Dosing** — The recommended dose of [vitamin D](#) depends upon the nature and severity of the vitamin D deficiency.

In people who do not have problems absorbing [vitamin D](#):

- In people whose 25OHD is <20 ng/mL [50 nmol/L]), treatment usually includes 50,000 international units of [vitamin D2](#) or D3 by mouth once or more per week for six to eight weeks, and then 800 to 1000 (or more) international units of [vitamin D3](#) daily thereafter.
- In people whose 25OHD is 20 to 30 ng/mL [50 to 75 nmol/L]), treatment usually includes 800 to 1000 international units of [vitamin D3](#) by mouth daily, usually for a three month period. However, many individuals will need higher doses. The "ideal" dose of [vitamin D](#) is determined by testing the individual's 25OHD level, and increasing the vitamin D dose if the level is not within normal limits.
- In infants and children whose 25OHD is <20 ng/mL [50 nmol/L]), treatment usually includes 1000 to 5000 international units of [vitamin D2](#) by mouth per day (depending on the age of the child) for two to three months.

In people who have diseases or conditions that prevent them from absorbing [vitamin D](#) normally (eg, kidney or liver disease), the recommended dose of vitamin D will be determined on an individual basis.

In people whose [vitamin D](#) level is normal (>30 ng/mL [ $\geq$ 75 nmol/L]), a dose of 800 international units of vitamin D per day is usually recommended. (See '[Prevention of vitamin D deficiency](#)' below.)

**Do I need other vitamins or minerals?** — During treatment for [vitamin D](#) deficiency, it is important to

consume at least 1000 mg of calcium per day (for people age 31 to 50 years) and 1200 mg per day (for people age 51 and older).

Calcium can be found in food sources ([table 1](#)) or dietary supplements ([table 2](#)). (See "[Patient information: Calcium and vitamin D for bone health](#)".)

**Monitoring** — A blood test is recommended to monitor blood levels of 25OHD three months after beginning treatment. The dose of [vitamin D](#) may need to be adjusted based on these results.

**Side effects** — Side effects of [vitamin D](#) are uncommon unless the 25OHD level becomes very elevated (>100 ng/mL or 250 mmol/L) and the person is taking high dose [calcium supplements](#). However, it is important to follow dosing instructions closely and to avoid taking multiple products that contain vitamin D (eg, multivitamin and vitamin D).

If 25OHD levels do become very elevated, complications such as high blood calcium levels or kidney stones can develop.

**PREVENTION OF VITAMIN D DEFICIENCY** — As mentioned previously, the amount of [vitamin D](#) you need per day to maintain a normal level of 25OHD depends upon your skin color, sun exposure, diet, and underlying medical conditions.

In general, adults are advised to take a supplement containing 800 international units of [vitamin D](#) per day to maintain a normal vitamin D level. Older people who are confined indoors may have vitamin D deficiency even at this intake level. (See '[Vitamin D supplements](#)' above.)

All infants and children are advised to take a [vitamin D](#) supplement containing 400 international units of vitamin D, starting within days of birth. For infants and children, vitamin D is included in most non-prescription infant multivitamin drops. In some countries, it is possible to buy infant drops that contain only vitamin D. (See "[Patient information: Deciding to breastfeed](#)" and "[Patient information: Starting solid foods during infancy](#)".)

Exposure to the sun or tanning beds is not recommended as a source of [vitamin D](#) because of the risk of skin cancer. (See "[Patient information: Basal cell and squamous cell skin cancer](#)".)

**WHERE TO GET MORE INFORMATION** — Your healthcare provider is the best source of information for questions and concerns related to your medical problem. Because no two people are exactly alike and recommendations can vary from one person to another, it is important to seek guidance from a provider who is familiar with your individual situation.

This discussion will be updated as needed every four months on our web site ([www.uptodate.com/patients](http://www.uptodate.com/patients)). Additional topics as well as selected discussions written for healthcare professionals are also available for those who would like more detailed information.

Some of the most pertinent include:

**Patient Level Information:**

[Patient information: Sunburn](#)

[Patient information: Weight loss surgery](#)

[Patient information: Bone density testing](#)

[Patient information: Osteoporosis prevention and treatment](#)

[Patient information: Calcium and vitamin D for bone health](#)

[Patient information: Deciding to breastfeed](#)

[Patient information: Starting solid foods during infancy](#)

[Patient information: Basal cell and squamous cell skin cancer](#)

## **Professional Level Information:**

[Causes of hypophosphatemia](#)

[Causes of vitamin D deficiency and resistance](#)

[Clinical manifestations and etiology of osteomalacia](#)

[Diagnosis and treatment of osteomalacia](#)

[Endocrine dysfunction in the nephrotic syndrome](#)

[Etiology of hypocalcemia in adults](#)

[Geriatric nutrition: Nutritional issues in older adults](#)

[Overview of vitamin D](#)

[Pathogenesis of renal osteodystrophy](#)

[Treatment of vitamin D deficient states](#)

A number of web sites have information about medical problems and treatments, although it can be difficult to know which sites are reputable. Information provided by the National Institutes of Health, national medical societies and some other well-established organizations are often reliable sources of information, although the frequency with which they are updated is variable.

- Mayo Clinic

([www.mayoclinic.com/health/vitamin-d/NS\\_patient-vitaminD](http://www.mayoclinic.com/health/vitamin-d/NS_patient-vitaminD))

- National Institutes of Health Office of Dietary Supplements

(<http://ods.od.nih.gov/factsheets/vitamind.asp>)

- American Academy of Dermatology

([www.aad.org/media/background/factsheets/fact\\_vitamind.htm](http://www.aad.org/media/background/factsheets/fact_vitamind.htm))

- National Osteoporosis Foundation

([www.nof.org/prevention/vitaminD.htm](http://www.nof.org/prevention/vitaminD.htm))

[1-3]

Use of *UpToDate* is subject to the [Subscription and License Agreement](#).

## **REFERENCES**

1. Misra, M, Pacaud, D, Petryk, A, et al. Vitamin D deficiency in children and its management: review of current knowledge and recommendations. *Pediatrics* 2008; 122:398.
2. Holick, MF. Vitamin D deficiency. *N Engl J Med* 2007; 357:266.
3. Dawson-Hughes, B, Heaney RP, Holick MF, et al. Estimates of optimal vitamin D status. *Osteoporos Int* 2005; 16:713.