Accurate Clinic
2401 Veterans Memorial Blvd. Suite16
Kenner, LA 70062 - 4799
Phone: 504.472.6130 Fax: 504.472.6128

www.AccurateClinic.com

Vitamin D is a fat-soluble vitamin that is naturally present in very few foods, added to others, and available as a dietary supplement. It is also produced when ultraviolet rays from sunlight strike the skin and trigger vitamin D synthesis. Vitamin D obtained from sun exposure, food, and supplements is biologically inactive and must undergo two chemical changes in the body for activation. The first occurs in the liver and converts vitamin D to 25-hydroxyvitamin D, also known as calcidiol. The second occurs primarily in the kidney and forms the physiologically active 1,25-dihydroxyvitamin D, also known as calcitriol.

Vitamin D promotes calcium absorption in the gut and maintains adequate blood levels of calcium and phosphate concentrations to enable normal mineralization of bone. It is also needed for bone growth. Without sufficient vitamin D, bones can become thin, brittle, or misshapen. Vitamin D sufficiency prevents rickets in children and osteomalacia and together with calcium, vitamin D also helps protect older adults from osteoporosis.

Vitamin D has other roles in the body, including modulation of cell growth, neuromuscular and immune function, and reduction of inflammation. Vitamin D is thought to play a role in chronic pain as well.

Conditions associated with increased risk for Vitamin D deficiency:

- Strict vegetarian diet
- Milk allergy, lactose intolerance
- People with limited sun exposure
- People with dark skin
- People who are obese or who have undergone gastric bypass surgery
- People with inflammatory bowel disease and other conditions associated with fat malabsorption: Fat malabsorption is associated with a variety of medical conditions, including some forms of liver disease, cystic fibrosis, celiac disease, and Crohn's disease, as well as ulcerative colitis when the terminal ileum is inflamed.
- Older adults: Older adults are at increased risk of developing vitamin D insufficiency in part because, as they age, skin cannot synthesize vitamin D as efficiently, they are likely to spend more time indoors, and they may have inadequate intakes of the vitamin. As many as half of older adults in the United States with hip fractures have vitamin D insufficiency.

Symptoms of Vitamin D deficiency may include weak bones prone to breakage. Symptoms of bone pain and muscle weakness can indicate inadequate vitamin D levels, but such symptoms can be subtle and go undetected in the initial stages.

Vitamin D Requirements

RDAs (Recommended Dietary Allowance: average daily level of intake sufficient to meet the nutrient requirements of nearly all (97%–98%) healthy people.) for vitamin D are listed in both International Units (IUs) and micrograms (mcg); the biological activity of 40 IU is equal to 1 mcg. Even though sunlight may be a major source of vitamin D for some, the vitamin D RDAs are set on the basis of minimal sun exposure: for age 1-70 y/o; 600 IU (15mcg); for >70 y/o: 800 IU (20mcg).

Testing for Vitamin D Deficiency

Based on its review of data of vitamin D needs, a committee of the Institute of Medicine concluded that persons are at risk of vitamin D deficiency at serum 25(OH)D concentrations <30 nmol/L (<12 ng/mL). Some are potentially at risk for inadequacy at levels ranging from 30–50 nmol/L (12–20 ng/mL). Practically all people are sufficient at levels ≥50 nmol/L (≥20 ng/mL); the committee stated that 50 nmol/L is the serum 25(OH)D level that covers the needs of 97.5% of the population.

Many pain experts recommend maintaining levels of 60-80 due to the pain benefits associated with Vitamin D. Serum concentrations >125 nmol/L (>50 ng/mL) are associated with potential adverse effects.

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Sources of Vitamin D

Food

Very few foods in nature contain vitamin D. The flesh of fatty fish (such as salmon, tuna, and mackerel) and fish liver oils are among the best sources. Small amounts of vitamin D are found in beef liver, cheese, and egg yolks. Vitamin D in these foods is primarily in the form of vitamin D3 and its metabolite 25(OH)D3. Fortified foods provide most of the vitamin D in the American diet. For example, almost all of the U.S. milk supply is voluntarily fortified with 100 IU/cup.

Supplements

In supplements and fortified foods, vitamin D is available in two forms, D2 (ergocalciferol) and D3 (cholecalciferol). It appears that at nutritional doses vitamins D2 and D3 are equivalent, but at high doses vitamin D2 is less potent. While symptoms of toxicity are unlikely at daily intakes below 10,000 IU/day, usual recommendations are 4000-6000 IU (100-150 mcg)/day.

Sun exposure as a source of vitamin D

Most people meet at least some of their vitamin D needs through exposure to sunlight. Ultraviolet (UV) B radiation with a wavelength of 290–320 nanometers penetrates uncovered skin and converts cutaneous 7-dehydrocholesterol to previtamin D3, which in turn becomes vitamin D3. Season, time of day, length of day, cloud cover, smog, skin melanin content, and sunscreen are among the factors that affect UV radiation exposure and vitamin D synthesis. Complete cloud cover reduces UV energy by 50%; shade (including that produced by severe pollution) reduces it by 60%. UVB radiation does not penetrate glass, so exposure to sunshine indoors through a window does not produce vitamin D. Sunscreens with a sun protection factor (SPF) of 8 or more appear to block vitamin D-producing UV rays, although in practice people generally do not apply sufficient amounts, cover all sun-exposed skin, or reapply sunscreen regularly. Therefore, skin likely synthesizes some vitamin D even when it is protected by sunscreen as typically applied.

The factors that affect UV radiation exposure and research to date on the amount of sun exposure needed to maintain adequate vitamin D levels make it difficult to provide general guidelines. It has been suggested by some vitamin D researchers, for example, that approximately 5–30 minutes of sun exposure between 10 AM and 3 PM at least twice a week to the face, arms, legs, or back without sunscreen usually lead to sufficient vitamin D synthesis and that the moderate use of commercial tanning beds that emit 2%–6% UVB radiation is also effective. Individuals with limited sun exposure need to include good sources of vitamin D in their diet or take a supplement to achieve recommended levels of intake.

Despite the importance of the sun for vitamin D synthesis, it is prudent to limit exposure of skin to sunlight and UV radiation from tanning beds. UV radiation is a carcinogen responsible for most of the estimated 1.5 million skin cancers and the 8,000 deaths due to metastatic melanoma that occur annually in the United States. Lifetime cumulative UV damage to skin is also largely responsible for some age-associated dryness and other cosmetic changes. The American Academy of Dermatology advises that photoprotective measures be taken, including the use of sunscreen, whenever one is exposed to the sun. Assessment of vitamin D requirements cannot address the level of sun exposure because of these public health concerns about skin cancer, and there are no studies to determine whether UVB-induced synthesis of vitamin D can occur without increased risk of skin cancer.

Health Risks from Vitamin D deficiency:

Osteoporosis

Osteoporosis is most often associated with inadequate calcium intakes, but insufficient vitamin D contributes to osteoporosis by reducing calcium absorption. Although rickets and osteomalacia (weak bones) are extreme examples of the effects of vitamin D deficiency, osteoporosis is an example of a long-term effect of calcium and vitamin D insufficiency. Adequate storage levels of vitamin D maintain bone strength and might help prevent osteoporosis in older adults, non-ambulatory individuals who have difficulty exercising, postmenopausal women, and individuals on chronic steroid therapy.

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Cancer
Laboratory and animal evidence suggest that vitamin D status could affect cancer risk and indicates that vitamin D plays a role in the prevention of colon, prostate, and breast cancers.

Health Risks from Excessive Vitamin D:
Vitamin D toxicity can cause non-specific symptoms such as loss of appetite, weight loss, frequent urination, and heart arrhythmias. More seriously, it can also raise blood levels of calcium which leads to vascular and tissue calcification, with subsequent damage to the heart, blood vessels, and kidneys. The use of supplements of both calcium (1,000 mg/day) and vitamin D (400 IU) by postmenopausal women was associated with a 17% increase in the risk of kidney stones. A serum 25(OH)D concentration consistently >500 nmol/L (>200 ng/mL) is considered to be potentially toxic

Interactions with Medications
Vitamin D supplements have the potential to interact with several types of medications. A few examples are provided below. Individuals taking these medications on a regular basis should discuss vitamin D intakes with their healthcare providers.

Steroids
Corticosteroid medications such as prednisone, often prescribed to reduce inflammation, can reduce calcium absorption and impair vitamin D metabolism. These effects can further contribute to the loss of bone and the development of osteoporosis associated with their long-term use.

Other medications
Both the weight-loss drug orlistat (brand names Xenical® and alliTM) and the cholesterol-lowering drug cholestyramine (brand names Questran®, LoCholest®, and Prevalite®) can reduce the absorption of vitamin D and other fat-soluble vitamins. Both phenobarbital and phenytoin (brand name Dilantin®), used to control epileptic seizures, increase the liver metabolism of vitamin D to inactive compounds and they reduce calcium absorption.