
**Continuing Education
Material:**

VITAMIN D

ABP, Inc.

ABP CONTINUING EDUCATION MATERIAL

UPDATE ON VITAMIN D

OBJECTIVES

1. Explain what vitamin D is and where it comes from.
2. Identify causes of low vitamin D.
3. Explain the effects of low vitamin D on a person's health.

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This continuing education material, VITAMIN D, will earn the participant 1.5 contact hours. If you have any questions regarding this information or would like further information on other continuing education opportunities, please contact:

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VITAMIN D

There is a lot of interest these days in vitamin D as more people learn about the rising prevalence of vitamin D deficiency and the potential health risks associated with it. Up to 75% of the world's population is vitamin D deficient. Do you know your level?

What is vitamin D and what does it do?

Vitamin D is a fat-soluble vitamin that is naturally present in very few foods. The general term vitamin D refers to two different vitamins. Vitamin D₂ (ergocalciferol) is synthesized by plants, and Vitamin D₃ (cholecalciferol) is synthesized in the skin when it is exposed to the sun's ultraviolet rays, hence its nickname, the "sunshine vitamin". Vitamin D obtained from sun exposure, food and supplements is biologically inert and must undergo two hydroxylations in the body for activation. Hydroxylation is a chemical process that introduces a hydroxyl group (OH) into an organic compound. The first occurs in the liver and converts Vitamin D to 25-hydroxyvitamin D (25-OH)D, also known as calcidiol. The second occurs primarily in the kidney and forms the physiologically active 1,25-dihydroxyvitamin D (1,25 (OH)₂D) also known as calcitriol. Vitamin D is a nutrient found in certain foods that is needed to maintain strong bones. Vitamin D promotes calcium absorption in the gut and maintains adequate serum calcium and phosphate concentrations to enable normal mineralization of bone and to prevent hypocalcemic tetany. It is also needed for bone growth and bone remodeling by osteoblasts and osteoclasts. People who get too little vitamin D may develop soft, thin and brittle bones. Muscles need vitamin D to move; nerves need vitamin D to carry messages from the brain to other parts of the body.; and the immune system needs vitamin D to help fight off infections. Along with calcium, vitamin D helps protect older adults from osteoporosis. Vitamin D is found in cells throughout the body.

How much vitamin D do you need each day?

Amounts of vitamin D needed per day depend on your age. The Food and Nutrition Board has established recommendations in International Units (IUs).

→ Birth to 12 months	400 IU/per day
→ Children 1 – 13 yrs.	600 IU/per day
→ Teens 14 -18 yrs.	600 IU/per day
→ Adults 19- 70 yrs.	600 IU/per day
→ Adults 71 yrs. and older	800 IU/per day
→ Pregnant/ breast feeding women	600 IU/per day

Where do you get vitamin D?

Very few foods contain vitamin D naturally so most vitamin D comes from fortified foods. Fatty fish such as salmon, tuna, and mackerel are the best sources. Small amounts of vitamin D come from beef liver, cheese and egg yolks. Mushrooms provide some vitamin D especially those that are exposed to ultraviolet light before being sold. Almost all of the US milk supply is fortified with 400 IU of vitamin D per quart; but foods made from milk like cheese and ice cream are not fortified. Make sure to check the labels – many breakfast cereals, orange juice, yogurt, margarine and soy beverages have vitamin D added. Vitamin D can come from supplements in two forms – D2 and D3. Both will increase the vitamin D level in blood. Vitamin D can also come from the sun. The body will make vitamin D when the skin is directly exposed to the sun. Skin exposed to sunshine indoors through a window will not produce vitamin D. Cloudy days, shade, and having dark-colored skin also cuts down on the amount of vitamin D that the skin makes. However, it is still wise to limit the amount of sun exposure to the skin to lower the risk of skin cancer. It is well known that Americans, Canadians, Europeans, and other people living in the northern hemisphere do not get enough vitamin D from the sun and need to rely on supplements.

What are causes of low vitamin D levels?

- Sun avoidance: People concerned about skin cancer avoid the sun and/or regularly use sunscreen. Sunscreen absorbs UV radiation and use a SPF 15 sunscreen reduces vitamin D production by up to 99 %.
- Melanin: Dark skinned people do not produce enough vitamin D from sun exposure. Melanin in the skin absorbs UV radiation and reduces vitamin D synthesis.
- Liver or kidney problems: Vitamin D undergoes two hydroxylation steps in the body to become a bioavailable form of vitamin D. One step occurs in the liver and one in the kidneys so reduced function in either organ can increase the risk for a deficiency.
- Malabsorption: People with Crohn's disease, cystic fibrosis, celiac disease or other digestive disorders are unable to absorb vitamin D through food digestion.
- Vegetarian diet: Most dietary sources of vitamin D are animal based so a plant based diet puts one at risk for vitamin D deficiency.
- Obesity: People with a BMI above 30 often have low vitamin D levels because vitamin D is sequestered in fat and is not available for use.

What groups are at risk of vitamin D inadequacy?

- ➔ Breastfed infants: Vitamin D requirements cannot ordinarily be met by human milk. The vitamin D content of human milk is related to the mother's vitamin D status. Mothers who supplement with high doses of vitamin D may have correspondingly high levels of this nutrient in their milk. Nutritional rickets have been attributed to those breastfed infants whose mothers have low vitamin D levels.
- ➔ Older adults: As people age, skin cannot synthesize vitamin D as efficiently since they are most likely spending more time indoors and they may have inadequate intakes of vitamin D. As many as 50% of older adults in the US with fractured hips have inadequate vitamin D levels.

- ➔ People with limited sun exposure: Homebound individuals, women who wear long robes and head coverings for religious reasons and people with occupations that limit sun exposure are unlikely to obtain adequate vitamin D from sunlight. Supplements and an increased intake of foods with vitamin D will provide these individuals with adequate amounts of vitamin D.
- ➔ People with dark skin: Reports consistently show lower serum 25(OH)D levels in persons with darker skin. The greater amounts of melanin pigment in the epidermal layer that result in darker skin also reduce the skin's ability to produce vitamin D from sunlight. Food and other supplements must be taken to compensate for what the body cannot produce.
- ➔ People with fat malabsorption: Vitamin D is a fat soluble vitamin and requires some dietary fat in the gut for absorption. Those people with medical conditions involving the liver will require vitamin D supplements.
- ➔ People who are obese or who have undergone gastric bypass surgery: Obesity does not affect the skin's capacity to synthesize vitamin D, but greater amounts of subcutaneous fat sequester more of the vitamin and alter its release into the circulations. Individuals who have had gastric bypass surgery may become vitamin D deficient over time since part of the upper small intestine where vitamin D is absorbed is bypassed and the vitamin D mobilized into the serum from fat stores may not compensate for that lost. Supplements will be needed.

What are some effects of low vitamin D on health?

Nutrient vitamin D deficiencies are usually the result of dietary inadequacy, impaired absorption and use, increased requirement, or increased excretion. A vitamin D deficiency can occur when usual intake is lower than recommended levels over time, exposure to sunlight is limited, the kidneys cannot convert 25(OH)D to its active form, or absorption of vitamin D from the digestive tract is inadequate. Vitamin D deficient diets are associated with milk allergy, lactose intolerance, ovo-vegetarianism, and veganism.

- Bone health: Vitamin D deficiency causes osteomalacia (rickets in children) and has been associated with falls and low mineral density. Osteoporosis, in adults, is characterized by a decrease in bone mineral density and the appearance of small holes in bones. In osteoporosis vitamin D inadequacy is seen with low serum 25-hydroxyvitamin D levels of less than 20ng/ml.
- Increased risk of death: Low levels of vitamin D are associated with increased mortality due to abnormal functioning and premature aging.
- Cancer: Some studies indicate that vitamin D may protect against colon cancer and possibly prostate and breast cancer as well. But higher levels of vitamin D have been linked to pancreatic cancer.
- Immune system: Vitamin D deficiency has been linked to an increased risk of viral infections.

- Multiple sclerosis: Vitamin D deficiency is thought to be a risk factor in MS because of the following:
 - 1- MS frequency increases with increasing latitude, which is strongly inversely correlated with duration and intensity of UVB from sunlight and vitamin D concentrations;
 - 2- Prevalence of MS is lower than expected 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.
- Pregnancy: Low levels of vitamin D in pregnancy are associated with gestational diabetes, pre-eclampsia, and small infants.

Can too much vitamin D be harmful?

Signs of high levels of vitamin D include nausea, vomiting, poor appetite, constipation, weakness and weight loss. Excess vitamin D can also damage the kidneys. By raising blood levels of calcium, too much vitamin D can cause confusion, disorientation, and heart dysrhythmias. The safe upper limit for vitamin D is 1000 to 1500 IU/day for infants, 2500 to 3000 for children 1-8 years, and 4000 IU/day for children 9 years and older, adults, and pregnant and lactating teens and women. Vitamin D toxicity almost always occurs from overuse of supplements. Excessive sun exposure does not cause vitamin D poisoning because the body limits the amount of this vitamin it produces.

Vitamin D may interact or interfere with other medicines or supplements. Examples include: prednisone and other corticosteroid medicines, weight loss drug orlistat (brand names Xenical® and Alli®), cholesterol lowering drug cholestyramine (brand names Questran®, LoCholest®, Prevalite®), and phenobarbital and phenytoin.

Vitamin D testing

Serum concentration of 25(OH) vitamin D is the best indicator of vitamin D status. It reflects vitamin D synthesized through unprotected skin or ingested in food or supplements and absorbed by the intestines. Total 25(OH) vitamin D is the sum of 25(OH) vitamin D₂ and 25(OH) vitamin D₃. If the assay does not detect vitamin D₂ fully or even partially, it is likely that the patient's result will be reported in the "insufficient" range when the actual circulating concentration is sufficient.

References

1. "Vitamin D testing: clinical and laboratory considerations", by Andrea M. Rose, PhD, MBA; MLO, May 2013.
2. "Vitamin D: how much is enough, too much, or too little?", by Beth A. Schodin, PhD; MLO, February 2012.
3. Vitamin D – Health Professional Fact Sheet; Office of Dietary Supplements; National Institutes of Health.

VITAMIN D – Self-Assessment Quiz

Please place all answers on the Continuing Education Registration form.
Mail form to ABP, Inc. to be graded so that you can get your P.A.C.E. certificate.

1. What is the name of the process that vitamin D must undergo in the body before it can be used by the body?
 - a. synthesis
 - b. hydroxylation
 - c. absorption
 - d. calcification
2. The chemical process that introduces a hydroxyl (OH) group to vitamin D occurs in what two (2) organs in the body?
 - a. liver and stomach
 - b. stomach and kidneys
 - c. liver and kidney
 - d. liver and intestines
3. The Food and Nutrition Board recommends what amount of vitamin D for adults 71 years and older?
 - a. 400 IU/day
 - b. 600 IU/day
 - c. 800 IU/day
 - d. 900 IU/day
4. The best source for vitamin D is?
 - a. sunshine
 - b. milk
 - c. mushrooms
 - d. fatty fish
5. Why are dark skinned people more at risk for low levels of vitamin D?
 - a. Increased melanin in the skin absorbs UV radiation
 - b. Increased melanin pigment in the skin affects kidney function.
 - c. Increased melanin pigment in the skin affects liver function.
 - d. Increased melanin pigment causes malabsorption problems.
6. Nutritional rickets in children with vitamin D deficiency is called?
 - a. osteoporosis
 - b. osteomyelitis
 - c. osteomalacia
 - d. osteoclasia
7. Which of the following is NOT a cause of low vitamin D level?
 - a. cystic fibrosis
 - b. vegetarian diet
 - c. obesity
 - d. excess sun exposure
8. The safe upper limit level for vitamin D in adults is?
 - a. 4000 IU/day
 - b. 3000 IU/day
 - c. 1500 IU/day
 - d. 1000 IU/day

9. Vitamin D may interact with certain cholesterol lowering drugs.

- a. True
- b. False

10. The laboratory test that is the best indicator of a person's vitamin D status is?

- a. Vitamin D₂ level
- b. Vitamin D₃ level
- c. Total 25 (OH) Vitamin D
- d. Total Vitamin D level