



## Vitamin D - description, benefits and where it is contained

*Eliseeva Tatyana*, editor-in-chief of the EdaPlus.info project

*Anastasia Mironenko*, nutritionist

*Email:* eliseeva.t@edaplus.info, myronenko.a@edaplus.info

**Abstract.** The article discusses the main properties of the vitamin D and its effect on the human body. A systematic review of modern specialized literature and relevant scientific data was carried out. The best natural sources of vitamin D are listed . The use of the vitamin in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of vitamin D on the human body under certain medical conditions and diseases are analyzed separately.

**Keywords:** vitamin D, vitamin D , benefits, harms, beneficial properties, contraindications, sources

## A Brief History of Vitamin Discovery

Diseases associated with vitamin D deficiency were known to mankind long before its official discovery.

- Mid 17th century - Whistler and Glisson pioneered independent research into the symptoms of the disease later called **rickets** . However, in scientific treatises nothing was said about the measures to prevent the disease - enough sunlight or good nutrition.
- 1824 Dr. Schötte first prescribed fish oil as a treatment for rickets.
- 1840 - Polish doctor Sniadecki released a report that children living in regions with low solar activity (in the polluted center of Warsaw) have a greater risk of getting rickets than children living in villages. Such a statement was not taken seriously by his colleagues, since it was believed that the sun's rays could not affect the human skeleton.
- Late 19th century - more than 90% of children living in polluted European cities suffered from rickets.
- 1905-1906 - it was discovered that with a lack of certain substances from food, people fall ill with a particular disease. Frederick Hopkins suggested that in order to prevent diseases such as scurvy and rickets, some special components must be supplied with food.
- 1918 - it was discovered that beagles who consume fish oil do not develop rickets.
- 1921 - Scientist Palm 's suggestion of lack of sunlight as the cause of rickets was confirmed by Elmer McCollum and Marguerite Davis . They demonstrated that giving lab rats fish oil and exposing them to sunlight accelerated the growth of the rats' bones.

- 1922 - McCollum isolated a "fat-soluble substance" that prevents rickets. Since vitamins A, B, and C of a similar nature had been discovered shortly before, it seemed logical to name the new vitamin in alphabetical order - D.
- 1920s - Harry Steenbock patents a method of exposing foods to UV rays to enrich them with vitamin D.
- 1920-1930 Various forms of vitamin D were discovered in Germany.
- 1936 - It was proved that vitamin D is produced by the skin under the influence of sunlight, as well as the presence of vitamin D in fish oil and its effect on the treatment of rickets.
- Beginning in the 1930s, some foods in the US began to be fortified with vitamin D. In the post-war period, there were frequent poisonings in Britain from an excess of vitamin D in dairy products. Since the early 1990s, numerous studies have appeared on the decline in vitamin levels in the world's population.

#### **Foods with the highest content of vitamin D [4-6]:**

	Content (D2 + D3) (µg/100g)	Content (IU/100 g)
Fish fat	250	10000
Mackerel	16.1	643
Salmon	eleven	441
Tuna	5.7	227
Egg yolk	5.4	218
C herring	4.2	167
Caviar (red, black)	2.9	117
beef liver	1.2	49
Mushrooms sh and itaka	0.4	eighteen
ricotta cheese	0.2	ten
Shrimps	0.1	2
Whole milk	0.1	2

See also **Top 100 Natural Sources of [Vitamin D](#)**.

#### **Daily requirement for vitamin D**

In 2016, the European Committee for Food Safety established the following recommended daily intake of vitamin D, regardless of gender:

Age	Recommended Amount (mcg/day) (International Units/day)
6-11 months	10 mcg (400 IU)
1-3 years	15 mcg (600 IU)
4-6 years old	15 mcg (600 IU)
7-10 years old	15 mcg (600 IU)
11-14 years old	15 mcg (600 IU)
15-18 years old	15 mcg (600 IU)
18 years and older	15 mcg (600 IU)

It is worth noting that many European countries set their own intake of vitamin D, depending on solar activity throughout the year. For example, in Germany, Austria and Switzerland, since 2012, the intake of 20 micrograms of vitamin per day has been considered the norm, since in these countries the amount obtained from food is not enough to maintain the required level of vitamin D in blood plasma -

50 nanomoles / liter. In the US, the recommendations are slightly different, with people over the age of 71 being advised to consume 20 mcg (800 IU) per day.

Many experts believe that the minimum amount of vitamin D intake should be increased to 20-25 mcg (800-1000 IU) per day for adults and the elderly. In some countries, scientific committees and nutrition societies have been able to increase the level of daily allowance to achieve the optimal concentration of the vitamin in the body <sup>[4]</sup>.

### **When does the need for vitamin D increase?**

Even though our body is able to produce vitamin D on its own, the need for it can increase in a few cases. First, **dark skin** reduces the body's ability to absorb ultraviolet B radiation needed to produce the vitamin. In addition, the use of **sunscreen** with an SPF factor of 30 reduces the ability to synthesize vitamin D by 95 percent. In order to stimulate the production of the vitamin, the skin must be fully exposed to the sun's rays.

People living in the northern parts of the Earth, in polluted regions, who work at night and spend the day indoors, or who work from home, should ensure that they receive adequate levels of the vitamin from food. Infants who are exclusively breastfed should receive vitamin D supplements, especially if the infant has dark skin or minimal exposure to sunlight. For example, American doctors advise giving infants 400 IU of vitamin D per day in the form of drops.

### **Physico-chemical properties of vitamin D**

Vitamin D is a group of **fat-soluble substances** that help the body absorb calcium, magnesium, and phosphate through the intestines. In total, there are five forms of vitamin - D<sub>1</sub> (a mixture of ergocalciferol and lumisterol), D<sub>2</sub> (ergocalciferol), D<sub>3</sub> (cholecalciferol), D<sub>4</sub> (dihydroergocalciferol) and D<sub>5</sub> (sitocalciferol). The most common forms are D<sub>2</sub> and D<sub>3</sub>. It is about them that we are talking about when they say "vitamin D" without indicating a specific number. By their nature, they are secosteroids. Vitamin D<sub>3</sub> is produced photochemically, under the influence of ultraviolet rays, from the protosterol 7-dehydrocholesterol, which is present in the epidermis of the skin of humans and most higher animals. Vitamin D<sub>2</sub> is present in some foods, notably portobello and shiitake mushrooms. These vitamins are relatively stable at high temperatures, but are easily destroyed by oxidizing agents and mineral acids.

### **Useful properties and its effect on the body**

According to the European Committee for Food Safety, vitamin D has been confirmed to provide clear health benefits. Among the positive effects of its use are observed:

- normal development of bones and teeth in infants and children;
- maintaining the condition of teeth and bones;
- normal functioning of the immune system and a healthy response of the immune system;
- reducing the risk of falls, which are often the cause of fractures, especially in people over 60 years of age;
- normal absorption and action of calcium and phosphorus in the body, maintaining a normal level of calcium in the blood;
- normal cell division.

In fact, vitamin D is a prohormone and has no biological activity on its own. Only after it undergoes metabolic processes (first turning into 25 (OH) D<sub>3</sub> in the liver, and then into 1,25 (OH)<sub>2</sub> D<sub>3</sub> and

24R,25(OH)<sub>2</sub>D<sub>3</sub> in the kidneys), are produced biologically active molecules. In total, about 37 vitamin D<sub>3</sub> metabolites have been isolated and chemically characterized.

The active metabolite of vitamin D ( calcitriol ) performs its biological functions by binding to vitamin D receptors, which are primarily located in the nuclei of certain cells. This interaction allows vitamin D receptors to act as a factor that modulates gene expression for the transport of proteins (such as TRPV6 and calbindin ) that are involved in calcium absorption in the intestine. The vitamin D receptor is a member of the superfamily of nuclear receptors for steroid and thyroid hormones and is found in the cells of most organs - the brain, heart, skin, gonads, prostate and mammary glands. Activation of the vitamin D receptor in the cells of the intestine, bones, kidneys and parathyroid gland leads to the maintenance of the level of calcium and phosphorus in the blood (with the help of parathyroid hormone and calcitonin ), as well as the maintenance of the normal composition of skeletal tissues.

### **The key elements of the vitamin D endocrine pathway are:**

1. photoconversion of 7-dehydrocholesterol to vitamin D<sub>3</sub> or dietary intake of vitamin D<sub>2</sub> ;
2. metabolism of vitamin D<sub>3</sub> in the liver to 25(OH)D<sub>3</sub> - the main form of vitamin D circulating in the blood;
3. the functioning of the kidneys as endocrine glands for the metabolism of 25(OH)D<sub>3</sub> and its conversion into two main dihydroxylated vitamin D metabolites - 1α,25(OH)<sub>2</sub>D<sub>3</sub> and 24R,25(OH)<sub>2</sub>D<sub>3</sub> ;
4. systemic transport of these metabolites to peripheral organs via plasma vitamin D binding protein;
5. the reaction of the above metabolites with receptors located in the nuclei of the cells of the corresponding organs, with subsequent biological responses (genomic and direct).

### **Interaction with other elements**

Our body is a very complex biochemical mechanism. How vitamins and minerals interact with each other is interconnected and depends on many factors. The effect that vitamin D produces in our body directly depends on the amount of other vitamins and minerals, which are called cofactors . There are a number of such cofactors , but the most important ones are:

- Calcium: One of the most important functions of vitamin D is to stabilize calcium levels in the body. That is why maximum absorption of calcium occurs only when there is a sufficient amount of vitamin D in the body.
- Magnesium: Every organ in our body needs magnesium to function properly and to fully transform food into energy. Magnesium helps the body absorb vitamins and minerals such as calcium, phosphorus, sodium, potassium, and vitamin D. Magnesium can be obtained from foods such as spinach, nuts, seeds, and whole grains.
- Vitamin K: Our body needs it to heal wounds (ensure blood clotting) and to keep bones healthy. Vitamin D and K work together to keep bones strong and develop properly. Vitamin K is found in foods such as kale, spinach, liver, eggs, and hard cheese.
- zinc: it helps us fight infections, form new cells, grow and develop, and fully absorb fats, carbohydrates and proteins. Zinc helps vitamin D to be absorbed in the tissues of the skeleton, and also helps transport calcium to the bones. A large amount of zinc is found in meat, as well as some vegetables and grains.
- boron: our body needs little of it, but it plays an important role in the metabolism of many substances, including vitamin D. Boron is found in foods such as peanut butter, wine, avocados, raisins, and some leafy vegetables .
- Vitamin A: Together with vitamin D, retinol and beta-carotene help our "genetic code" work. If the body lacks vitamin A, vitamin D will not be able to function properly. Vitamin A can be

obtained from carrots, mangoes, liver, butter, cheese and milk. It must be remembered that vitamin A is fat-soluble, so if it comes from vegetables, it must be combined with various fat-containing foods. In this way, we can get the maximum benefit from food.

### **Healthy Vitamin D Food Combinations**

The most useful is the combination of vitamin D with calcium. The vitamin is needed by our body in order to fully absorb calcium, which is indispensable for our bones. Good product combinations in this case would be, for example :

- grilled salmon and lightly braised kale;
- omelet with broccoli and cheese;
- sandwich on whole grain bread.

It is useful to combine vitamin D with magnesium, for example, by eating sardines with spinach. This combination may even reduce the risk of heart disease and colon cancer.

*Of course, it is better to get the required amount of vitamin directly from food and spending as much time as possible in the fresh air, allowing the skin to produce vitamin D. Taking vitamins in tablets is not always useful, and only a doctor can determine how much of a particular element our body needs. Incorrect intake of vitamins can often harm us and lead to certain diseases.*

### **Application in official medicine**

Vitamin D is essential for regulating the absorption and levels of the minerals calcium and phosphorus in the body. It also plays an important role in maintaining proper bone structure. Walking on a sunny day is an easy and reliable way to get the right vitamin dose for most of us. When exposed to sunlight on the face, arms, shoulders and legs once or twice a week, the skin will produce enough of the vitamin. Exposure time depends on age, skin type, time of year, day. It's amazing how quickly vitamin D can be replenished with sunlight. Just 6 days of intermittent sun exposure can make up for 49 days without sun. Our body's fat stores serve as a storehouse for the vitamin, which is gradually released in the absence of ultraviolet rays.

However, vitamin D deficiency is more common than one might expect. People living in northern latitudes are especially at risk. But it can occur even in sunny climates, as people in southern countries spend a lot of time indoors and use sunscreen to escape excessive solar activity. In addition, deficiency often occurs in older people.

### **Vitamin D as a drug is prescribed in such cases:**

1. with a low content of phosphorus in the blood due to a hereditary disease ( familial hypophosphatemia ). Taking vitamin D along with phosphate supplements is effective for treating bone disorders in people with low blood phosphate levels;
2. with a low content of phosphates in Fanconi syndrome ;
3. with a low content of calcium in the blood due to low levels of parathyroid hormones. In this case, vitamin D is taken orally;
4. taking vitamin D ( cholecalciferol ) is effective in the treatment of osteomalacia (softening of the bones), including those caused by liver disease. In addition, ergocalciferol may help with osteomalacia due to certain medications or poor intestinal absorption ;
5. with psoriasis. In some cases, a very effective treatment for psoriasis is the topical application of vitamin D along with medications containing corticosteroids;

6. with renal osteodystrophy. Vitamin D supplementation prevents bone loss in people with kidney failure;
7. rickets. Vitamin D is used in the prevention and treatment of rickets. People with kidney failure need to use a special form of the vitamin - calcitriol ;
8. while taking corticosteroids. There is evidence that vitamin D in combination with calcium improves bone density in people taking corticosteroids;
9. osteoporosis. Vitamin D<sub>3</sub> is believed to prevent bone loss and weakening of bones in osteoporosis.

Some studies show that getting enough vitamin D can reduce the risk of **certain types of cancer** . For example, it was observed that men taking high doses of the vitamin had a 29% lower risk of colon cancer compared to men with low blood levels of 25(OH)D (study of more than 120,000 men over five years). Another study tentatively concluded that women with sufficient sun exposure and dietary vitamin D supplementation had a lower risk of breast cancer 20 years later.

There is evidence that vitamin D can reduce the risk of **autoimmune diseases** , in which the body produces an immune response against its own tissues. Vitamin D<sub>3</sub> has been found to modulate autoimmune responses mediated by immune cells ("T cells") such that autoimmune responses are reduced. These include diseases such as type 1 diabetes, multiple sclerosis and rheumatoid arthritis.

The results of epidemiological and clinical studies suggest an association between higher blood levels of 25(OH)D and lower blood pressure, leading to the conclusion that 25(OH)D reduces the synthesis of the enzyme "renin", which plays a key role in the *regulation of blood pressure* .

Low vitamin D levels can increase the chance of getting TB. Preliminary evidence suggests that vitamin D may be a useful adjunct to conventional treatment for this infection.

### Dosage forms of vitamin D

Vitamin D in dosage form can be found in different forms - *in the form of drops, alcohol and oil solutions, injections, capsules* , both alone and in combination with other useful substances. For example, there are such multivitamins as:

- cholecalciferol and calcium carbonate (the most popular combination of calcium and vitamin D);
- alfalcidol and calcium carbonate (the active form of vitamin D<sub>3</sub> and calcium);
- calcium carbonate, calciferol, magnesium oxide, zinc oxide, copper oxide, manganese sulfate and sodium borate;
- calcium carbonate, cholecalciferol , magnesium hydroxide, zinc sulfate heptahydrate ;
- calcium, vitamin C, cholecalciferol ;
- and other additives.

In supplements and fortified foods, vitamin D is available in two forms: D<sub>2</sub> ( *ergocalciferol* ) and D<sub>3</sub> ( *cholecalciferol* ). Chemically, they differ only in the structure of the side chain of the molecule. Vitamin D<sub>2</sub> is produced by ultraviolet irradiation of ergosterol from yeast, and vitamin D<sub>3</sub> by irradiation of 7-dehydrocholesterol from lanolin and chemical conversion of cholesterol. The two forms are traditionally considered equivalent based on their ability to cure rickets, and indeed most of the steps involved in the metabolism and action of vitamin D<sub>2</sub> and vitamin D<sub>3</sub> are identical. Both forms effectively increase 25(OH)D levels. Specific conclusions about any different effects of these two forms of vitamin D have not been made. The only difference appears when high doses of the vitamin are used, in which case vitamin D<sub>3</sub> is more active.

### The following dosages of vitamin D have been studied in scientific studies:

- to prevent osteoporosis and fractures - 400-1000 International Units per day;
- to prevent falls - 800-1000 IU of vitamin D in combination with 1000-2000 mg of calcium per day;
- to prevent multiple sclerosis - long-term intake of at least 400 IU per day, preferably in the form of multivitamins ;
- to prevent all types of cancer - 1400-1500 mg of calcium per day, in combination with 1100 IU of vitamin D<sub>3</sub> (especially for women during menopause);
- for muscle pain from drugs called statins : vitamin D<sub>2</sub> or D<sub>3</sub> , 400 IU per day.

Most supplements contain 400 IU (10 mcg) of vitamin D.

### The use of vitamin D in traditional medicine

Traditional medicine has long valued foods rich in vitamin D. With them, there are many recipes used to treat certain diseases. The most effective of them:

- **fish oil intake** (both in capsule form and in natural form - eating 300 g / week of oily fish): for the prevention of hypertension, arrhythmias, breast cancer, for maintaining a healthy body weight, against psoriasis and for protecting the lungs when smoking , with arthritis, depression and stress, inflammatory processes. **Recipe for ointment** for skin itching, psoriasis, urticaria, herpetic dermatitis: 1 teaspoon of elecampane, 2 teaspoons of fish oil, 2 teaspoons of melted lard.
- **use of chicken eggs** : raw egg yolk is useful for fatigue and overwork (for example, a mixture of gelatin powder and raw eggs dissolved in 100 m of water is used; a drink of warm milk, raw chicken yolk and sugar). When coughing, use a mixture of 2 raw yolks, 2 teaspoons of butter, 1 dessert spoon of flour and 2 dessert spoons of honey. In addition, there are several recipes for the treatment of various diseases of the gastrointestinal tract. For example, with unpleasant sensations in the liver, folk recipes advise drinking 2 beaten egg yolks, drinking 100 ml of mineral water and applying a warm heating pad to the right side for 2 hours. There are also eggshell recipes. For example, in chronic catarrh of the stomach and intestines, hyperacidity, constipation or worms, folk recipes advise taking half a teaspoon of ground eggshell in the morning on an empty stomach. And to reduce the risk of stone formation, you can use the calcium salt of citric acid (pour eggshell powder with lemon juice, wine or apple cider vinegar, stir until dissolved, or 2-3 drops of lemon juice are dripped onto 1 tablespoon of egg powder). An infusion of egg shells and citric acid is also considered an effective remedy for arthritis. With sciatica, it is advised to rub the back with a mixture of raw eggs and vinegar. Raw eggs are considered a good remedy for psoriasis, raw yolks (50 grams) are mixed with birch tar (100 grams) and heavy cream. For burns, an ointment is used from the black-fried yolks of hard-boiled eggs.
- **milk rich** in vitamin D is a storehouse of folk recipes for a variety of diseases. For example, goat milk helps with fever, inflammation, belching, shortness of breath, skin diseases, coughs, tuberculosis, sciatica, urinary system, allergies, and insomnia. With a severe headache, it is advised to drink 200 grams of goat's milk with grated viburnum berries with sugar. For the treatment of pyelonephritis, folk recipes advise drinking milk with apple peel. With exhaustion and asthenia, you can use oatmeal in milk (1 cup of oatmeal simmer in the oven with 4 cups of milk for 3-4 hours on low heat). With inflammation of the kidneys, you can use an infusion of birch leaves with milk. It is also recommended to take a decoction of horsetail in milk for inflammation of the urinary system and edema. Milk with mint will help relieve an attack of bronchial asthma. With constant migraines, a mixture of boiling milk with a fresh egg stirred in it is used for several days - one week. To reduce acidity, pumpkin porridge cooked in milk is

useful. With weeping eczema, lubricate the affected areas with a decoction of 600 ml of milk with 100 grams of black radish seeds and 100 grams of hemp seeds (you can also apply compresses for 2 hours). For dry eczema, applications from a decoction of 50 grams of fresh burdock leaves in 500 ml of milk are used.

- **Butter** is used, for example, for bedsores and trophic ulcers - in the form of an ointment from 1 part of marsh cudweed powder, 4 parts of oil and 4 parts of honey.

### Vitamin D in the latest scientific research

- It has been found that taking a high dose of vitamin D for four months can slow down the process of vascular hardening in overweight dark-skinned young people. Hard vessel walls are a harbinger of many deadly heart diseases, and vitamin D deficiency appears to be one of the major contributory factors. According to studies at the Georgia Medical Institute, USA, very high doses of the vitamin (4000 International Units per day, instead of the recommended 400-600 IU) were seen to reduce vascular hardening by a record 10.4 percent in 4 months. 2000 IU lowered it by 2%, 600 IU led to a deterioration of 0.1%. At the same time, in the placebo group, the condition of the vessels worsened by 2.3%. Overweight people, especially black people, are at risk for vitamin D deficiency. Dark skin absorbs less sunlight, and fat prevents the production of the vitamin [25].
- Vitamin D supplements help relieve painful irritable bowel syndrome, according to the latest study from scientists at the University of Sheffield, Department of Oncology and Metabolism. The study found that vitamin D deficiency is common in patients with IBS, regardless of their ethnicity. In addition, the effect of this vitamin in relation to the symptoms of the disease was studied. While scientists believe that further observations are needed, the results already show that taking the vitamin in the dosage form reduces IBS symptoms such as abdominal pain, bloating, diarrhea and constipation. "From the data obtained, it is clear that all people suffering from irritable bowel syndrome should have their vitamin D levels checked. It is a poorly understood disease that directly affects the quality of life of patients. Nowadays, we still do not know what causes it and how to treat it," says Dr. Bernard Corfi, leader of the study [26].
- The results of their clinical trials, published in the Journal of the American Osteopathic Association, show that about one billion of the world's population may suffer from complete or partial vitamin D deficiency due to chronic diseases, as well as due to the regular use of sunscreen. "We're spending more and more time indoors, and when we go outside, we usually put on sunscreen, and ultimately stop our bodies from producing vitamin D," says Kim Pfothenauer, a doctoral student at Touro University and researcher on the subject. "While overexposure to the sun can lead to skin cancer, moderate amounts of ultraviolet rays are beneficial and necessary for boosting vitamin D levels." It has also been noted that chronic diseases - type 2 diabetes, malabsorption, kidney disease, Crohn's disease, and celiac disease - markedly inhibit the absorption of vitamin D from food sources [27].
- Low amounts of vitamin D in newborns have been associated with an increased likelihood of developing autism spectrum disorders in children as young as 3 years of age, according to a recent study published in the journal Bone and Mineral Research. In a study of 27,940 newborns from China, 310 were diagnosed with autism spectrum disorder at age 3, for a prevalence of 1.11 percent. When comparing data from 310 children with ASD with 1240 controls, the risk of ASD was significantly increased in each of the three lower quartiles of vitamin D levels at birth compared to the highest quartile: an increased risk of ASD of 260 percent in the lowest quartile, 150 percent in second quartile and 90 percent in the third quartile. "Newborn vitamin D status



was significantly associated with the risk of autism and intellectual disability," said senior study author Dr. Yuan-Ling Zheng [28].

- Maintaining adequate levels of vitamin D may help prevent the onset of certain inflammatory diseases, such as rheumatoid arthritis, according to scientists at the University of Birmingham . However, while vitamin D is effective in preventing inflammation, it is not as active once an inflammatory disease has been diagnosed. Rheumatoid arthritis, along with other diseases, leads to resistance to vitamin D in the body. Another key finding of the study was that the effect of vitamin D on inflammation cannot be predicted by studying the cells of healthy people or even the blood cells of those patients who suffer from inflammation. The scientists concluded that even if vitamin D is prescribed for inflammatory conditions, doses must be significantly higher than currently prescribed. Treatment should also correct the vitamin D susceptibility of immune cells in the joint. In addition to the already known positive effect of vitamin D on skeletal tissues, it also acts as a powerful immunity modulator - this vitamin is able to reduce the inflammatory process in autoimmune diseases. Vitamin D deficiency is common in patients with rheumatoid arthritis and can be prescribed by physicians in medicinal form [29].
- Sufficient vitamin D intake during infancy and childhood reduces the risk of developing an autoimmune reaction to the islets of Langerhans (clusters of endocrine cells, mainly in the tail of the pancreas) with an increased genetic risk of type 1 diabetes. "Over the years, there has been controversy among researchers about whether vitamin D can reduce the risk of developing self-immunity and type 1 diabetes," says Dr. Norris , who led the study. Type 1 diabetes is a chronic autoimmune disease that is increasing by 3-5 percent annually worldwide. Currently, the disease is the most common metabolic disorder in children under 10 years of age. In young children, the number of new cases is especially high. And the risks appear to be higher at higher latitudes, further north of the equator. Vitamin D is a protective factor in type 1 diabetes as it regulates the immune system and autoimmunity . Moreover, vitamin D status varies by latitude. But associations between vitamin D levels and autoimmune response to the islets of Langerhans have been inconsistent, due to different study designs, as well as different levels of vitamin D in different populations. This study is unique in its kind and shows that higher levels of vitamin D in childhood significantly reduce the risk of this autoimmune reaction. "Because the current results do not reveal a causal relationship to this process, we are developing prospective studies to see if vitamin D intervention can prevent type 1 diabetes," said Dr. Norris [30].
- According to a study by Queen Mary University of London (QMUL), vitamin D supplementation helps protect against acute respiratory infections and the flu. The findings, which appeared in the British Medical Journal, were based on clinical trials among 11,000 participants in 25 clinical trials conducted in 14 countries, including the UK, the United States, Japan, India, Afghanistan, Belgium, Italy, Australia and Canada. It should be noted that individually these trials showed conflicting results - some participants reported that vitamin D helps protect the body from SARS, and some - that it does not have a noticeable effect. "The fact is that the immune effect of vitamin D supplementation is most pronounced in those patients who initially have low levels of vitamin D, when taken every day or every week." Vitamin D - often referred to as the "sunshine vitamin" - protects the body from airborne infections by increasing levels of antimicrobial peptides - natural antibiotic substances - in the lungs. The result may also explain why we get colds and flu most often in winter and spring. During these seasons, the level of vitamin D in the body is the least high. In addition, vitamin D protects against asthma attacks that cause respiratory infections. Daily or weekly intake of the vitamin reduced the likelihood of getting SARS in people with

levels below 25 nanomoles / liter. But even those who had enough vitamin D in their bodies benefited, although they had a more modest effect (10 percent reduction in risk). In general, the reduction in the risk of catching a cold after taking vitamin D was on par with the protective effect of the injectable flu and SARS vaccine [31].

### The use of vitamin D in cosmetology

Vitamin D can be used in many recipes for homemade skin and hair masks. It nourishes the skin and hair, gives them strength and elasticity, rejuvenates. We offer you the following recipes:

- **Skin masks with fish oil** . These masks are suitable for aging skin, especially dry. Fish oil goes well with honey: for example, a mixture of 1 tablespoon of yeast, full-fat sour cream, 1 teaspoon of fish oil and honey is effective. This mask must first be placed in a water bath in hot water until the fermentation process begins, then stir and apply on the face for 10 minutes. You can also use a mixture of fish oil and honey (1 teaspoon each, with the addition of 1 tablespoon of boiled water) - this mask after 10-12 minutes will help smooth fine wrinkles and improve skin color. Another effective fish oil mask recipe that is suitable for any skin type will give it freshness and beauty. For such a mask, you need to mix 1 teaspoon of eggshell powder, 1 teaspoon of fish oil, 1 egg yolk, 2 teaspoons of mustard honey and half a glass of boiled pumpkin pulp. The mask is applied to the face with warm water, washed off with cool water after 10-15 minutes.
- **Egg skin masks** . These masks are very popular and effective for all ages and skin types. For example, for aging skin, a moisturizing mask with 1 tablespoon of crushed dried lemon peel, 1 egg yolk and 1 teaspoon of olive oil is suitable. For any skin type, a nourishing and cleansing mask of 2 proteins, 1 tablespoon of honey, half a teaspoon of almond oil and 2 tablespoons of oatmeal is suitable. For dry aging skin, you can use a mask of 1 tablespoon of banana puree, 1 egg yolk, sour cream and honey. To get rid of wrinkles, a mask of 1 yolk, 1 teaspoon of vegetable oil and 1 teaspoon of aloe leaf juice (previously aged in the refrigerator for 2 weeks) is suitable. To care for oily skin and narrow the pores, a mask is suitable, which includes 2 tablespoons of cottage cheese, half a teaspoon of liquid honey and one egg. A whitening mask for any skin type contains half a glass of carrot juice, 1 teaspoon of potato starch and half a raw egg yolk, applied for 30 minutes and washed off in a contrasting way - either with cold or hot water.
- **Masks for hair and scalp with vitamin D**. Such masks most often include an egg or egg yolk. For example, for hair growth, a mask is used, which includes 1 tablespoon of lemon juice, 1 tablespoon of onion juice and 1 egg yolk - applied once a week for 2 hours before washing your hair. For dry hair, a mask with 2 egg yolks, 2 tablespoons of burdock oil and 1 teaspoon of calendula tincture is suitable. Nourishing mask for thinning hair - 1 tablespoon of burdock oil, 1 egg yolk, 1 teaspoon of honey, 2 teaspoons of onion juice and 2 teaspoons of liquid soap (apply this mask an hour or two before washing your hair). To strengthen the hair roots and get rid of dandruff, use a mask of infusion of 1 tablespoon of crushed plantain leaves, burdock, 2 tablespoons of aloe juice and egg yolk. Effective masks against hair loss are cinnamon mask (1 egg, 2 tablespoons of burdock oil, 1 teaspoon of ground cinnamon and 1 teaspoon of honey; wash off after 15 minutes) and sunflower oil mask (1 tablespoon of sunflower oil and 1 yolk, washed off after 40 minutes). Also useful for strengthening and shining hair is a mask with 1 tablespoon of honey, 1 tablespoon of castor oil, 1 egg yolk and 1 tablespoon of cognac. To restore dry and damaged hair, use a mask with 2 yolks, 1 tablespoon of hazelnut oil and a drop of lemon essential oil.

### Use of vitamin D in animal husbandry

Unlike humans, cats, dogs, rats, and birds need to get their vitamin D from food because their skin is unable to produce it on its own. Its main function in the animal body is to maintain normal bone mineralization and skeletal growth, regulation of the parathyroid gland, immunity, metabolism of various nutrients and protection against cancer. Through research, it has been proven that dogs cannot be cured of rickets by exposure to ultraviolet radiation. For normal development, growth, reproduction, the food of cats and dogs must also contain a sufficiently high amount of calcium and phosphorus, which help the body synthesize vitamin D.

However, because natural foods are low in this vitamin, most commercially prepared pet foods are synthetically fortified. Therefore, vitamin D deficiency in pets is extremely rare. Pigs and ruminants do not need to obtain the vitamin from food, provided they have sufficient exposure to sunlight. Birds that are also exposed to UV rays for a long time can produce some vitamin D, but to maintain skeletal health and egg shell strength, the vitamin must also be supplied through diet. As for other animals, namely carnivores, it is believed that they can get enough vitamin D by eating fat, blood and liver.

### **Use in crop production**

Although adding fertilizer to the soil can improve plant growth, dietary supplements intended for human consumption, such as calcium or vitamin D, are not considered to provide clear benefits to plants. The main plant nutrients are nitrogen, phosphorus and potassium. Other minerals, such as calcium, are needed in small amounts, but plants use a different form of calcium from supplements. According to popular belief, plants do not absorb vitamin D from soil or water. At the same time, there are some practical, independent studies that show that adding vitamin D to the water used to water plants speeds up their growth (because the vitamin helps the roots absorb calcium).

### **Contraindications and warnings**

#### **Signs of a Vitamin D deficiency**

The vitamin D molecule is fairly stable. A small percentage of it is destroyed during cooking, and the longer the product is exposed to heat, the more vitamin we lose. So, when boiling eggs, for example, 15% is lost, when frying - 20%, and when baking for 40 minutes, we lose 60% of vitamin D.

The main function of vitamin D is to maintain calcium homeostasis, which is essential for the development, growth, and maintenance of a healthy skeleton. With vitamin D deficiency, it is impossible to get full absorption of calcium and meet the body's need. Vitamin D is essential for effective dietary absorption of calcium from the gut. Symptoms of vitamin D deficiency are sometimes difficult to identify and may include general fatigue and pain. Some people don't show symptoms at all. However, there are a number of common indications that may indicate a lack of vitamin D in the body:

- frequent infectious diseases;
- back and bone pain;
- depression;
- long wound healing;
- hair loss;
- muscle pain.

If vitamin D deficiency continues for long periods of time, it can lead to:

- obesity
- diabetes

- hypertension;
- fibromyalgia ;
- chronic fatigue syndrome;
- osteoporosis;
- neurodegenerative diseases such as Alzheimer's disease.

A lack of vitamin D can be one of the causes of certain types of cancer, especially breast, prostate, and colon cancers.

### **Signs of Too Much Vitamin D**

While for most people, vitamin D supplementation goes well without any complications, cases of overdose do occur occasionally. These are called vitamin D toxicity. Vitamin D toxicity, when it can be harmful, usually occurs if you take 40,000 International Units a day for several months or longer, or take a very large single dose.

An excess of 25(OH)D can develop if you:

- took more than 10,000 IU per day daily for 3 months or longer. However, vitamin D toxicity is more likely to develop if you take 40,000 IU per day every day for 3 months or more;
- have taken more than 300,000 IU in the last 24 hours.

Vitamin D is fat soluble, meaning it is difficult for the body to get rid of it if too much has been taken. In this case, the liver produces too much of a chemical called 25(OH)D. When its level is too high, high levels of calcium in the blood ( hypercalcemia ) can develop.

### **Symptoms of hypercalcemia include:**

- bad feeling;
- poor appetite or loss of appetite;
- feeling of thirst;
- frequent urination;
- constipation or diarrhea;
- abdominal pain;
- muscle weakness or muscle pain;
- bone pain
- confusion;
- feeling tired.

In some rare diseases , hypercalcemia can develop, even when vitamin D levels are low. These diseases include primary hyperparathyroidism , sarcoidosis , and a number of other rare diseases.

Vitamin D should be taken with caution in diseases such as granulomatous inflammation - in these diseases, the body has no control over the amount of vitamin D that it uses, and what level of calcium in the blood it needs to maintain. Such diseases are sarcoidosis , tuberculosis, leprosy, coccidioidomycosis , histoplasmosis , cat scratch disease, paracoccidioidomycosis , granuloma annulare. In these diseases, vitamin D is prescribed only by a doctor and is taken strictly under medical supervision. With great care, vitamin D is taken for lymphoma .

### **Interaction with other drugs**

Vitamin D supplements can interact with several types of medications. A few examples are given below. Individuals taking these medicines on a regular basis should discuss their vitamin D intake with their health care providers.

Corticosteroid drugs such as prednisone, given to reduce inflammation, can decrease calcium absorption and interfere with vitamin D metabolism. These effects may further promote bone loss and osteoporosis. Some weight loss and cholesterol-lowering drugs can reduce the absorption of vitamin D. Seizure control drugs increase liver metabolism and decrease calcium absorption.

## Literature

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[An extended HTML version of the article](#) is available on the website edaplust.info.

## Vitamin D - useful properties, composition and contraindications

*Eliseeva Tatyana*, editor-in-chief of the project EdaPlus.info

*Anastasiia Myronenko*, nutritionist

*E-mail:* eliseeva.t@edaplust.info, myronenko.a@edaplust.info

*Получено 25.01.18*

**Abstract.** The article discusses the main properties of the vitamin D and its effect on the human body. A systematic review of modern specialized literature and relevant scientific data was carried out. The best natural sources of vitamin D are listed. The use of the vitamin in various types of medicine and the effectiveness of its use in various diseases are considered. The potentially adverse effects of vitamin D on the human body under certain medical conditions and diseases are analyzed separately.