

Vitamins in diet

Vitamins in general

Virtually all books on nutrition and diets deal with the issue of vitamins, and our publication also devotes a brief entry to them. Currently, the most important issue is vitamin D. In our conditions, a patient cannot get into a vitamin withdrawal if he is healthy, so the passages on most vitamins are very brief; other areas of nutrition are more important today, e.g. the problem of fats. Vitamin withdrawal can occur in developing countries. In some diseases, especially those of the digestive tract, there is only a risk of deficiency of fat-soluble vitamins - A, D, E, K. The use of polyvitamin mixtures is unnecessary in the general population and in athletes. Excessive intake of multivitamins has even been shown to be related to prostate cancer.

Vitamin A

Vitamin A is important for the renewal of pigments in the retina and also positively affects the condition of all mucous membranes. **Deficiency** is manifested by visual disturbances and inflammation of the conjunctiva. Deficiency of both vitamin A and vitamin E has also historically led to fertility disorders. Vitamin A is contained as **retinol** in foods of animal origin (milk, liver, egg yolk, butter). Provitamin A (mainly called beta-carotene) is contained in plant pigments in red and yellow vegetables and fruits. Food sources are sufficient and deficiency can only occur in the case of a significant fat absorption disorder, as it is a fat-soluble vitamin. Vitamin A has the highest toxicity, and the greatest risk of overdose is from dietary supplements. High doses are toxic in pregnancy, and also cause headaches, apathy, lack of appetite, bone and liver damage.

Vitamin B

Vitamin B1 is most abundant in yeast, legumes, milk, meat and vegetables. Deficiency is a risk in alcoholics.

Vitamin B2 is especially necessary for skin and mucous membrane function. Deficiency is rare and administration e.g. in case of mouth ulcers (so called corners), aphthae and mucosal abrasion by dentures is a placebo effect. The sources are the same as for vitamin B1.

There is no deficiency of **vitamin B3** - nicotinic acid (pellagra, hence the older name vitamin PP). The deficiency of this vitamin has corn and thus arises in countries where there is a pure corn diet. It manifests itself in skin manifestations and can arise practically only due to the influence of some rarely used drugs (isoniazid, hydralazine, cycloserine and penicillamine).

Vitamin B12 deficiency is manifested by anaemia and impaired function of the nervous system, especially the spinal cord (involvement of the posterior cord). It occurs frequently, but is not dietary conditioned. The absorption of vitamin B12 is conditioned by the so-called intrinsic factor, formed in the stomach, which is necessary for the absorption of vitamin B12 in the small intestine. This is particularly lacking in gastric diseases and in the presence of antibodies against gastric cells (so-called pernicious anaemia). The reserves of this vitamin in the body are enormous. Insufficient intake is only apparent after the body's reserves are depleted, after about 1-2 years. The main sources of vitamin B12 are liver and meat, it is also synthesized by intestinal bacteria. When a deficiency occurs with stomach disease, it must be administered by injection. Control of dietary intake is only necessary in vegetarians; its blood level is routinely tested in any laboratory.

Vitamin C

Vitamin C is the most commonly used vitamin. Its use is poorly supported by scientific evidence. Scurvy, a vitamin C deficiency, is a thing of the past.

Vitamin C is involved in many reactions in the body and many species can synthesize it. Man is dependent on food sources; however, in normal life and in serious illnesses, it is almost impossible to be deficient. The body's reserves are only sufficient for about 50 days, but vitamin C is abundant in our diet. **The recommended daily dose** is under 50 mg per day; doses above 200 mg should not be taken. Vitamin C in doses taken in the normal diet undoubtedly has anti-cancer and anti-atherosclerotic effects. Higher doses are unnecessary and toxic. **The main sources** are fresh fruits and vegetables, especially the green parts of plants, potatoes, liver. Easily destroyed by improper processing, contact with metals, drying and heating. Alcoholics, elderly people who do not accept fruit and vegetables, e.g. because of poor dental quality, pregnant and lactating women, and smokers may be at risk of **mild deficiency**. However, a natural diet should definitely be preferred to tablet administration. The routine administration of vitamin C for acute infections and upper respiratory tract inflammation is not supported by scientific evidence.

High doses of vitamin C in an unnatural form (in injections or tablets) contribute to the formation of urinary oxalate stones, may contribute to the development of megaloblastic anaemia and may harm the newborn if taken during pregnancy.

Vitamin D

Historically, vitamin D is primarily associated with rickets, a disease known for more than 400 years. It wasn't until the 20th century that a fish oil ingredient was described as eliminating the symptoms of rickets - rickets.

Vitamin D is today a complex-acting substance included almost among the hormones. Staying in daylight is more important for its action in us (90% of vitamin D is produced by this conversion) than diet (which provides provitamin D and only up to 10% of the real vitamin).

Vitamin D2 from food and vitamin D3 produced in the skin act in the same way.

The main source of vitamin D is fish. In many countries, foods are fortified with vitamin D (milk, juices, yoghurt in the USA, fats and yoghurt in Europe). If sunscreens with a factor of 8 or more are used, vitamin D synthesis in the skin is not present. However, the importance of sunscreens is primarily to protect against skin cancer and vitamin D can be covered by diet.

Vitamin D does not only contribute to **healthy bone development and the prevention of bone diseases**, including osteoporosis, but it also has anti-cancer effects (antiproliferative and differentiation effects on the genome) and has a positive effect on the cardiovascular system, immunity, defence against infections and protection against autoimmunity. Prostate cancer is more prevalent in Nordic countries, which has been linked to lower skin irradiance and vitamin D status.

Some fat intake is important for the absorption of fat-soluble vitamin D.

Vitamin D **promotes a positive calcium balance**. In our conditions, sunbathing, as mentioned, is more important than dieting. The most important sources of vitamin D are meat and fish. Enriched (fortified) cereals (cereals) and dairy products are important. Vegans are particularly deficient in vitamin D, while other otherwise healthy populations are unlikely to be deficient. Deficiency in old age is very common, not only because of a monotonous diet but also because of insufficient skin illumination.

Bone softening (osteomalacia) in adults, however, is caused by a disturbance in the body's metabolism and absorption of vitamin D rather than by dietary reasons. The steroid molecule vitamin D undergoes several transformations in the body. The main source of vitamin D is the precursor 7-dehydrocholesterol (provitamin D3) in the skin. This is sensitive to irradiation by the ultraviolet B spectrum. Rays of wavelengths 290 to 315 nm break the double bond between the 9th and 10th carbons of the B cycle. The molecule then rotates around carbon 6 in ring A. Provitamin D binds to the vitamin D binding protein and is transported through the circulation. 25-hydroxylase in liver cells converts (hydroxylates) the vitamin at the 25th carbon, 25-OH vitamin D is the major circulating form of vitamin D. It is metabolically inactive. In the kidney, another hydroxylase, also on cytochrome P-450, converts it to 1,25 vitamin D on the 1-alpha carbon. This reaction is already tightly controlled, both by parathyroid hormone and by phosphate levels (phosphatemia), for example.

The main source of vitamin D is therefore sun exposure (insolation), but at the same time vitamin D2 and D3 are also found in the diet, e.g. in fish (typically mackerel, salmon, cod liver). The target cells for vitamin D are bone osteoblasts, intestinal and kidney cells. Vitamin D maintains calcium homeostasis. White blood cells (monocytes) also have a receptor for vitamin D, but osteoclasts no longer have a receptor. However, cytokinins produced by osteoblasts can stimulate osteoclasts indirectly without vitamin D. Vitamin D inhibits the expression of the gene for parathyroid hormone, but only large doses of vitamin D affect its production. Vitamin D also acts on some immune cells and attempts have been made to use it in the treatment of leukaemia and breast cancer. Vitamin D overdose is accompanied by high calcium levels (hypercalcemia), depression, fatigue, confusion, constipation and shortening of the QT interval on ECG.

Neither dietary **overdose** nor overdose of sunlight (insolation) is practically possible. Intoxication is only induced by an overdose of oral or parenteral vitamin D in pharmaceutical form. Vitamin D deficiency may rarely be nutritional, more often due to malabsorption or conversion disorder at some level. Nutritional intake and radiation dose are borderline in our country; in summer, lipophilic vitamin D is usually stored in fat, from where it is released. A number of diseases can lead to impaired absorption of vitamin D. These include Crohn's disease and other malabsorption disorders including, for example, chronic pancreatitis. Liver and renal disorders can also lead to vitamin D deficiency. Substitution with full 1,25-hydroxyvitamin D is then necessary. Not only the decrease in renal conversion is involved in the decrease in renal parenchymal quantum in some diseases, but also the hyperphosphatemia accompanying renal insufficiency. Typical osteomalacia develops in adults, and rickets in children. Also, the ability to absorb vitamin D through the intestinal mucosa decreases with age.

Ergocalciferol provitamin (vitamin D2) is found in plants. The problem of conversion by radiation may arise in blacks living in the north, e.g. Canada, and in those northern countries where little plant food is eaten, then even fish intake may not be sufficient.

Oatmeal, margarines, dairy products and baked goods are fortified with vitamin D. Meat also contains a lot of 25-hydroxyvitamin D.

Vitamin D is not the only vitamin acting on bone. Vitamin K also has a significant effect on bone. Also, high sodium intake leaches calcium and so more salting promotes osteoporosis. Adequate protein intake is also necessary for the effect of vitamin D and for bone quality. However, excesses in protein intake above 90 g per day are detrimental to bone. The negative effect of alcohol has been mentioned, and bone quality is also harmed by reduction diets. Obesity, on the other hand, is usually beneficial to bone quality. The negative effect of smoking becomes apparent practically only after menopause. These factors may be partly related to vitamin D. The relationship of vitamin D to osteoporosis is related to the number of receptors for vitamin D rather than diet.

Vitamin E

It is an **antioxidant substance** that should protect especially the fatty layers in the membranes. Many studies have been carried out to investigate possible anti-atherosclerotic and anti-cancer effects. Although vitamin E should logically have these effects, they have never been demonstrated in humans. Some studies have even shown the harmfulness of vitamin E in dietary supplements, tablets or injections. Natural sources include milk, vegetable oils, offal and cereals. Common food sources are sufficient.

Vitamin K

Vitamin K **deficiency** causes blood clotting disorders. It is induced by targeted anticoagulant therapy with dicoumarin anticoagulants, usually warfarin. It may also occur in diseases of the gastrointestinal tract with impaired absorption of fats or impaired synthesis of vitamin K by intestinal bacteria. The main source in humans is the intestinal microflora, with a high prevalence in the diet. Recently, leaflets forcing patients treated with warfarin to stop fruit intake have been widely circulated. This is not sufficiently justified, and most patients violate this by eating a different diet, which can cause obesity, diabetes, tumours and atherosclerosis, i.e. with a predominance of animal fat. Patients taking warfarin should avoid excesses such as taking huge doses of leafy greens, cabbage or broccoli, and can eat the usual daily doses, e.g. according to the split-plate principle.

Folic acid

Folic acid is usually found in sufficient quantities in our diet. Its deficiency threatens practically only during breastfeeding and pregnancy. It is particularly important **for the healthy development of the brain and nervous system**.

The richest sources of folic acid			
Food 100 g	Folic acid [µg]	Food 100 g	Folic acid [µg]
yeast	1020	duck liver	700
chicken liver	380	wheat germ	304
soya beans	230	beef liver, pork liver	220
parsley sprig	170	wheat bran	164
white beans	130	beetroot	93
winter kale	90	curly kale	90
asparagus	86	cabbage	83
spinach	78	brussel sprouts	78
walnuts	77	hazelnuts	71
boiled eggs	62	wholemeal bread	60
poppy seeds	60	liver pate	60

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