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Vitamins – Do we really need them?

Where does the name 'vitamin' come from?

A Polish scientist, Kazimierz Funk named the special nutritional parts of food a "vitamine". The name is from "vita" meaning life and "amine" from compounds found in the thiamine he isolated from rice husks when he was working at the Lister Institute of Preventive Medicine. In 1912 he suggested that the organic micronutrient food factors that prevent beriberi and perhaps other similar dietary-deficiency diseases might be chemical amines. Vitamine was later shortened to vitamin (Website 1).

Vitamins- definition and classification

A vitamin is one of a group of organic substances, present in minute amounts in natural foodstuff, that are essential to normal metabolism; insufficient amounts in the diet may cause deficiency diseases such as beriberi, rickets, scurvy and other. Vitamins have no energy value (Gertig, Przysławski 2006).

Foods provide almost all vitamins. But people who don't get enough vitamins and minerals from food alone, are on low-calorie diets, have a poor appetite, or avoid certain foods (such as strict vegetarians and vegans) might consider taking multivitamin supplements.

The human body can produce a few vitamins. For example: human organism makes vitamin D when the skin is directly exposed to the sun. That is why it is often called the "sunshine" vitamin (Website 2). It is biologically inert and has to undergo two hydroxylation reactions to become active in the body. The active form of vitamin D in the body is called Calcitriol (1.25-Dihydroxycholecalciferol) (Website 3).

Human body obtains vitamin K from certain foods and from bacteria that normally live in the intestines. Intestinal bacteria also produce vitamin B7 (H) in quantities beyond our daily requirements.

Vitamins are classified as either water-soluble or fat-soluble. In humans there are 13 vitamins: 4 fat-soluble ones (A, D, E, and K) and 9 water-soluble ones (8 B

vitamins and vitamin C). Water-soluble vitamins dissolve easily in water and, in general, are readily excreted from the body, to the degree that urinary output is a strong predictor of vitamin consumption.

There is a fine line between getting enough of these nutrients (which is healthy) and getting too much (which can be harmful). Only eating different foods provides an assortment of vitamins (Website 4).

The recommended amounts of nutrients people should get vary by age and gender and are known as Recommended Dietary Allowances (RDAs) and Adequate Intakes (AIs).

Tab. 1. Classification of vitamins with recommended levels of intake and detailed food sources of each vitamin according to Ziemiański (2001) and Griffith (1994)

Solubility	Vitamin generic descriptor name	Vitamer chemical name(s)	Recommended level of intake; age under 25		Food sources
			male	female	
Fat-soluble	A	Retinol, retinal, and four carotenoids including beta carotene	1000 µg	800 µg	Fresh apricots, carrot, liver, cucurbit, spinach, potato
	D	Cholecalciferol	5 µg	5 µg	Fish, eggs, liver, sun light,
	E	Tocopherols, tocotrienols	10 mg	9 mg	fruits and vegetables, nuts and seeds
	K	phylloquinone, menaquinones	80 µg	65 µg	Spinach, oat, green tea, camembert chesses
Water-soluble	B_1	Thiamine	1.8 mg	1.7 mg	Salmon, seeds of sunflower, seeds of wheat
	B_{12}	Cyanocobalamin, hydroxycobalamin, methylcobalamin	3µg	3µg	Meat and other animal products
	B_2	Riboflavin	2.6 mg	1.8 mg	Chickens, Dairy products, almonds, liver
	B_3	Niacin, niacinamide	23 mg	21 mg	Meat, fish, nuts, vegetables
	B_5	Pantothenic acid	5 mg	5 mg	Meat, eggs, liver, peas, corn
	B_6	Pyridoxine, pyridoxamine, pyridoxal	2.4 mg	2.0 mg	Avocado, bananas, tree nuts, vegetables
	H	Biotin	30 µg	30 µg	Cheese, wheat, meat, liver, milk, butter, peanuts, certain vegetables
	B_9	Folic acid, folinic acid	300 µg	290 µg	Fruits, liver, cereal, veal, bean
	C	Ascorbic acid	60 mg	60 mg	Fruits, vegetables, liver

The role of fat-soluble vitamins in our organism

Vitamins are essential nutrients because they perform hundreds of roles in the body. Each vitamin takes part in different, multiple reactions, and, therefore, most have multiple functions.

Vitamin A helps form and maintain healthy skin, teeth, skeletal and soft tissue, and mucous membranes. It is also known as retinol because it produces the pigments – in the retina of the eye. Vitamin A promotes good vision, especially in low light. It may also be needed for reproduction and breast-feeding (Ziemiański 2001).

Beta-carotene is an antioxidant. Antioxidants are substances that may protect cells against the effects of free radicals. Free radicals are believed to contribute to certain chronic diseases and play a role in the aging processes (Website 5).

Food sources of carotenoids such as beta-carotene may reduce the risk for cancer. However, beta-carotene supplements do not seem to reduce cancer risk (Website 6).

Vitamin D helps the body to absorb calcium and reabsorb calcium in the kidneys – this increases the flow of calcium in the bloodstream. Calcium and phosphate are two minerals that are essential to normal bone formation (Moszczyński, Pyć 1999). Higher Vitamin D dietary intake is associated with lower risk of Alzheimer's disease (Annweiler et al. 2012).

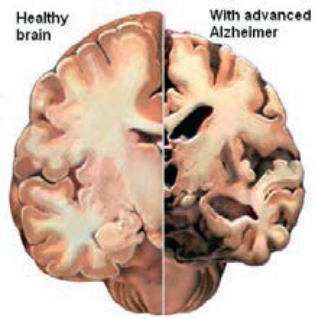

Fig. 1. Alzheimer's is a type of dementia that causes problems with memory, thinking and behaviour (Website 7, 8)

Vitamin E is an antioxidant such as beta-carotene. In the Women's Health Study among women aged 65 and older, vitamin E supplementation reduced the risk of major cardiac events by 26 percent. A later analysis found that women who took the vitamin E supplements also had a lower risk of developing serious blood clots in the legs and lungs in comparison with women who did not take the vitamin E supplements (Glynn et al. 2007).

Some observational studies and clinical trials suggested that vitamin E supplements might lower the risk of advanced prostate cancer in smokers (Chan et al. 1999).

However, most observational studies have not found vitamin E in food or supplements to offer much protection against cancer in general, or against specific cancers (Hunter et al. 1993). Some studies suggest that getting higher intakes of vitamin

E from diet – not from high-dose supplements – is associated with a reduced risk of Parkinson's disease (Etminan et al. 2005; Morens et al. 1996).

Vitamin K is necessary for normal blood clotting and may be needed for other activities (Moszczyński, Pyć 1999). Additionally, vitamin K helps protect bones from fracture, prevents calcification of arteries or provides possible protection against liver and prostate cancer (Website 9).

Health risks from deficiency and excess of fat-soluble vitamins

Fat-soluble vitamins are stored in the fat tissues of our bodies, as well as the liver. Fat-soluble vitamins are easier to store than water-soluble ones, and can stay in the body as reserves for days, some of them for months.

When large amounts of the water-soluble vitamins are consumed, a large fraction of the vitamin is absorbed into the bloodstream and not stored in body tissues but excreted into the urine. The fat-soluble vitamins are more likely to be absorbed into the bloodstream and deposited in the fat and other tissues. It is the main reason why an excessive amount of fat-soluble vitamins is more dangerous than redundant amounts of water-soluble vitamins.

In the case of both water-soluble and fat-soluble vitamins, any vitamin not absorbed by the intestines is excreted in the faeces. High doses of many vitamins produce diarrhoea, because the non-absorbed nutrient draws water out of the body and into the gut, resulting in the loss of this water from the body (Website 10).

Diseases can be divided into two groups involved with deficiency and excess of vitamins. The group of diseases caused by the deficiency of one or more vitamins is named avitaminosis.

Vitamin A deficiency can cause blindness and lead to infection within the mucous membranes and the skin, the cornification expressing these elements. The skin then becomes dry and easy to peel. Also capacity of lacrimal gland secretion is reduced, and as a result there is dryness of the cornea and conjunctiva- xerophthalmia (dry eye) (Moszczyński, Pyć 1999).

Vitamin E deficiency is uncommon. It may cause mild haemolytic anaemia in newborns – destruction of red blood cells (Rożnowska 1997).

The main complication associated with vitamin K deficiency is bleeding (Moszczyński, Pyć 1999).

Vitamin D deficiency may cause rickets, osteomalacia (a bone-thinning disorder that occurs exclusively in adults and is characterized by proximal muscle weakness and bone fragility) (Griffith 1994).

Hypervitaminosis refers to a condition of high storage levels of vitamins, which can lead to toxic symptoms. The medical names of the different conditions are derived from the vitamin involved: an excess of vitamin A, for example, is called hypervitaminosis A (Gertig, Przysławski 2006). The mains symptoms of hypervitaminosis A are: intracranial pressure, bone pain, dizziness, headache, decreased

appetite, oily skin and hair (seborrhea), coma, vision changes, nausea, skin irritation (Moszczyński, Pyć 1999; Institute of Medicine 2001).

An excess of vitamin D causes abnormally high levels of calcium in the blood. This can severely damage the bones, soft tissues, and kidneys over time. The symptoms are e.g.: decreased appetite, vomiting, muscle weakness, irritability, fatigue, constipation (Website 11), calcification of soft organs (Moszczyński, Pyć 1999).

Hypervitaminosis E is a very rare phenomenon. The probable mechanism of increased incidence of bleeding tendency is because of the fact that vitamin E at a high dose antagonizes vitamin K and prolongs prothrombin time (Moharana, Moharana 1999). Symptoms of Vitamin E overload include: fatigue, headache, diarrhoea, nausea, bloating. Data suggest a possible increase in mortality and in the incidence of heart failure with long-term use of vitamin E (400 IU or more), especially in patients with chronic diseases (Website 12).

Common symptoms of hypervitaminosis of vitamin K include skin rash, diarrhoea, nausea, vomiting. But over time, these symptoms progress into liver damage and, if an infant is given large doses, that infant is at risk of brain damage (Website 13).

Prolonged consumption of megadoses of vitamin K (menadione is synthetic vitamin K) results in anaemia, which is a reduced level of red blood cells in the bloodstream. When large doses of menadione are given to infants, they result in the deposit of pigments in the brain, nerve damage, the destruction of red blood cells (haemolysis), and death. A daily injection of 10 mg of menadione into an infant for three days can kill the child (Website 14).

What is the role of water-soluble vitamins in our body?

The most popular vitamin from this group is vitamin C. Vitamin C is required for the synthesis of collagen, an important structural component of blood vessels, tendons, ligaments, and bone. Vitamin C also plays an important role in the synthesis of the neurotransmitter, norepinephrine. Neurotransmitters are critical to brain function and are known to affect mood. In addition, vitamin C is required for the synthesis of carnitine, a small molecule that is essential for the transport of fat into cellular organelles called mitochondria, where the fat is converted to energy (Website 15). Research also suggests that vitamin C is involved in the metabolism of cholesterol to bile acids, which may have implications for blood cholesterol levels and the incidence of gallstones (Simon, Hudes 2000).

Vitamin C is also a highly effective antioxidant. Even in small amounts vitamin C can protect indispensable molecules in the body, such as proteins, lipids (fats), carbohydrates, and nucleic acids (DNA and RNA), from damage by free radicals and reactive oxygen species that can be generated during normal metabolism as well as through exposure to toxins and pollutants (e.g., cigarette smoke). However, according to recent scientific evidence, vitamin C is associated with a reduced risk

of chronic diseases such as cancer, cardiovascular disease, and cataract, probably through antioxidant mechanisms (Carr, Frei 1999).

Vitamin C may also be able to regenerate other antioxidants such as vitamin E (Carr, Frei 1999). One recent study of cigarette smokers found that vitamin C regenerated vitamin E from its oxidized form (Bruno et al. 2006). Vitamin C affects several components of the human immune system; for example, vitamin C has been shown to stimulate both the production (Prinz 1977) and function (Levy et al. 1996) of leukocytes (white blood cells), especially neutrophils, lymphocytes, and phagocytes. Deficiency of C vitamin causes scurvy, as vitamin C is required for the synthesis of collagen in humans.

B complex vitamins

All B vitamins help the body convert food (carbohydrates) into fuel (glucose), which is used to produce energy. These B vitamins, often referred to as B complex vitamins, also help the body metabolize fats and protein. B complex vitamins are needed for healthy skin, hair, eyes, and liver. They also help the nervous system function properly (Website 16).

Diseases associated with deficiency of some vitamins of B vitamin complex

Beriberi is a disease in which the body does not have enough thiamine (vitamin B_1) – deficiency B_1 (Website 17).

Wernicke-Korsakoff syndrome is directly caused by a thiamine deficiency and is linked to long-term (chronic) alcohol consumption – however, some patients who do not abuse alcohol may also develop this syndrome. Thiamine deficiency is a common consequence of alcoholism. Most commonly, Wernicke-Korsakoff syndrome is seen in alcoholics because heavy drinkers typically are poor eaters. Alcohol also interferes with the proper absorption of nutrients from the digestive system. Thiamine is essential for energy production for proper neuron function. If thiamine levels are very low, the neurons may either become damaged or die (Website 18). The disease is characterized by mental confusion, amnesia (a permanent gap in memory) and impaired short-term memory. Other symptoms include ataxia, slow walking, rapid, tremor-like eye movements or paralysis of eye muscles. In the advanced stages, coma can occur (Website 19).

Deficiency of vitamin B_{12} is the main reason of pernicious anaemia disease. Pernicious anaemia is a chronic illness caused by impaired absorption of vitamin B_{12} because of a lack of intrinsic factor (IF) in gastric secretions. Intrinsic factor is a special protein which helps intestines to absorb vitamin B_{12}. When the stomach does not make enough intrinsic factor, the intestine cannot properly absorb vitamin B_{12}. When the intestine cannot absorb vitamin $B_{12,}$ the amount of red blood cells decreases (Website 20). Pernicious anaemia is a disease where large, immature, nucleated cells, megaloblasts, which are precursors of red blood cells, circulate in the blood, and do not function as blood cells. It was termed “pernicious" because before it was learned that vitamin B_{12} could treat the anaemia, most people that developed the disease died from it (Website 21).

In pernicious anaemia blood shows increased number of megaloblasts, which are large and oval. The number of megaloblasts is increased in part due to the lower number of functioning red blood cells (RBCs) available in the blood. These are the defective mature RBCs that can no longer function properly due vitamin B_{12} deficiency (Website 22, 23).

Ariboflavinosis is a condition characterized by a deficiency of B_2 (riboflavin). It is characterized by angular cheilosis, nasolabial lesions, optic changes, and seborrheic dermatitis (Website 24).

Anther disease involving B_3 vitamin (niacin) deficiency is pellagra. The early symptoms of pellagra include loss of appetite, generalized weakness, irritability, abdominal pain and vomiting. Later symptoms are bright red glossitis, chronic or recurrent diarrhoea (watery, but occasionally bloody), which leads to a state of malnutrition and cachexia. The typical skin rash is characterized by pigmentation and scaling, particularly involving the sun exposed areas (Pipili et al. 2008).

Conclusions

In conclusion, we should remember that vitamins are essential nutrients because they perform hundreds of roles in our body. Each vitamin takes part in different, multiple reactions and, therefore, most have multiple functions. If we want to be healthy, we have to have a varied diet, and eat lots of fruit and vegetables which are the main sources of vitamins. We should remember about a fine line between getting enough of these nutrients (which is healthy) and getting too much (which can be harmful). So, we should always follow common sense and moderation because *our health and life is invaluable*.

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Vitamins – Do we really need them?

Abstract

Vitamins are substances that the human body needs to grow and develop normally. We get vitamins from food, because the human organism either does not produce enough of them, or none at all. Your body can also make vitamins D and K and vitamin from B complex vitamins. The main sources of vitamins are: fruit, vegetables, meat. Vitamins are classified as either water-soluble or fat-soluble. Vitamins perform many roles in our body: they help shore up bones, heal wounds, and bolster the immune system. They also convert food into energy, and repair cellular damage. Insufficient amounts of vitamins in the diet may cause deficiency diseases such as night-blindness, beriberi, anaemia, scurvy, rickets, bleeding diathesis. However, a group of researchers are now saying that vitamins may be doing some people more harm than good when they are taken in higher doses than recommended. According to Dr. Edgar Miller (2005) from Johns Hopkins University, 'High-dosage vitamin E supplementation may increase all-cause mortality'.

Key words: vitamins, health, diet

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