

Vitamins for Chronic Disease Prevention in Adults Scientific Review

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This article cites 152 references

FROM ABSTRACT

Context

Although vitamin deficiency is encountered infrequently in developed countries, inadequate intake of several vitamins is associated with chronic disease.

Objective

To review the clinically important vitamins with regard to their biological effects, food sources, deficiency syndromes, potential for toxicity, and relationship to chronic disease.

Data Sources and Study Selection

We searched MEDLINE for English-language articles about vitamins in relation to chronic diseases and their references published from 1966 through January 11, 2002.

Data Synthesis

Our review of 9 vitamins showed that elderly people, vegans, alcohol-dependent individuals, and patients with malabsorption are at a higher risk of inadequate intake or absorption of several vitamins.

Excessive doses of vitamin A during early pregnancy and fat-soluble vitamins taken anytime may result in adverse outcomes.

Inadequate folate status is associated with neural tube defect and some cancers.

Folate and vitamins B6 and B12 are required for homocysteine metabolism and are associated with coronary heart disease risk.

Vitamin E and lycopene may decrease the risk of prostate cancer.

Vitamin D is associated with decreased occurrence of fractures when taken with calcium.

Conclusions

Some groups of patients are at higher risk for vitamin deficiency and suboptimal vitamin status.

Many physicians may be unaware of common food sources of vitamins or unsure which vitamins they should recommend for their patients.

Vitamin excess is possible with supplementation, particularly for fat-soluble vitamins.

Inadequate intake of several vitamins has been linked to chronic diseases, including coronary heart disease, cancer, and osteoporosis.

THESE AUTHORS ALSO NOTE:

"Vitamins are organic compounds that cannot be synthesized by humans and therefore must be ingested to prevent metabolic disorders."

Classic vitamin deficiency syndromes such as scurvy, beriberi, and pellagra are now uncommon in Western societies.

Elderly patients are particularly at risk for vitamins B12 and D deficiency.

Alcohol-dependent individuals are at risk for folate, B6, B12, and thiamin deficiency.

Hospitalized patients are at risk for deficiencies of folate and other water-soluble vitamins.

"Inadequate intake or subtle deficiencies in several vitamins are risk factors for chronic diseases such as cardiovascular disease, cancer, and osteoporosis."

Pregnancy and alcohol use increases vitamin requirements.

These authors reviewed the 9 vitamins that are especially central in the preventive care of adults:

folate, vitamins B6 and B12, vitamin D, vitamin E, the provitamin A carotenoids, vitamin A, vitamin C, and vitamin K.

The authors did not include thiamin (vitamin B1) or riboflavin (B2), "because of little evidence of their relationship to chronic disease."

They included the carotenoid lycopene.

"Current recommendations are expressed as daily values, a new dietary reference term that is made up of reference daily intakes (RDIs) for vitamins and minerals, which has replaced US recommended daily allowance."

FOLATE, VITAMIN B6, and VITAMIN B12

"Folate and vitamins B6 and B12 are discussed together in relation to coronary heart disease (CHD) because of their joint effects on homocysteine."

"Elevated plasma total homocysteine level is a major risk factor for coronary disease."

"People with the highest homocysteine levels have an approximate 2-fold increase in risk of CHD compared with those with the lowest levels, similar to the increase in risk associated with cigarette smoking or hypercholesterolemia."

FOLATE

Folate is a water-soluble B vitamin that is necessary in forming coenzymes for purine and pyrimidine synthesis, erythropoiesis, and methionine regeneration.

The RDI for folate is 400 µg.

"The richest food sources of folate are dark-green leafy vegetables, whole-grain cereals, fortified grain products, and animal products."

Folate deficiency is caused by alcoholism.

Suboptimal folate intake causes fetal neural tube defects.

There is evidence to support the use of folate in preventing CHD and cancer.

VITAMIN B6

Vitamin B6 contains nitrogen and has 3 primary forms: pyridoxine, pyridoxal, and pyridoxamine.

Vitamin B6 is water soluble and found in a variety of plant and animal products.

The RDI for vitamin B6 is 2 mg.

"The best dietary sources include poultry, fish, meat, legumes, nuts, potatoes, and whole grains."

"Vitamin B6 participates in more than 100 enzymatic reactions and is needed for protein metabolism, conversion of tryptophan to niacin, and neurotransmitter formation."

Deficiency effects the central nervous system, including depression and neuropathy.

VITAMIN B12

"Vitamin B12 (cyanocobalamin) is water soluble and found in animal products only (meat, poultry, fish, eggs, and milk)."

The current RDI for vitamin B12 is 6 µg.

"It acts as a coenzyme for fat and carbohydrate metabolism, protein synthesis, and hematopoiesis."

"Deficiency can result from poor intake, including strict veganism, throughout a period of several years or malabsorption from absence of intrinsic factor, from gastric or ileal disease, and among elderly individuals in general."

"Vitamin B12 deficiency results in a macrocytic anemia and neurologic abnormalities: loss of proprioception and vibration sense."

B VITAMINS and CHD

There is increased risk of CHD or ischemic stroke associated with low folate intake or low blood folate levels.

"Folate, along with vitamins B6 and B12, is required for the metabolism of homocysteine to methionine."

"Folate appears to be the critical vitamin in determining plasma homocysteine levels."

800 µg/d of folate is necessary to minimize homocysteine levels.

"Serum B6 and B12 levels were also inversely associated with homocysteine levels, but this relationship was weaker than for folate."

"Recommending a daily multivitamin [400 µg/d] for most adults may be the most prudent approach" to minimize homocysteine levels.

"For patients with premature CHD or a family history of premature CHD, either testing for hyperhomocysteinemia or recommending folate at 800 µg/d is appropriate."

FOLATE and CANCER

"Folate deficiency may contribute to aberrant DNA synthesis and carcinogenesis by decreasing methionine availability and interfering with normal DNA methylation."

"Higher dietary folate intake appears to reduce the risk of colon and breast cancer."

FOLATE and COLORECTAL CANCER

Folate ingestion from multivitamins for longer than 10 years had a 25% reduction in colon cancer risk.

15 or more years of multivitamin use (with folate) had a 75% reduction in colorectal cancer risk.

“Men who used alcohol and consumed diets low in folate and methionine were at highest risk for colon cancer.”

FOLATE and BREAST CANCER

“Higher folate intake may also reduce breast cancer risk.”

“Colon and breast cancers are among the most common cancers in Western societies, so folate's potential for helping to prevent these cancers is important.”

The interaction between alcohol use and folate intake is substantial.

FOLATE and NEURAL TUBE DEFECTS

“Folate is necessary for embryogenesis, and supplementation reduces the risk of neural tube defects.”

Doses of folate well above the current RDI of 400 μg are necessary to maximally reduce the risk of neural tube defects.

“Because the neural tube closes within 3 weeks of conception (before most women know they are pregnant), supplementing all women who might become pregnant with folate at 800 $\mu\text{g}/\text{d}$ is the best way of preventing this birth defect.”

VITAMIN E

“Vitamin E is fat soluble and composed of a family of 8 related compounds, the tocopherols and the tocotrienols.”

Alpha-tocopherol is the most abundant form in foods, but excess may displace gamma-tocopherol in those taking supplements.

Both alpha- and gamma-tocopherol are associated with prostate cancer reduction.

“Vitamin E, like other antioxidants, can scavenge free radicals and may, as a result, prevent oxidative damage to lipid membranes and low-density lipoprotein.

Vitamin E is also needed in immune function.

The RDI for vitamin E is 20 mg (30 IU).

Major dietary sources of vitamin E include salad oils, legumes, and nuts.

"In adults, 200 to 800 mg/d is generally tolerated without adverse effects."

VITAMIN E and CORONARY HEART DISEASE

"Vitamin E is postulated to prevent atherosclerotic disease not only by its antioxidant effects, but also by inhibitory effects upon smooth muscle proliferation and platelet adhesion."

Dietary supplementation of vitamin E is more beneficial than food only sources in preventing CHD. **[IRONIC]**

VITAMIN E and PROSTATE CANCER

Alpha-tocopherol may decrease prostate cancer risk among smokers.

CAROTENOIDS

"Carotenoids are a class of yellow, orange, and red plant-derived compounds."

"All of the more than 600 known carotenoids are antioxidants, and approximately 50 are vitamins because they have provitamin A activity."

"Vitamin A refers to preformed retinol and the carotenoids that are converted to retinol by cleavage of a central bond."

There is no known deficiency state for carotenoids themselves and no RDI.

Carotenoid include alpha carotene, beta cryptoxanthin, lycopene, lutein, and zeaxanthin.

CAROTENOIDS and CANCER

The best evidence for carotenoids is for lung, colon, breast, and prostate cancers.

CAROTENOIDS and LUNG CANCER

There is an inverse relationship between beta-carotene intake and lung cancer risk.

However, supplementation with beta-carotene may increase lung cancer.

[IMPORTANT]

There is a significant lung cancer risk reduction for lycopene and alpha carotene.

CAROTENOIDS and COLORECTAL CANCER

Beta-carotene supplements decreased colon cancer risk among regular alcohol users.

CAROTENOIDS and PROSTATE CANCER

"Dietary lycopene comes primarily from tomato products, including tomato paste, juice, and sauce, but watermelon, pink grapefruit, and other fruits and vegetables also contribute to intake."

"There is a reduction in prostate cancer risk among men with high lycopene consumption and those with high intakes of lycopene-rich foods, including tomatoes and tomato products."

VITAMIN D

"Vitamin D (calciferol) is not a true vitamin, since humans are able to synthesize it with adequate sunlight exposure."

The RDI for vitamin D is 0.01 mg (400 IU).

Food sources include fortified milk, saltwater fish, and fish-liver oil.

Vitamin D deficiency is associated with rickets in children.

"In adults, vitamin D deficiency leads to secondary hyperparathyroidism, bone loss, osteopenia, osteoporosis, and increased fracture risk."

"Inadequate vitamin D levels are more common than previously thought, particularly among housebound and elderly people."

"Vitamin D deficiency was correlated with poor intake, winter, and being housebound."

50% of postmenopausal women with hip fractures are vitamin D deficient.

"Supplementation with vitamin D and calcium decreases bone loss and fracture rates in the elderly."

"The effects of vitamin D on bone mass are strongly supported by the literature."

"Vitamin D supplementation at 400 IU daily can benefit a large proportion of the population."

VITAMIN C

"Vitamin C (ascorbic acid) is water soluble and acts as a cofactor in hydroxylation reactions, which are required for collagen synthesis."

Vitamin C is a strong antioxidant.

The RDI for vitamin C is 60 mg.

"Food sources of vitamin C include citrus fruits, strawberries, melons, tomatoes, broccoli, and peppers."

"Vitamin C also promotes hormone synthesis, wound healing, and iron absorption."

"Vitamin C deficiency results in scurvy, marked by bruising and easy bleeding."

VITAMIN C AND CANCER

"Diets high in vitamin C have been linked to lower cancer rates," including cancers of the oral cavity, esophagus, stomach, and breast.

VITAMIN A

Vitamin A refers to a family of fat-soluble compounds called retinoids.

Retinal is the active form important for vision.

Approximately 50 of the more than 600 carotenoids can be converted to vitamin A.

The current RDI for vitamin A is 1500 µg/L (5000 IU).

"Preformed vitamin A is found only in animal products, including organ meats, fish, egg yolks, and fortified milk."

"Vitamin A is critical in vision (particularly night vision), the immune response, and epithelial cell growth and repair."

There is a modest inverse relationship between vitamin A and breast cancer.

VITAMIN K

Vitamin K is fat soluble and essential for normal clotting.

The RDI for vitamin K is 80 µg/L.

"Dietary sources of vitamin K include dark-green vegetables, particularly spinach, but it is also synthesized by intestinal bacteria."

There is poor placental transfer of vitamin K, and therefore newborns often receive intramuscular vitamin K at birth.

VITAMIN K and COAGULATION

The most critical role of vitamin K relates to clotting.

“Patients with poor intake throughout a long period are particularly at risk when taking antibiotics, which deplete intestinal bacteria.”

VITAMIN K and FRACTURE RISK

Women with low dietary vitamin K levels were at increased risk of hip fracture.

Supplementation may prevent fractures.

CONCLUSION

“Suboptimal vitamin status is associated with many chronic diseases, including cardiovascular disease, cancer, and osteoporosis.”