



# Food for Thought

## Health benefits of selected vitamins

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### Question

Several patients have inquired about the health benefits of vitamins. What are the new dietary reference intakes for vitamins, and how are they related to recent research into the role of vitamins in health?

### Answer

Dietary reference intakes are values used primarily to assess and plan diets and do not address amounts proposed for optimal health. In some circumstances (folate and vitamins D and E, for example), dietary reference intakes were increased to reflect new knowledge about vitamins and health. A daily multivitamin and mineral supplement with rational levels of these nutrients is safe for nearly everyone. Advice to patients about vitamin supplements should incorporate individual risk assessment so that appropriate choices are made. Recommended intake, upper levels, food sources, and health benefits of selected vitamins are shown in **Table 1**.

### Folate

Food folates are not as well absorbed as folic acid. The new units selected for dietary reference intakes (DRIs), termed dietary folate equivalents, are intended to account for this difference. When dietary folate equivalents are adopted, nutrient content tables for foods will need to be revised. The upper level, 1000 µg

of folic acid, applies to folic acid from supplements or fortified foods, not to food folate, and is based on the possibility that high intake could mask vitamin B<sub>12</sub> deficiency.<sup>1</sup>

Folic acid fortification appears to have had a positive effect on the incidence of neural tube defects in Canada.<sup>2</sup> The new dietary recommendation for folic acid takes into account the benefits of protecting against these birth defects, but makes no recommendation on the benefits of protecting against heart disease. Research shows, however, that folic acid supplementation greatly affects homocysteine levels, and hence, coronary artery disease.<sup>3</sup>

### Vitamin B<sub>6</sub>

Older adults need more vitamin B<sub>6</sub> than younger adults, for example, to reduce high plasma homocysteine levels. The upper limit for vitamin B<sub>6</sub> is based on the fact that people taking large amounts of B<sub>6</sub> in supplements have been shown to have sensory neuropathy.<sup>1</sup>

### Vitamin B<sub>12</sub>

An acidic environment is necessary to break the bond between vitamin B<sub>12</sub> and protein so that the vitamin can bind with the intrinsic factor for absorption. About 10% to 30% of adults older than 50 have low gastric acid levels and are probably absorbing inadequate amounts of B<sub>12</sub> from food. To prevent this, adults older than 50 should

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**Table 1. Recommended intake, upper level, food sources, and health benefits of selected vitamins for adults ≥19 years**

VITAMIN (UNIT)	RECOMMENDED DIETARY ALLOWANCE OR AVERAGE INTAKE	UPPER LEVEL	FOOD SOURCES	POSSIBLE HEALTH BENEFITS
Folate (µg DFE/d)	400 600 if pregnant 500 if lactating	1000	Legumes, grains, leafy greens, oranges	Neural tube defects, cardiovascular disease, cancer
Vitamin B <sub>6</sub> (mg/d)	1.3 if ≤50 y 1.7 if male ≥51 y 1.5 if female ≥51 y 1.9 if pregnant 2.0 if lactating	100	Meat, fish, poultry, legumes, bananas	Stroke
Vitamin B <sub>12</sub> (µg/d)	2.4 2.6 if pregnant 2.8 if lactating	Undetermined	Meat, fish, poultry, eggs, dairy products	Stroke
Vitamin D (µg/d)	5 if ≤50 y 10 if 51-70 y 15 if >70 5 if pregnant 5 if lactating	50	Fluid milk, margarine, fatty fish and fish oils	Bone health
Vitamin E (mg alpha-tocopherol/d)	15 15 if pregnant 19 if lactating	1000	Vegetable oils, almonds, sunflower seeds, peanut butter	Heart disease, cancer
Vitamin C (mg/d)	90 if male 75 if female 85 if pregnant 120 if lactating	2000	Citrus fruit, strawberries, broccoli, red peppers, potatoes	Eye health, cancer
Vitamin K (µg/d)	120 if male 90 if female 90 if pregnant 90 if lactating	Undetermined	Leafy greens, soy and canola oils	Bone health
Vitamin A (µg RAE/d)	900 if male 700 if female 770 if pregnant 1300 if lactating	3000	Retinol: organ meats, dairy products; Carotenoids: deep green or yellow-orange vegetables	General health, including immunity
Thiamin (mg/d)	1.2 if male 1.1 if female 1.4 if pregnant 1.4 if lactating	Undetermined	Grain products, pork, legumes	Health of elderly people
Riboflavin (mg/d)	1.3 if male 1.1 if female 1.4 if pregnant 1.6 if lactating	Undetermined	Dairy products, meat, fish, legumes	Health of elderly people
Niacin (mg NE/d)	16 if male 14 if female 18 if pregnant 17 if lactating	135	Meat, fish, poultry, nuts	Health of elderly people
Pantothenic acid (mg/d)	5 6 if pregnant 7 if lactating	Undetermined	Widely distributed in food supply	Health of elderly people
Biotin (µg/d)	30 30 if pregnant 35 if lactating	Undetermined	Unknown	Health of elderly people
Choline (mg/d)	550 if male 425 if female 450 if pregnant 550 if lactating	3500	Milk, liver, eggs, peanuts, processed foods with added lecithin	Health of elderly people

DFE—dietary folate equivalents, NE—niacin equivalents, RAE—retinol activity equivalents.

obtain most of their vitamin B<sub>12</sub> from supplements or fortified foods because synthetic B<sub>12</sub> is not bound to protein. Foods fortified with B<sub>12</sub> include meat, poultry, and egg substitutes; meal replacements; and enriched plant-based beverages, such as soy milk.<sup>1</sup>

Both vitamin B<sub>6</sub> and vitamin B<sub>12</sub> have been investigated, usually in conjunction with folic acid, for their role in protecting against cardiovascular disease, especially stroke.

## Vitamin D

Recommended levels for daily intake of vitamin D were recently increased because of heightened awareness of the importance of vitamin D in preventing bone loss due to aging. Sunlight is not a reliable source of vitamin D for Canadians because they have limited exposure to sunlight and they use sunscreen. A recent study showed that many older Canadians, whose vitamin D intake was inadequate, had low serum vitamin D levels.<sup>4</sup> Canadians with darker skin are at a particular risk of vitamin D deficiency.

Some scientists believe that an upper level of 2000 international units (IU) (50 µg) of vitamin D is too low and that higher doses are safe and can contribute not only to prevention of osteoporosis but also to a reduction in certain cancers and multiple sclerosis and to an improvement in the prognosis of patients with osteoarthritis.<sup>5</sup>

## Vitamin E

The recommended dietary allowance of vitamin E is expressed in milligrams of alpha-tocopherol. The naturally occurring form and three biologically active synthetic versions can be used to meet the recommended dietary allowance, but different factors must

be applied to determine their equivalency to alpha-tocopherol.<sup>6</sup>

Research on the role of vitamin E in protecting against heart disease is equivocal. Clinical trials do not demonstrate that vitamin E supplementation has a protective effect against coronary artery disease among those with a history of heart disease or at increased risk of heart disease.<sup>7</sup> Two large cohort studies<sup>8,9</sup> showed, however, that vitamin E supplementation of at least 100 IU per day for 2 or more years reduced adverse outcomes related to heart disease by 37% in men and 41% in women. In the Cambridge Heart Antioxidant Study clinical trial,<sup>10</sup> treatment with 400 to 800 IU of alpha-tocopherol daily substantially reduced risk of cardiovascular death and non-fatal myocardial infarction.

## Vitamin C

Vitamin C plays an important role in providing antioxidant protection; therefore, the recommended daily allowance has been increased to 90 mg for men and to 75 mg for women. Smokers need an additional 35 mg/d because smoking increases oxidative stress, and more protection is required. The upper limit for vitamin C (2000 mg) is based on a tendency toward gastrointestinal irritation and diarrhea at high intake.<sup>6</sup>

Vitamin C supplementation for 10 or more years was associated with a substantial reduction in risk of cataracts.<sup>11</sup> Higher vitamin C intake among elderly people might also provide some protection against both cognitive impairment and cerebrovascular disease.<sup>12,13</sup>

## Vitamin K

Vitamin K intake has been increased to 120 µg for men and to 90 µg for women.<sup>14</sup> Vitamin K plays an important role in

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blood clotting, but has recently received attention for its potential role in bone metabolism, atherosclerosis, nerve signaling, and kidney stones. For example, research has shown that undercarboxylated osteocalcin might contribute to osteoporotic fractures. Carboxylation is a vitamin K-dependent reaction.<sup>15</sup>

### Vitamin A

New units, retinol activity equivalents, were adopted for the dietary reference intake for vitamin A. One retinol activity equivalent equals 1 µg and 3.33 IU of retinol. Special conversion factors for carotenoids found in foods can be used to determine retinol activity equivalents. The upper limit for vitamin A applies only to preformed retinol and was based on risk of birth defects and liver abnormalities. An upper limit was not set for carotenoids, but caution was recommended because of some evidence that high intake of carotenoids might be harmful to some groups, such as smokers.<sup>14</sup>

### Thiamin, riboflavin, and niacin

An upper limit could not be established for either thiamin or riboflavin, and the upper limit for niacin (35 mg niacin equivalents) applies only to intake from supplements or fortified foods, not naturally occurring niacin. Niacin

equivalents can be synthesized from the tryptophan in food containing protein.<sup>1</sup>

Generally speaking, the B vitamins have been investigated for their role in improving the health of elderly people who are often undernourished. Low plasma thiamine has been detected in patients with senile dementia of the Alzheimer type.<sup>16,17</sup>

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