



## **FAT-SOLUBLE VITAMINS**

by Jerry Casados

### **What are Fat-Soluble Vitamins?**

Fat soluble vitamins are essential to your health, and each one has its one very important function in the body.

Vitamins A, D, E and K are all classified as fat soluble vitamins - since they are soluble in fat and are absorbed by the body from the intestinal tract.

They follow the same path of absorption as fat and any condition interfering with the absorption of fats would result in poor absorption of these vitamins as well.

This class of vitamin can be stored in the body to some extent, mostly in the liver, and because of this, short term deficiencies are less likely to manifest themselves slower than the water soluble vitamins.

### **Quick Facts**

- Small amounts of vitamins A, D, E and K are needed to maintain good health
- Foods that contain these vitamins will not lose them when cooked
- The body does not need these every day and stores them in the liver when not used
- Most healthy people do not need vitamin supplements
- Mega-doses of vitamins A, D, E or K can be toxic and lead to health problem

Vitamins are essential nutrients your body needs in small amounts for various roles in the human body. Vitamins are divided into two groups: water-soluble (B-complex and C) and fat-soluble (A, D, E and K). Unlike water-soluble vitamins that need regular replacement in the body, fat-soluble vitamins are stored in the liver and fatty tissues, and are eliminated much more slowly than water-soluble vitamins.

Because fat-soluble vitamins are stored for long periods, they generally pose a greater risk for toxicity than water-soluble vitamins when consumed in excess. Eating a normal, well-balanced diet will not lead to toxicity in otherwise healthy individuals. However, taking vitamin supplements that contain mega doses of vitamins A, D, E and K may lead to toxicity. Remember, the body only needs small amounts of any vitamin.

While diseases caused by a lack of fat-soluble vitamins are rare in the United States, symptoms of mild deficiency can develop without adequate amounts of vitamins in the diet. Additionally, some health problems may decrease the absorption of fat, and in turn, decrease the absorption of vitamins A, D, E and K. Consult your doctor about this.

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Table 1 lists sources of fat-soluble vitamins, their basic functions in the body.

Table 2 lists major deficiency symptoms caused by a lack of these vitamins, and symptoms of over-consumption.

**Table 1: Fat-soluble Vitamins Function and Dietary Source**

Vitamin	Function	Sources
A	Roles in vision, growth, promotes bones and tooth development; reproduction	Green plants, carrots, sweet potatoes, squash, spinach, apricots, green peppers
D	Regulation of calcium and phosphate metabolism	Sunlight exposure (on skin), fortified milk, fish oils
E	Antioxidant; protects vitamins A and C and fatty acids; prevents damage to cell membranes	Green and leafy vegetables, wheat germ, whole grain products, nuts, seeds, vegetable oils
K	Blood coagulation (helps blood to clot)	Dark green leafy vegetables, liver; also made by bacteria in the intestine

**Table 2: Fat-soluble Vitamins Overconsumption and Deficiency Symptoms**

Vitamin	Overconsumption	Deficiency
A	Mild: nausea, irritability, blurred vision. Severe: growth retardation, enlargement of liver and spleen, loss of hair, bone pain, increased pressure in skull, skin changes.	Night blindness, cornea damage, damage to respiratory and gastrointestinal tract
D	Loss of calcium causing soft, brittle and deformed bones; progressive weakness	Rickets in children (skeletal deformities, impaired growth); Osteomalacia in adults (soft, bending bones)
E	Nontoxic under normal conditions; may augment the effects of anti-clotting medication	Red blood cell breakage; lesions in muscles and nerves (rare)
K	None known	Excessive bleeding



## **VITAMIN A**

Vitamin A, also called retinol, has many functions in the body. In addition to helping the eyes adjust to light changes, vitamin A plays an important role in bone growth, tooth development, reproduction, cell division and gene expression. Also, the skin, eyes and mucous membranes of the mouth, nose, throat and lungs depend on vitamin A to remain moist. With enough beta-carotene available in the body, the body can manufacture its own vitamin A.

Vitamin A and carotene can be obtained from either animal or vegetable sources. Some foods of plant origin contain beta-carotene, an antioxidant that the body converts to vitamin A. Beta-carotene, or provitamin A, comes from fruits and vegetables. Carrots, pumpkin, winter squash, dark green leafy vegetables and apricots are rich sources of beta-carotene.

True vitamin A deficiency in the United States is rare. Night blindness and very dry, rough skin may indicate a lack of vitamin A. Other signs of possible vitamin A deficiency include decreased resistance to infections, faulty tooth development, and slower bone growth.

### **Amount Needed**

In the United States, toxic or excess levels of vitamin A are of more concern than deficiencies. The tolerable upper intake level for adults is 3,000 mcg RAE. It would be difficult to reach this level consuming food alone. But some multivitamin supplements contain high doses of vitamin A. If you take a multivitamin, check the label to be sure the majority of vitamin A provided is in the form of beta-carotene, which appears to be safe. Symptoms of vitamin A toxicity include dry, itchy skin, headache, nausea, and loss of appetite. Signs of severe overuse over a short period of time include dizziness, blurred vision and slowed growth. Vitamin A toxicity also can cause severe birth defects and may increase the risk for hip fractures.

Physicians sometimes recommend that young infants take vitamin supplements that contain vitamin A. However, toddlers and children need protection from too much vitamin A due to their smaller body size. Typical foods eaten in large amounts by toddlers and children usually contain sufficient amounts of vitamin A. Provide a variety of foods for your children, and if in doubt, check with a pediatrician or Registered Dietitian.

### **Vitamin A intakes and healthful diets**

According to the 2005 Dietary Guidelines for Americans, "Nutrient needs should be met primarily through consuming foods. Foods provide an array of nutrients and other compounds that may have beneficial effects on health. In certain cases, fortified foods

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and dietary supplements may be useful sources of one or more nutrients that otherwise might be consumed in less than recommended amounts. However, dietary supplements, while recommended in some cases, cannot replace a healthful diet [56]."  
For more information about building a healthful diet, refer to the Dietary Guidelines for Americans

(<http://www.health.gov/dietaryguidelines/dga2005/document/pdf/DGA2005.pdf>) and the U.S. Department of Agriculture's food guidance system (My Pyramid; <http://www.mypyramid.gov>).



## **VITAMIN D**

### **WHY DO WE NEED VITAMIN D?**

Vitamin D helps with increasing the absorption of calcium, assists in bone growth and the integrity of bone and promotes strong teeth.

It also helps regulate the amount of phosphorus in the body as well as assisting in a healthy heart and nervous system. In some recent studies it has also shown great promise in assisting psoriasis, the immune system, thyroid function as well as normal blood clotting.

Vitamin D is also referred to as calciferol and can rightly be called the sunshine vitamin, since the body, in a sunny climate can manufacture this nutrient from sunshine on your skin using cholesterol from your body to do so.

Please remember that this can be achieved in about 30 minutes by fair skinned people, while dark skinned people, because of the pigmentation need about 3 hours to reach the same level of manufacture. The sunlight needed for this process is pure unfiltered sunlight.

Other sources of vitamin D include egg yolks, saltwater fish, and liver. Some other foods, like milk and cereal, often have added vitamin D.

Symptoms of vitamin D deficiency in growing children include rickets (long, soft bowed legs) and flattening of the back of the skull. Vitamin D deficiency in adults is called osteomalacia, which results in muscular weakness and weak bones. These conditions are rare in the United States.

### **Amount Needed**

The tolerable upper intake level for vitamin D is set at 50 mcg for people 1 year of age and older. High doses of vitamin D supplements coupled with large amounts of fortified foods may cause accumulations in the liver and produce signs of poisoning. Signs of vitamin D toxicity include excess calcium in the blood, slowed mental and physical growth, decreased appetite, nausea and vomiting.

Some medications interfere with vitamin D metabolism. Do not take vitamin D supplements without medical supervision.

### **Can vitamin D be harmful?**

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In healthy children and adults, vitamin D at doses up to 2,000 IU is safe. (In infants, up to 1,000 IU is safe.) When taken as a supplement at very high doses, vitamin D can cause nausea and vomiting, confusion, and serious heart problems. Vitamin D made in the body from sunlight does not rise to dangerous levels.

Does vitamin D interact with any medicines or dietary supplements?

Yes. For example, prednisone and some medicines taken to lose weight, lower cholesterol, or control epileptic seizures can raise the need for vitamin D.

Bottom line: Tell your doctor, pharmacist, and other health care providers about any dietary supplements you take. They can tell you if those supplements might interact or interfere with your prescription or over-the-counter medicines and provide advice.



## **VITAMIN E**

### **WHY DO WE NEED VITAMIN E?**

Vitamin E is a powerful antioxidant, protects your cells from oxidation, and neutralizes unstable free radicals, which can cause damage. This is done by the vitamin E giving up one of its electrons to the electron deficient free radical, making it more stable. While Vitamin E performs its antioxidant functions, it also protects the other antioxidants from being oxidized.

This antioxidant capability is then also great in helping to prevent degenerative diseases - including heart disease, strokes, arthritis, senility, diabetes and cancer. It also assists in fighting heart disease and cancers and is essential for red blood cells, helps with cellular respiration and protects the body from pollution - especially the lungs. Vitamin E is also useful in preventing blood clots from forming and promotes fertility, reduces and/or prevents hot flushes in menopause. An increase in stamina and endurance is also attributed to Vitamin E.

Vitamin E is also used topically to great effect for skin treatments in helping the skin look younger, promoting healing and cutting down the risk of scar tissue forming. Used on the skin it is also reported to help with eczema, skin ulcers cold sores and shingles.

Vitamin E acts as an antioxidant, protecting vitamins A and C, red blood cells and essential fatty acids from destruction. Research from a decade ago suggested that taking antioxidant supplements, vitamin E in particular, might help prevent heart disease and cancer. However, newer findings indicate that people who take antioxidant supplements are not better protected against heart disease and cancer than non-supplement users. On the other hand, there are many studies that show a link between regularly eating antioxidant-rich fruits and vegetables and a lower risk for heart disease, cancer and several other diseases.

### **Amount Needed**

The RDA for vitamin E is based on the most active and usable form called alpha-tocopherol (see Table 2). One milligram of alpha-tocopherol equals to 1.5 International Units (IU). About 60 percent of vitamin E in the diet comes from vegetable oil or products made with vegetable oils. Therefore, good food sources of vitamin E include vegetable oils and margarines. Vitamin E is also found in fruits and vegetables, grains, nuts, seeds and fortified cereals.

Vitamin E deficiency is rare. Cases of vitamin E deficiency only occur in premature infants and people unable to absorb fats.

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The tolerable upper intake levels for vitamin E are shown in Table 3. Large doses of vitamin E pose a hazard to people who take blood-thinning medications. People taking statin drugs are also not advised to take supplemental vitamin E because it may interfere with how the medication works.

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### Food sources of vitamin E

Vitamin E is found in nuts, oils, vegetables, sunflower seeds, whole grains, spinach, oils, seeds, wheat oils, asparagus, avocado, beef, seafood, apples, carrots, celery etc .

### **Vitamin E and Healthful Diets**

According to the 2005 Dietary Guidelines for Americans, "nutrient needs should be met primarily through consuming foods. Foods provide an array of nutrients and other compounds that may have beneficial effects on health. In certain cases, fortified foods and dietary supplements may be useful sources of one or more nutrients that otherwise might be consumed in less than recommended amounts. However, dietary supplements, while recommended in some cases, cannot replace a healthful diet."

The Dietary Guidelines for Americans describes a healthy diet as one that:

Emphasizes a variety of fruits, vegetables, whole grains, and fat-free or low-fat milk and milk products.

Vitamin E is found in green leafy vegetables, whole grains, and fortified cereals. Includes lean meats, poultry, fish, beans, eggs, and nuts.

Nuts are good sources of vitamin E.

Is low in saturated fats, trans fats, cholesterol, salt (sodium), and added sugars.

Vitamin E is commonly found in vegetable oils.

Stays within your daily calorie needs.

For more information about building a healthful diet, refer to the Dietary Guidelines for Americans (<http://www.health.gov/dietaryguidelines/dga2005/document/default.htm>) and the USDA's food guidance system, My Pyramid (<http://www.mypyramid.gov>).



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## **VITAMIN K**

Naturally produced by the bacteria in the intestines, vitamin K plays an essential role in normal blood clotting and helps promote bone health.

Good food sources of vitamin K are green vegetables such as turnip greens, spinach, cauliflower, cabbage and broccoli, and certain vegetable oils including soybean oil, cottonseed oil, canola oil and olive oil. Animal foods, in general, contain limited amounts of vitamin K.

To help ensure people receive sufficient amounts of vitamin K, an Adequate Intake (AI) has been established for each age group (see Table 2).

Without sufficient amounts of vitamin K, hemorrhaging can occur. Deficiencies may appear in infants, or in people who take anticoagulants or antibiotic drugs. Newborn babies lack the intestinal bacteria to produce vitamin K and need a supplement for the first week. People on anticoagulant drugs (blood thinners) may become deficient in vitamin K, but should not change their vitamin K intake without consulting a physician because the effectiveness of the drug may be affected. People taking antibiotics may lack vitamin K temporarily because intestinal bacteria are sometimes killed as a result of long-term use of antibiotics. Also, people with chronic diarrhea may have problems absorbing sufficient amounts of vitamin K through the intestine and should consult their physician to determine if supplementation is necessary.

Although a tolerable upper intake level has not been established for vitamin K, excessive amounts can cause the breakdown of red blood cells and liver damage. Large doses are not advised.

### Standards for Measuring Intake

Vitamin requirements are expressed in small units. Most are given in milligrams (mg) or micrograms (mcg). When comparing vitamin amounts on labels, note whether values are in micrograms (mcg), milligrams (mg) or International Units (IU). Make sure you compare the same units.

Dietary Reference Intakes (DRI) are dietary standards for desirable and/or safe vitamin intake levels published by the Food and Nutrition Board of the National Academy of Sciences National Research Council. DRIs include three sets of values: recommended dietary allowances (referred to as RDAs) which are intended to meet the nutrient needs of healthy individuals; tolerable upper intake levels (UL) which are designed to help people avoid harmful effects caused by consuming too much of a nutrient; and adequate intakes (AI), which are established when there is not enough scientific evidence to set an RDA and are based on diets known to be nutritionally adequate for U.S. and Canadian populations. Table 2 lists the recommended amounts

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of fat-soluble vitamins that individuals in the United States need daily for good health. Table 3 provides the tolerable upper intake levels.

Vitamin K is found in cabbage, cauliflower, spinach and other green leafy vegetables, cereals, soybeans, and other vegetables. Vitamin K is also made by the bacteria that line the gastrointestinal tract.

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