

Vitamin E

by Gary Null, Ph.D.

Vitamin E reminds us of a Hollywood actor who has been typecast in a particular type of role. No matter how great his talent, we tend to recognize him as the character that first made him famous. Likewise, vitamin E has long been recognized as the "fertility" nutrient. The scientists who discovered vitamin E in 1922 named it "tocopherol," a Greek word meaning the ability to reproduce. While it's true that vitamin E aids the reproductive organs – and even helps cells to reproduce themselves correctly – this nutrient has many other talents that deserve recognition.

The greatest of those talents is its antioxidant function. Along with vitamin C, beta carotene and certain enzyme systems, vitamin E is one of the superstars of the battle against free radicals. Beyond that, vitamin E also plays important roles in treating burns, maintaining a healthy heart, preventing cancer, and enhancing the immune system.

How Does Vitamin E Function in the Body?

Vitamin E's key jobs include the following:

Antioxidant function. Much like vitamin C its water-soluble counterpart, vitamin E protects our cells from free radical damage. Its primary function is to guard the lipids of the cell membranes – such as polyunsaturated fatty acids – from the process of oxidation, which can damage the membranes.

Once this damage is done, nutrients can no longer pass through the membrane properly. Too many nutrients may cause the cell to grow irregularly, while too few nutrients may starve the cell and eventually kill it. The body cannot function properly, of course, if too many cells are damaged or destroyed. In short, the disease process may start.

Blood and oxygen function. Vitamin E ensures that the brain, heart and organs get the supply of oxygen they need. It helps the blood use oxygen more efficiently and assists the circulatory system by keeping blood vessels open, strengthening the capillary walls and enhancing the walls of red blood cells. This all-purpose nutrient also serves as an anti-thrombotic agent; it can break up troublesome blood clots without altering the body's necessary clotting functions. Your body will have an adequate supply of blood platelets, which are needed for clotting, when vitamin E is on the scene.

Immune function. Vitamin E may enhance several aspects of the immune response, including the production of

antibodies and the activity of immune system cells that resist infections and tumor cells in the body.

What Specific Locations in the Body does Vitamin E Affect?

Since vitamin E protects the cell membranes and assists the blood, it is at work throughout the body. In *Vitamin Intake and Health*, authors S.K. Gaby and L.J. Machlin report that the largest pools of this nutrient are found in the testes, pituitary and adrenal glands, muscles, platelets and heart.¹ Vitamin E can help the skin – both inside and out – by healing scar tissue and burns. In the muscles, it can help to prevent or relieve cramps by transporting glucose to the affected site. Finally, this nutrient can help to protect the eyes from oxidative damage.

What Foods are Good Sources of Vitamin E?

Some excellent dietary sources of vitamin E are wheat germ, whole grains, nuts, whole eggs and cold-pressed polyunsaturated oils. Notice that we specify "cold-pressed." That's because most commercial oils are heated to extend their shelf life. Unfortunately, vitamin E is destroyed in the process. Thus, only cold-pressed oils offer significant amounts of the vitamin.

How Is It Absorbed in the Body?

A small amount of oil is needed in the diet to absorb and utilize the fat-soluble vitamin E. Secretions from the pancreas and bile from the liver contribute to this process. For the most part, vitamin E is stored in the adipose or fatty tissue, liver and muscle.²

Who is Likely to Require a Higher Quantity of Vitamin E?

The elderly. As we age, all of our body systems begin to function less efficiently, and the antioxidant mechanisms that protect our cells are no exception. When oxygen destroys lipids, for example, the resulting lipid peroxides can weaken your ability to fight off infectious invaders and destroy tumors. Vitamin E has been shown to enhance the immunity of elderly people by warding off lipid peroxides, according to researchers at the Tufts University Center on Aging.³

Smokers. A study reported in the *Journal of Clinical Investigation* found that cigarette smokers had much less vitamin E in their lung cells than did non-smokers, even though the two seemed to have similar levels

of vitamin E in their blood. Therefore, vitamin E may help to protect smokers, especially since oxygen-related lung damage may contribute to emphysema.⁴

In addition, an animal study has noted a link between a low intake of vitamin E and death from smoking. In this case, certain rats were fed a diet deficient in vitamin E and selenium and then exposed to cigarette smoke. Nearly one-third of them died. Among the rats that received vitamin E and selenium, only 8% died.⁵

Users of oral contraceptives. Women who take the pill often experience an excessive build-up of blood platelets. Vitamin E may be useful in preventing this aggregation, according to a study reported in *Contraception*.⁶ Researchers found that 200 mg of vitamin E was helpful.

Diabetics. Vitamin E may help to reduce excessive platelet clotting activity in diabetics. In one study, Type 1 diabetics took 1 gram of vitamin E a day for 35 days. Platelet aggregation was reduced significantly, as was the release of an oxidation product called malondialdehyde.⁷ In a study of diabetic animals, those that received vitamin E showed a reduced oxidation of lipoproteins and cytotoxicity.⁸

People with digestive problems. People who have difficulty absorbing fats may need extra vitamin E to facilitate the digestive process.

How Does Vitamin E Aid the Immune System?

Vitamin E supports the immune function in several key ways. First and foremost, this antioxidant can help to protect the lymphocytes from free radical damage to the membranes or DNA. The functioning of both B cells and T cells may be reduced with a vitamin E deficiency, although the T cells seem to be most susceptible to vitamin E levels. Beyond that, the macrophage membranes and phagocytic activities also depend on vitamin E.⁹ This nutrient can enhance the activity of other immune-enhancing vitamins and minerals, including vitamin A, vitamin C, selenium and zinc.

Studies on vitamin E and the immune system found the following results:

Healthy adults. In a 1989 study, the immune response of older adults improved when they took 800 I.U. of vitamin E a day for one month. As Adrienne Bendich reports in *Antioxidant Nutrients in Immune Responses*, the treatment improved their delayed hypersensitivity responses, which are an important indicator of a person's ability to fight off infections.¹⁰ The treatment also reduced the lipid peroxides in plasma and

increased interleukin-2 response to mutagens.¹¹

Chronically ill adults. Hemodialysis patients who received 300 mg of vitamin E per day (via intramuscular injections) registered positive changes in the ratio of certain T cells. In another study, diabetic patients who took about 1,500 I.U. of vitamin E daily showed improvement in some previously depressed aspects of phagocytosis.¹²

As An Antioxidant, How Does Vitamin E Help to Protect the Body?

Vitamin E, the primary fat-soluble antioxidant, protects your cells from oxidative damage by interfering with free radical chain reactions.¹³ The chemical bonds in the polyunsaturated fatty acids of cell membranes have a high absorption capacity. Therefore, they are susceptible to free radicals in search of an electron to restore their balance.

Vitamin E can keep these unwelcome guests from damaging or mutating cells. For example, vitamin E can slow or prevent the formation of free radicals when ozone reacts with polyunsaturated fatty acids.¹⁴ It can also prevent free radical attack from the oxidative compounds found in smog, cigarette smoke or the toxic by-products of alcohol.

As an antioxidant, vitamin E can help to prevent a premature aging process, which gets its start at the cellular level. As we age, our cells begin to malfunction or die, and the body's entire functioning will eventually slow down. Vitamin E protects cell membranes and the enclosed DNA from free radical attack.

In certain cells, the DNA contains instructions that tell the cell how to reproduce itself over and over again. These new cells may not be copied correctly if the DNA is damaged by free radicals. To make matters worse the distorted instructions could be damaged a second or third time, eventually affecting the functioning of cells, tissues and organs. As an antioxidant, then, vitamin E also assists in the proper creation of new cells.

In addition, Vitamin E helps to preserve the membranes of lysosomes contained in your cells. If these membranes are damaged, the poisonous substances stored inside the lysosomes could be released. Vitamin E also protects collagen, the substance that helps form tissue and gives shape to muscle. Free radicals can cause the collagen to develop "cross links," or irregular bonds that impede normal functioning. What's more, damaged collagen can constrict blood vessels, thereby reducing the supply of nutrients in the body.

How does vitamin E affect free radical activity? Vitamin E scavenges free radicals before they can damage cells. Its targets include the peroxy radical, hydroxyl radical, superoxide anion radical and other oxidation products such as malondialdehyde, which can lead to cross-linking of proteins.¹⁵ Researchers estimate that a single molecule of vitamin E can protect up to 1,000 membrane lipid molecules from peroxidation. This protection is intensified when vitamin C is present.¹⁶

Does Vitamin E Contribute to Cardiovascular Health?

Vitamin E is a vital nutrient for cardiovascular health. It can help to prevent an excessive buildup of platelets, which can cause blood clotting and, in turn, increase the risk of strokes and heart attacks. It also reduces the amount of oxygen needed for proper heart functioning, thereby enhancing the efficiency of the organ. Of course, vitamin E also preserves the integrity of cell membranes in the heart and nearby arteries.

As a result, vitamin E may play a role in preventing heart disease. Consider the preliminary results of a study conducted by Charles H. Hennekens, M.D., acting chair of preventive medicine at Harvard Medical School: In this ten-year analysis of more than 87,000 nurses, those who took in larger amounts of vitamin E through supplementation and in their diet were far less likely to develop heart disease.¹⁷

Here's how vitamin E affects cardiovascular function:

Oxidative stress. As Gaby and Machlin report, platelets in the bloodstream will rush to the site of an injured blood vessel to repair the damage. In the process, the platelets generate certain prostaglandins and the oxidation of arachidonic acid increases. While this clotting mechanism is needed to prevent excessive bleeding from the vessel, too much of a good thing can lead to an overaccumulation of platelets and possibly to strokes and other heart problems.

Vitamin E may be able to prevent this scenario due to its "anti-aggregatory" effects, state Gaby and Machlin. While the specifics of these

actions are not entirely understood, they may be attributed to vitamin E's ability to hinder the oxidation process or its effect on membranes.¹⁸ Better yet, vitamin E does not interfere with the normal formation of blood clots in performing this beneficial function.

In a study of heart metabolism, both vitamin E and pantethine were needed to protect animal hearts from the free radicals generated by deep hypothermia. When vitamin E was taken alone, it prevented lipid peroxidation activation but decreased superoxide dismutase (SOD), a potent free radical fighter. However, when vitamin E was combined with pantethine, lipid peroxidation was prevented and SOD was increased, thereby normalizing heart metabolism.¹⁹

Atherosclerosis status. By preventing platelets from clumping together, vitamin E may indirectly inhibit the buildup of fatty plaques that contribute to atherosclerosis. This condition can diminish the blood flow in the body, leading to muscle cramps, pain and even a lack of feeling in the affected area, according to Gaby and Machlin. Yet attempts to treat intermittent claudication with vitamin E have reported mixed results.²⁰

However this nutrient has proven to be helpful in cases of poor circulation to the lower legs. In one two-year study, patients who took vitamin E supplements, increased their exercise and gave up smoking experienced a 34% increase in the blood



"Not only did they take away our vitamin E and selenium, but now we're all breathing this darn cigarette smoke!"

Vitamin E

flow to their lower legs. Control subjects who took anticoagulant or vasodilator drugs showed no such change.²¹

Serum lipid levels. A number of studies have examined the effect of vitamin E on lipoproteins, the substances that transport cholesterol in the bloodstream. In one such study, the mean level of beneficial high density lipoproteins (HDLs) increased 13.6% in 30 patients who received 500 I.U. of vitamin E for three months. Among the control subjects, the increase was only 3.8%.²² A study of 33 patients with exercise-induced angina found that when vitamin E was combined with finoptin, a calcium antagonist, the level of lipid hydroperoxide in low density lipoproteins (LDLs) was reduced.²³

Ischemic heart disease. The antioxidant nutrients help to protect the heart against the free radical activity that occurs during a "reperfusion injury," in which the supply of oxygen to the heart is cut off and then allowed to reflow again. According to Gaby and Machlin, the evidence that scavengers such as vitamin E protect the body against reperfusion injury is substantial.²⁴ Ironically, the procedures used in cardiopulmonary bypass surgery can produce this type of ischemic injury to the heart. But in one study patients who received 2,000 I.U. of vitamin E before their bypass surgery showed a significant reduction in hydrogen peroxide when compared to control subjects.²⁵

Do Any Disease States Respond to the Use of Vitamin E?

Cataracts. Scientists believe that oxidative stress on the eye contributes to the formation of cataracts. Animal and human studies show that vitamin E, like other antioxidants, can go to battle against this stress, thereby protecting against cataracts and slowing down the progression of the disorder.²⁶ In one human study, for example, a high plasma level of vitamin E was correlated with a reduced risk of posterior subcapsular cataract. While the evidence of vitamin E's effect was not especially strong, say Gaby and Machlin, the risk of cataract was greatly reduced when a high level of vitamin E was combined with a high level of beta-carotene and/or vitamin C.²⁷

"Antioxidant nutrients, specifically vitamins C and E and carotenoids...are probable preventive agents against light-induced cataract and age-related degeneration of the macula," states Allen Taylor, director of the Laboratory for Nutrition and Vision Research at the USDA Human Nutrition Research Center on Aging, Tufts University.²⁸ In the United States alone, 1.4

million lens extractions are performed each year. By postponing the onset of cataracts for 10 years, half of these procedures could be eliminated.

Hemolytic and sickle cell anemias. By stabilizing cell membranes, vitamin E may prevent the oxidation process that destroys red blood cells. When too many cells become a victim of oxidation, hemolytic anemia may result.²⁹ A chronic form of hemolytic anemia may be caused by a genetic disorder that reduces the antioxidant capacity and survival time of red blood cells, report Gaby and Machlin. A study by Corash found that when patients with this anemia received 800 I.U. daily of vitamin E for more than a year, their hemoglobin concentration improved and the life span of their red blood cells increased.³⁰

Sickle cell anemia, by contrast, is a genetic disorder that causes red blood cells to become deformed. If these cells are completely oxygenated, most can return to their normal shape, state Gaby and Machlin. Some, however, will remain irreversibly "sickled" and can lead to cell destruction. In several studies, vitamin E supplementation of 400 to 450 I.U. a day lead to positive results by decreasing the number of red blood cells that permanently sickled.^{31,32}

Neurological disorders. In its role as an antioxidant, vitamin E can ward off limited neurological problems by stabilizing the membranes of neurons and protecting them from oxidative damage. Without adequate vitamin E, muscular symptoms may develop. In these cases vitamin E supplementation is part of an effective treatment.^{33,34}

Indeed, vitamin E's antioxidant actions may be helpful for people with Alzheimer's and Parkinson's disease, if the nutrient is taken early in the development of the disease. In both cases, oxidative damage from environmental factors may initiate the disease process.³⁵ In one study of Parkinson's patients who had been taking vitamin E supplements on their own, the disease was less severe than for control subjects who did not take supplements.³⁶

Another study found that vitamin E helped to reduce the number of seizures in epileptic children. Ten out of 12 children who took 400 I.U. daily had significantly fewer seizures, while the children given a placebo showed no reduction.³⁷ In a study of spinal cord injury in rats, vitamin E greatly reduced the motor disturbances caused by the injury.³⁸

Can Vitamin E Help to Prevent or Treat Cancer?

Vitamin E can help to protect the body against cancer in three primary ways: by boosting the functioning of the immune

system, defending the DNA of the cells from an attack by mutagens and inhibiting the formation of nitrosamines, the substances that can form in the body and become carcinogenic.

As an antioxidant, vitamin E helps put a stop to the free radicals that can damage cell membranes and DNA, setting the stage for cancerous mutations of the cell. It also repairs cell membranes and assists in the repair of DNA.³⁹

Vitamin E blocks the formation of nitrosamines. As Gaby and Machlin point out, these powerful carcinogens are created when nitrates and nitrites combine with amines in the body, in foods or in cigarette smoke.⁴⁰

Vitamin E can boost your immunity in various ways. According to Gaby and Machlin, this nutrient may increase the following aspects of the immune response: humoral antibody production, cell mediated immunity, resistance to bacterial infections, lymphocyte response, tumor necrosis factor and natural killer cell activity.⁴¹

The relationship between vitamin E serum levels and cancer development was examined in a study of 766 adults in Finland. Of these cancer patients, those with a low level of vitamin E had a 1.5 fold risk of cancer compared to the patients with a higher level of vitamin E. The strength of this link varied with the cancer sites, and the researchers concluded that vitamin E's protective effects were particularly beneficial against gastrointestinal cancer.⁴²

In the mid to late 1980s, at least 13 epidemiological studies explored the connection between low serum levels of vitamin E and cancer risk, according to Gaby and Machlin. The results were split almost down the middle, with seven of the studies concluding that low levels of vitamin E were associated with cancer risk and six finding that the status of the vitamin had no effect.⁴³

Even in the latter group, however, the cancer patients tended to have lower vitamin E levels than did control subjects. Among the studies that found a connection, low levels of vitamin E increased the risk of breast cancer, lung cancer, esophageal cancer and precancerous gastric dysplasia.⁴⁴⁻⁴⁶ Studies on elderly people also have shown that they are less likely to contract an infectious disease when the plasma concentration of vitamin E is high. Likewise, their risk of developing cancer is lower when vitamin E levels are high.⁴⁷

Here's how vitamin E affects the following types of cancer:

Oral and esophagus. In two animal studies, vitamin E either prevented the development of tumors in the oral cavity or

decreased the size of existing tumors.^{48,49} Another study of esophageal tumors concluded that vitamin E treatment reduced the incidence of esophageal and forestomach tumors by 37%. This result was accompanied by about a two-fold drop in tumor multiplicity and a reduced incidence of carcinomas.⁵⁰

Lung. Vitamin E is also helpful in preventing lung cancer, which may be related to air pollution or to cigarette smoking. In the case of air pollution, it helps to prevent the pollution from peroxidizing the fat molecules in the lung cell membranes. And for cigarette smokers, it can reduce the free radical damage and carbon monoxide damage caused by the smoke. Carbon monoxide inhibits the hemoglobin in red blood cells from transporting oxygen to the brain and other organs.⁵¹

Breast. One epidemiological study points to a strong connection between vitamin E serum levels and breast cancer. In fact, there was a 500% greater risk of breast cancer in individuals with low levels of vitamin E.⁵² Other studies have found that vitamin E can help to treat cystic breast disease which often serves as a precursor to breast cancer.

Vitamin E levels may be significantly lower in individuals with gastric cancer.⁵³ However, people with ovarian cancer did not have these decreased concentrations.⁵⁴ Also, the children of lung cancer patients were found to have low blood levels of vitamin E.⁵⁵

Is There Any Evidence that Vitamin E has Harmful Side Effects?

Vitamin E generally causes few side effects. However, some people have complained of nausea, headaches and fatigue at daily dosages exceeding 300 I.U.s.⁵⁶ It should be noted that vitamin E can cause a temporary rise in blood pressure. According to the authors of *Formula for Life*, people with high blood pressure who take vitamin E should begin with small dosages of 100 I.U. a day and slowly build up to their desired dosage.⁵⁷ It should be noted that vitamin E can inhibit the activity of vitamin K. Therefore, people who take medications that already reduce their level of vitamin K should not take vitamin E as well.⁵⁸

If you've wondered why nutrition experts recommend that vitamin E and vitamin A be taken together, it's because vitamin E helps to protect vitamin A from oxidation. In fact, 110 I.U. daily of vitamin E may actually double the beneficial effects of vitamin A. Vitamin E also functions synergistically with beta-carotene and vitamin C, according to studies by P.F. Jacques.⁵⁹

For vitamin E to function properly, you need sufficient amounts of selenium and the sulfur amino acids, especially cysteine and methionine. These nutrients work as partners to protect polyunsaturated fatty acids and the membranes that contain them. Selenium assists glutathione peroxidase, the enzyme that does the tough job of neutralizing harmful peroxides. The sulfur amino acids, in turn, are necessary for the production of glutathione peroxidase. Good sources of selenium include meat, seafood and whole grains, provided they are grown in selenium-rich soil. Sulfur amino acids are contained in meat, seafood, milk, eggs and beans.

Direct correspondence to the *Townsend Letter*.

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