

Understanding Cholesterol

High levels of cholesterol have been repeatedly associated with atherosclerosis and heart disease. Cholesterol is also found in high quantities in the atheromas seen in vascular disease.

Cholesterol is a necessary substance that is even produced by the body from fatty acids, especially saturated fats, in the diet. Ready-made cholesterol is also absorbed from foods derived from animals. From the bloodstream, cholesterol is taken up by cells and used to make cell membranes, certain hormones and vitamin D.

Cholesterol is produced by a number of steps involving several different enzymes. One of the main enzymes involved is called HMG Co-A reductase. This enzyme has the single most say-so over how much cholesterol is produced. HMG Co-A reductase usually works to produce just enough cholesterol for normal function, but sometimes, especially when the diet is high in saturated fats, it becomes a workaholic and contributes to elevated cholesterol levels. If the diet is also high in cholesterol-containing animal foods, then cholesterol levels can be raised even more.

Cholesterol is packaged into particles called low-density lipoproteins, or LDL cholesterol, and distributed throughout the body to where it is needed. High-density lipoprotein particles, or HDL cholesterol, then travels throughout the body collecting the extra cholesterol not used by cells. For this reason, HDL is often referred to as the "good" cholesterol.

Cholesterol in the body that is not used to produce hormones, vitamin D, or cell membranes is also eliminated by the liver. The liver converts the cholesterol to bile, which is stored in the gall bladder until it is needed in the intestines. When bile is released into the intestines, it aids digestion by making dietary fats easier to absorb. Much of the bile that passes into the intestines is reabsorbed and recycled for future use. If it binds to certain food substances, like fiber, however, it can pass out of the body and new bile must be produced from cholesterol to replace the bile that is lost.

Normally, cholesterol is not toxic to the body. It flows through the blood vessels without causing any damage or atheroma build-up. However, when cholesterol becomes oxidized, either by heat or free radicals before it is absorbed in the intestines, or by free radicals found in the body, it can become dangerous. Oxidized LDL cholesterol is directly toxic to endothelial cells. It increases the adhesion of monocytes and macrophages to vascular lesions, increases the proliferation of smooth muscle cells, increases platelet clumping and thrombus formation, and inhibits the production of nitric oxide, a messenger chemical needed for vasodilation.

Macrophages and monocytes normally only take in small amounts of unoxidized cholesterol, but when they are exposed to oxidized cholesterol, they take in large amounts, causing them to greatly increase in size. A high blood level of oxidized LDL cholesterol, therefore, is a strong contributing factor for the production and growth of atheromas and the progression of heart disease.

Nutrients That Help Lower Cholesterol Levels

Soluble Fiber

While diets low in fat and cholesterol may be able to lower total and LDL cholesterol levels about 5-10%, diets high in soluble fiber have been shown in some studies to lower total cholesterol and LDL cholesterol as much as 20-30%. The soluble fiber used in these studies was the naturally-occurring fiber found in oat bran, beans, and other food sources. In these same studies, the use of cooked soy beans, a rich source of both soy protein and naturally occurring soluble fiber, led to a decrease in total cholesterol of 30% and a decrease in LDL cholesterol of 35-40%.

Soluble fiber acts to reduce cholesterol levels in several ways:

First, soluble fiber in the intestines binds to bile from the liver, so it is carried out of the body as waste instead of being reabsorbed. In order for the body to make more bile, which is necessary for digestion, it must break down more cholesterol, removing it from the bloodstream. In addition, because bile is needed for the absorption of cholesterol from food, binding the bile makes it less able to assist in cholesterol absorption, so less dietary cholesterol is absorbed from the food.

Secondly, when normal levels of bacteria are present in the colon, they are able to break down some of the soluble fiber into what are called short-chain fatty acids. In addition to being very good for the health of the colon cells, some short-chain fatty acids are absorbed into the bloodstream, where they travel to the liver and decrease the action of HMG Co-A reductase, one of the main enzymes involved in the production of cholesterol.

So, soluble fiber acts to reduce cholesterol levels by:

- Decreasing the absorption of dietary cholesterol
- Increasing the removal of bile
- Increasing the breakdown of blood cholesterol
- Decreasing the production of cholesterol by the liver

Some excellent food sources of fiber include cinnamon, raspberries, mustard greens, peppermint leaves, collard greens, broccoli, celery, red chili peppers, fennel bulb, grapefruit, cauliflower, cabbage, green beans, eggplant, strawberries, split peas, and lentils. [Click here](#) for more food sources of fiber.

Niacin

Niacin, also known as vitamin B3, has been shown to decrease the activity of HMG Co-A reductase, which leads to a decrease in the body's production of cholesterol. It also helps to increase the breakdown of cholesterol to bile, decreases the proliferation of smooth muscle cells, helps to prevent LDL oxidation, reduces platelet clumping, lowers lipoprotein a levels, and can increase HDL, or good cholesterol, levels by as much as 15-40%. Increasing HDL levels, particularly through diet, can significantly decrease atherosclerosis progression.

Niacin use has been shown to decrease cholesterol levels by 10-26% and decrease myocardial infarction recurrence by 29%. Niacin given to patients after an acute myocardial infarction reduced non-fatal MI recurrence by 27% and decreased long-term overall mortality by 11%.

Excellent food sources of niacin include crimini mushrooms, dry active yeast, yellowfin tuna, chicken breast, and salmon fillet. [Click here](#) for more food sources of niacin.

Soy

Cultures in which soy foods constitute a major portion of the diet typically have much lower rates of heart disease than cultures with a low consumption of soy. In addition to this epidemiological data, clinical studies have shown that soy foods are protective against the development of heart disease and its associated mortality. The beneficial effects found in these studies are due to an intake of whole soy foods and not the isolated soy components that are currently available in supplement form.

Soy foods have been shown to decrease LDL by 35-40% and total cholesterol levels by 30%, decrease triglyceride levels, and decrease platelet aggregation, reducing the risk of blot clots. Soy foods may also increase HDL cholesterol levels.

Some good soy foods include tofu, tempeh, soymilk, edamame (soybeans), roasted soybeans, and soy miso.

Taurine

Taurine is an amino acid component of protein particularly common in fish protein. It has been shown to decrease elevated cholesterol levels by decreasing the absorption of cholesterol in the intestines as well as by increasing the conversion of cholesterol into bile, thereby removing it from the body. Studies have shown that those with higher intakes of taurine have a lower risk of ischemic heart disease mortality. It is suggested that people eat fish, a rich source of taurine, at least 5 days a week in order to gain the maximum benefit.

Best Food Sources of Taurine: Fish. Cold-water fish such as salmon and cod are recommended as these are also rich in beneficial omega-3 essential fatty acids.

Vitamin B6

Blood vitamin B6 levels tend to be lower in coronary artery disease and myocardial infarction patients, and some believe that low blood vitamin B6 levels may actually be useful as an indicator of risk for myocardial infarction. Vitamin B6 is one of the vitamins needed for the proper metabolism of homocysteine, discussed below.

Vitamin B6 may be beneficial to those trying to prevent cardiovascular disease for several other reasons:

Vitamin B6 has been shown in studies to decrease platelet clumping and thereby decrease risk of thrombosis.

Vitamin B6 supplement use has been shown to decrease LDL cholesterol levels by as much as 17%. Unfortunately, the use of excessive amounts of vitamin B6 in supplement form for long periods of time has been associated with the development of a neurological condition of decreased sensation in the hands and feet. These high levels are not attainable through dietary sources of vitamin B6 and only occur in those taking high levels of vitamin B6 supplements.

Some excellent food sources of vitamin B6 include green peppers, cauliflower, garlic, yellowfin tuna, mustard greens, bananas, asparagus, dry active yeast, and kale. [Click here](#) for more food sources of vitamin B6.

Nutrients That Help Prevent Oxidation Of Cholesterol

Vitamin E

Vitamin E, the primary fat-soluble antioxidant in the body, is the antioxidant found in highest quantities in LDL cholesterol particles, which it protects from oxidation. Vitamin E is the main defender of lipids (fats) and is responsible for putting a halt to chain reactions of lipid peroxidation anywhere in the body. Vitamin E has also been shown to decrease platelet clumping, prevent the rupture of existing atheromas, decrease the migration of macrophages to atheromas, prevent the inhibition of NO production, and to decrease the expression of adhesion molecules on the surfaces of endothelial cells, thereby reducing the amount of binding that can occur with monocytes and other immune cells.

Studies have shown that people with lower vitamin E levels tend to have a higher rate of ischemic heart disease mortality and vice versa. One study found that people with the highest intake of vitamin E from dietary sources had less than half the risk of cardiac events when compared to those with the lowest intake. Other studies have shown that the use of vitamin E supplements has produced a 50% reduction in the progression of atheroma growth, a 63% decrease in coronary heart disease death, a 34% reduction in risk of cardiac events in women, a 77% decrease in the reoccurrence of non-fatal myocardial infarction, and a 39% decrease in risk of heart

disease in men. Overall, the use of vitamin E supplements at any time was associated with a 47% decrease in heart disease related mortality.

The downside of the use of vitamin E is that large amounts have been associated with a possible increase in oxidation. In order to prevent oxidation of fats, the vitamin E itself must become oxidized. If all of the vitamin E in an LDL particle becomes oxidized, it is then able to cause oxidation of LDL cholesterol. A way to prevent this from happening is to make sure that there is enough of the antioxidant vitamin C available. Vitamin C is very effective at restoring oxidized vitamin E back to its non-oxidized, antioxidant form. For this reason, studies recommend that an increase in vitamin E intake be accompanied by an increase in vitamin C intake. Also, because of its ability to decrease platelet clumping and clot formation, supplemental vitamin E should not be used by those taking blood thinners unless they are being closely monitored by their doctor.

Mustard greens, chard, and sunflower seeds are a few excellent sources of vitamin E. [Click here](#) for more food sources of vitamin E.

Vitamin C

Vitamin C is the primary water-soluble antioxidant found in the body. Although it is not found in LDL cholesterol particles because it is not fat-soluble, it does play a large role in the prevention of LDL oxidation. In addition to restoring antioxidant function to vitamin E, vitamin C also eliminates many free radicals produced by normal body metabolism, thus preventing them from affecting cholesterol.

Low levels of vitamin C have also been associated with higher levels of total cholesterol and LDL cholesterol and lower levels of HDL cholesterol. Vitamin C is required for the breakdown of cholesterol to bile in the liver and also for the uptake of LDL cholesterol into cells for normal use. Vitamin C use is therefore associated with a decrease in total and LDL cholesterol levels as well as an increase in HDL levels. These effects seem to be most pronounced in men and tend to take about six months of increased vitamin C intake to be significant.

Low vitamin C levels are associated with an increase in cholesterol deposition in the aorta, the main artery leaving the heart. Vitamin C has been shown to decrease the binding of monocytes to atheroma lesions, thereby reducing the rate of atheroma growth. It is especially beneficial in preventing the negative effects of smoking on the blood vessels and heart. Vitamin C also reduces the deactivation of NO and actually increases the production of NO, leading to decreased vessel spasm and increased vasodilation.

Excellent food sources of vitamin C include green chili peppers, broccoli, parsley, green bell peppers, strawberries, cauliflower, lemons, romaine lettuce, mustard greens, Brussels sprouts, papaya, kale, snow peas, cabbage, spinach, kiwifruit, cantaloupe, oranges, grapefruit, tomatoes, chard, collard greens, raspberries, peppermint leaves, asparagus, celery, fennel bulb, pineapple, and watermelon. [Click here](#) for more food sources of vitamin C.

Bioflavonoids

Bioflavonoids, which are chemical substances classified as pigments, help provide fruits and vegetables with their recognizable colors, and have many different effects in the body including antioxidant effects. A high intake of bioflavonoids, specifically those found in tea, onions, citrus fruits, red grape skins, and apples, has been associated with a significant decrease in risk of cardiovascular disease mortality. Although the exact mechanisms of bioflavonoids' actions are not fully understood at this point in time, their beneficial effects have been well documented.

Some good food sources of bioflavonoids include red grapes, onions, apples, and citrus fruits.

Beta-carotene

Beta-carotene is another antioxidant found in foods. Although it is not found in high quantities in LDL cholesterol particles, it has been shown to prevent the oxidation of LDL cholesterol. Beta-carotene, like vitamin C, is also able to increase vessel dilation and reduce vessel spasm. One study has shown that patients with the lowest level of beta-carotene intake had almost twice the risk of having a myocardial infarction compared to those with the highest intake. The group of patients taking the highest intake of beta-carotene had about 1/3 the risk of fatal myocardial infarction and about 1/2 the risk of cardiovascular death as those in the group with the lowest intake. Excellent food sources of beta-carotene include sweet potatoes, carrots, kale, winter squash, collard greens, chard, cantaloupe, mustard greens, romaine lettuce, spinach, parsley, cayenne pepper, peppermint leaves, Brussels sprouts, tomatoes, broccoli, asparagus, and apricots.

Lycopene

Research conducted at Brigham and Women's Hospital, Boston, MA, suggests that in addition to its inverse association with various cancers, a high dietary consumption of lycopene may play a role in cardiovascular disease prevention. The researchers tracked 39,876 middle-aged and older women who were free of both cardiovascular disease and cancer when the study began. During more than 7 years of follow-up, those who consumed 7 to 10 servings each week of lycopene-rich foods (tomato-based products, including tomatoes, tomato juice, tomato sauce and pizza) were found to have a 29% lower risk of CVD compared to women eating less than 1.5 servings of tomato products weekly. Women who ate more than 2 servings each week of oil-based tomato products, particularly tomato sauce and pizza, had an even better result—a 34% lower risk of CVD. (September 8, 2003)

Monounsaturated fats

Monounsaturated fats are a unique type of fat found in particularly high quantities in olive oil. Studies have revealed that populations that follow the "Mediterranean" diet, which is high in vegetables and whole grains, and low in saturated fats, but relatively high in total fat due to a high intake of olive oil, tend to have fairly low rates of cardiovascular disease and its associated mortality. Based on studies of fat intake and heart disease in many countries, it would be expected that these populations would have high rates of heart disease because of the level of fat in their diets. However, the opposite is true.

Recent studies have shown that LDL cholesterol particles that contain monounsaturated fats, such as from olive oil, are much more resistant to oxidation than those that contain high levels of polyunsaturated fats, such as from other vegetable oils like safflower oil. In addition, the substitution of dietary saturated fats with monounsaturated fats has been shown to decrease total cholesterol by 13.4% and to decrease LDL cholesterol by 18%. The most important aspect of the use of monounsaturated fats is that they be used in place of saturated fats. Adding olive oil onto a diet that is already high in fats and saturated fats can have negative effects on heart disease progression and risk. Olive oil should instead be used to replace animal sources of fat and other vegetable oils. Even though olive oil is a relatively stable fat and is therefore recommended for cooking, it is important not to use olive oil for baking, broiling, or frying. Exposing it to very high temperatures for long periods of time in these fashions may cause it to oxidize.

The best sources of monounsaturated fats include olive oil, high oleic safflower oil, high oleic sunflower oil, canola oil, grapeseed oil, avocado.

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