
Benefits of Long Chain Omega-3 Fatty Acids (EPA, DHA): Help Protect Against Heart Disease

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An abundance of evidence strongly suggests that increased intakes of long chain omega-3 fatty acids can markedly reduce the risk of heart disease. The omega-3 fatty acids believed to be largely responsible for these effects include EPA and DHA. These “good fats” are naturally present in some types of fish and in other marine organisms such as algae, and they are also readily available in purified form in dietary supplements. Most Americans eat very little fish and have very low intakes of long chain omega-3 fatty acids (sometimes also referred to as n-3 fatty acids).

According to Dr. William E. Connor of the Oregon Health Sciences University, an internationally recognized expert on omega-3 fatty acids and health, hundreds of experimental and clinical studies have provided strong evidence that omega-3 fatty acids may help prevent heart disease through a number of different mechanisms. Several studies indicate that eating fish once or twice a week can reduce deaths from coronary artery disease by about 50 percent. “The most important finding is of a reduction in sudden death from ventricular fibrillation and tachycardia.” Omega-3 fatty acids also reduce the tendency to thrombosis (formation of blood clots), and thus help prevent myocardial infarction. EPA and DHA also have several actions that inhibit the development of atherosclerosis. While these fatty acids do not lower plasma cholesterol levels, they do have a substantial triglyceride-lowering effect and also raise levels of HDL (“good” cholesterol). Connor concludes that omega-3 fatty acids “are natural food substances that prevent coronary artery disease and sudden death.” He emphasizes that these fatty acids “have immense public health significance for the control of the current coronary epidemic.” (Connor 2001)

What Does “Omega-3” Mean?

The term “omega-3” or “n-3” indicates that the first double bond is located at the third carbon from the end of the fatty acid chain. The long-chain omega-3s from marine sources are EPA and DHA, with 20 and 22 carbons. These are the focus of this chapter. There are also plant sources of omega-3 fatty acids with 18 carbons.

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Structure of Omega-3 Fatty Acids

Docosahexaenoic acid (DHA):	22 carbons and six double bonds
Eicosapentaenoic acid (EPA):	20 carbons and five double bonds
Alpha-linolenic acid (ALA):	18 carbons and three double bonds

In the Physicians' Health Study, researchers identified 94 men "in whom sudden death was the first manifestation of cardiovascular disease." These men were matched with 184 controls, and blood levels of long chain omega-3 fatty acids (also called n-3 fatty acids) were assessed. Men with low blood levels of omega-3 fatty acids were three to five times more likely to suffer sudden death from heart disease than men with higher blood levels of omega-3 fatty acids. The researchers suggest that omega-3 fatty acids may protect against death from heart disease by decreasing the heart's tendency to arrhythmia. They conclude: "In summary, taken together with previous data from observational studies and randomized trials, these prospective data suggest that the long-chain n-3 fatty acids found in fish may reduce the risk of sudden death from cardiac causes, even among men without a history of cardiovascular disease. Because more than 50 percent of all sudden deaths from cardiac causes occur in people with no history of cardiac disease, preventive efforts must address this segment of the population to have a substantial effect on the overall incidence of sudden death from cardiac causes. If the observed association is causal, increasing the intake of n-3 fatty acids by eating more fish or by taking supplements is an intervention that could be applied to this segment of the population at low cost and little risk." (Albert 2002)

Fish Consumption Lowers Risk of Heart Disease

For many years, scientists were puzzled by the fact that heart disease among Greenland Eskimos was extremely rare despite their consumption of a high-fat, high-cholesterol diet. Research revealed that the Eskimos were protected by diets largely based on seals, whales, and fish, all of which provide high intakes of omega-3 polyunsaturated fatty acids, especially EPA and DHA. (Bang and Dyerberg 1973)

Later, epidemiological studies in many countries, including the United States, demonstrated that even people who eat moderate amounts of fish get some degree of protection against heart disease.

In the Nurses' Health Study, fish consumption was found to be associated with a lower risk of coronary heart disease (CHD) and a lower rate of all-cause mortality during 16 years of followup. The protective effect was stronger for fatal CHD than for nonfatal myocardial infarction (MI). The protective association with omega-3 fatty acid intake was similar to that for fish intake. "This finding is consistent with the hypothesis that omega-3 fatty acids are the active agent primarily responsible for the apparent protective effect of fish." The researchers conclude that "this prospective study provides strong evidence for an inverse association between fish and omega-3 fatty acid consumption and risk of CHD in women, particularly CHD death. These findings lend further support to

current dietary guidelines recommending fish consumption twice weekly for the prevention of CHD.” (Hu 2002)

An earlier report from the Nurses’ Health Study found that fish consumption lowered the risk of stroke. The researchers found that the “risk of thrombotic infarction [stroke] was significantly reduced by 48% among women who ate fish 2 to 4 times per week.” (Iso 2001)

In the Chicago Western Electric Study, researchers evaluated the association between fish consumption and mortality from heart disease over a 30-year period. The risk of death from heart disease was 40 percent lower in men who ate at least 35 grams of fish daily. This amounts to a little more than an ounce a day, equivalent to 4.4 ounces twice a week or 8.8 ounces once a week. (Daviglus 1997)

In the MRFIT trial (Multiple Risk Factor Intervention Trial), involving men at high risk of heart disease, the consumption of polyunsaturated fatty acids from fish had a protective effect against mortality from cardiovascular disease over a period of 10.5 years. (Dolecek 1992) Another study in this same group of men examined serum fatty acid levels and also found that men with higher levels of omega-3 polyunsaturated fatty acids had a lower risk of heart disease. (Simon 1995)

Among the Inuit of northern Quebec, the traditional diet is very high in long chain omega-3 fatty acids from fish, whales and seals, and the Inuit have traditionally had low rates of heart disease. In modern times, the Inuit diet may be shifting away from traditional patterns. However, a recent study showed that the Inuit still have relatively high intakes and therefore high blood levels of omega-3 fatty acids, although levels are higher in older people than in younger ones. Higher omega-3 levels were associated with lower triglycerides and higher HDL cholesterol, LDL cholesterol, and total cholesterol. The Inuit still have a very low rate of heart disease, and the researchers attribute this protective effect to the diet rich in omega-3 fatty acids. Average consumption of marine products in this population was 131 grams per day (about 4.8 ounces). This corresponds to an intake of about 2 grams of EPA and DHA per day. (Dewailly 2001)

In the Netherlands, people over the age of 65 were followed for 17 years, and the relationship between fish consumption and heart disease was evaluated. About 60 percent of this elderly cohort ate fish and 40 percent did not. Those who ate fish had a significantly lower rate of mortality from heart disease. (Kromhout 1995)

In a case-control study of 334 people with primary cardiac arrest and 493 controls, researchers in the Cardiovascular Health Research Unit at the University of Washington found seafood consumption to be protective. People who ate even one fatty fish or seafood meal per week had a 50 percent reduced risk of cardiac arrest, compared to people who ate none. People with higher levels of omega-3 fatty acids in their red blood cell membranes (5 percent compared to 3 percent) had a 70 percent lower risk of cardiac arrest. The researchers suggested that an increase in membrane levels of omega-3 fatty acids in some way lowers the subjects’ vulnerability to arrhythmia or ventricular

fibrillation. They concluded that modest amounts of omega-3 fatty acids from seafood “may reduce vulnerability to ventricular fibrillation and, thereby, reduce the risk of coronary heart disease mortality.” (Siscovick 1995)

In the Physicians’ Health Study, researchers from Brigham and Women’s Hospital and Harvard Medical School found that doctors who consumed fish at least once a week had half the risk of sudden cardiac death, compared to doctors who ate fish less than once a month. The doctors who ate more fish also tended to eat more vegetables, use antioxidant vitamin supplements, and exercise vigorously at least once a week. On the downside, they were also more likely to have a family history of high cholesterol, hypertension, or heart disease. The analysis controlled for all of these factors, and still concluded that eating fish seemed to be protective. The researchers noted that there are about 250,000 sudden cardiac deaths every year in the United States, and over half of these occur in people with no history of heart disease. Therefore, the public health impact of any intervention that could reduce that risk would be substantial. (Albert 1998)

How Do Omega-3 Fatty Acids Protect Against Cardiovascular Disease?

Omega-3 fatty acids have been shown to impact several key risk factors related to heart disease. Dr. Alexander Leaf and coworkers at the Harvard Medical School and Massachusetts General Hospital in Boston have examined the effects of omega-3 fatty acids in preventing arrhythmia in heart cells and have suggested that omega-3s may prevent sudden cardiac death through this mechanism. (Leaf 1996)

Elevated triglycerides are considered a risk factor for heart disease, and the long chain omega-3 fatty acids derived from marine products (EPA and DHA) have potent effects in reducing serum triglycerides. Consumption of as little as 3 grams of these fatty acids can reduce triglycerides by 30 percent, and they are often used therapeutically for this purpose. There is little or no net effect on total serum cholesterol, LDL cholesterol, or HDL cholesterol. The usual dietary intake of long chain omega-3 fatty acids in the United States is only about 0.15 g (or 150 mg) per day—far less than the amount associated with a beneficial effect on serum triglycerides. (Harris 1997)

Long chain omega-3 fatty acids can have an impact on the risk of atherosclerosis through numerous mechanisms. They not only lower triglycerides, but also decrease platelet aggregation, favor dilation of the blood vessels, and decrease the tendency to thrombosis. In a review article, Dr. Artemis Simopoulos of the Center for Genetics, Nutrition and Health lists no less than 17 separate mechanisms by which omega-3 fatty acids may have these physiological effects. In clinical trials, beneficial effects have been attributed primarily to reducing arrhythmias and reducing thrombosis in the vessels. (Simopoulos 1999)

Clinical Trials With Supplements of Long Chain Omega-3 Fatty Acids

Numerous studies have specifically investigated the benefits of long chain omega-3 fatty acids given as nutritional supplements. One large intervention trial studied more than 11,000 men who had survived a heart attack (MI, or myocardial infarction). It examined the effects of supplements of omega-3 fatty acids or vitamin E in protecting against later events, including nonfatal MI, stroke, or death. The patients followed Mediterranean dietary habits (considered beneficial for heart health) and continued to receive appropriate medical treatment with pharmaceutical preparations during the study. The omega-3 group was given one gram of combined EPA and DHA per day, and the vitamin E group was given 300 mg per day. No effect of supplemental vitamin E was observed, but the omega-3 supplement “significantly decreased, over 3.5 years, the rate of death, non-fatal myocardial infarction, and stroke.” The decrease in risk was 10 to 15 percent. This study is known as the GISSI trial. GISSI stands for the Italian name of the study, Gruppo Italiano per lo Studio della Sopravvivenza nell’Infarto miocardico. (GISSI 1999)

In a study of 2033 men who had recovered from heart attacks, researchers advised one group of men to eat more fish, but allowed them to take fish oil supplements instead of fish if they preferred. Two other groups were advised to decrease total fat consumption or to increase fiber intake. Over a two-year period, the fish and fish oil group had a 29 percent reduction in risk of death compared with the groups not advised to eat fish. The fish and fish oils may have reduced mortality through their favorable effects on clotting mechanisms, platelet aggregation, and ventricular fibrillation. (Burr 1989)

In postmenopausal women, supplementation with 4 g of EPA and DHA (2.4 g EPA plus 1.6 g DHA) reduced triglyceride levels by 26 percent. Reductions were similar in women using hormone replace therapy (HRT) and in those not using HRT. The researchers suggest that “this approach could potentially reduce the risk of coronary heart disease by 27% in postmenopausal women.” (Stark 2000)

What Other Benefits Do Omega-3 Fatty Acids Have?

While there is an abundance of recent research on the cardiovascular benefits of omega-3 fatty acids, it should also be recalled that these substances are essential nutrients, critical to life itself and to many physiological functions. Maternal levels of omega-3 fatty acids during pregnancy determine the levels present in the developing infant. The long chain omega-3 fatty acid DHA is particularly critical in supporting infant growth and development, and DHA levels in newborns are correlated with birth weight, birth length, and head circumference. It has been suggested that women and their infants may benefit if the mother is supplemented with DHA during pregnancy. The ratio of omega-3 to omega-6 fatty acids in the total diet is also important, and many scientists believe current diets in the United States are too low in omega-3 fatty acids, compared to the relatively high intakes of omega-6 fatty acids. (Hornstra 2000)

What are omega-6 fatty acids?

Omega-6 fatty acids are polyunsaturated fatty acids that have the first double bond at the sixth carbon from the end of the fatty acid chain. These are the types of fats present in some of the most commonly used vegetable oils such as corn oil, safflower oil, and sunflower oil.

Long chain omega-3 fatty acids are present in breast milk and have been related to improved visual acuity and cognitive function in infants. (Birch 2000) In many countries, omega-3 fatty acids are added to infant formula, but this practice has only recently been approved by the Food and Drug Administration for formulas marketed in the United States.

In older adults, low blood levels of omega-3 fatty acids have been linked to cognitive impairment and dementia. (Conquer 2000)

Cost of Omega-3 Fatty Acids

Long chain omega-3 fatty acids are naturally found in fish, especially in fatty fish such as salmon, but also occur in smaller amounts in other types of fish and seafood. These nutrients are also available in dietary supplements. Relative costs are shown below, based on the amount of fish or supplements needed to provide 900 mg of long chain omega-3 fatty acids (almost as much as was given in the large clinical trial in Italy). The amount of omega-3 in fish is based on data provided on the website of the National Fisheries Institute. Costs are based on prices in supermarkets in the Baltimore-Washington metropolitan area early in 2002.

Cost of 900 mg omega-3

Fresh salmon provides an average of 1.1 gram of omega-3 fatty acids per 3-ounce serving, at a cost of \$4.99 per pound of salmon. Two and a half ounces provide 900 mg omega-3.	\$ 0.80
Canned tuna provides an average of 0.36 g of omega-3 fatty acids per 3-ounce serving, at a cost of \$1.29 for a 6 ounce can. Seven and a half ounces provide 900 mg omega-3.	\$ 1.61
Dietary supplements, fish oil capsules, provide 300 mg omega-3 fatty acids per capsule, at a cost of \$8.33 per 100 capsules. Three capsules provide 900 mg omega-3.	\$ 0.25

Bottom Line

In summary, an abundance of scientific evidence suggests that most American diets are very low in omega-3 fatty acids, and that increasing intakes could potentially reduce the risk of cardiovascular disease. Eating more fish is an excellent way to increase the consumption of omega-3 fatty acids. Another way is to use a dietary supplement providing these critical nutrients.

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