



Functional Foods Fact Sheet: Omega-3 Fatty Acids

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Background

Interest in omega-3 fatty acids can be traced to observational studies of Greenland Inuits conducted in the late 1970s. The low occurrence of coronary heart disease (CHD) in this Eskimo population was attributed to their traditional diet of marine animals and fish.¹ Such food sources are rich in omega-3 fatty acids called eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).² Other population studies have also shown that cultures with high fish consumption, such as the Alaskans and the Japanese, have similarly low rates of CHD mortality.³⁻⁴

Omega-3 fatty acids are probably known best for their heart health benefits.⁵⁻⁹ However, a growing body of research suggests that omega-3 fatty acids may provide benefits beyond reducing the risk of cardiovascular disease, such as lowering the risk of developing certain cancers, neurological disorders, and complications from metabolic syndrome and diabetes.¹⁰⁻¹⁵ Improved bone health among older adults;¹⁶ healthy pregnancy outcomes; and good visual acuity and cognitive development among infants have also been observed in some studies.¹⁶⁻²¹

Understanding the role of omega-3 fatty acids in health begins with knowledge of the chemical make-up of certain fatty acids. Omega-3 fatty acids are long-chain polyunsaturated fatty acids (LC-PUFAs) that include alpha-linolenic acid (ALA), EPA, and DHA.²² The human body cannot synthesize ALA, making it an "essential fatty acid" because it needs to be obtained from dietary sources.² ALA can be converted by the body into EPA and DHA, but the amounts are not significant (less than five percent).²³ LC-PUFAs comprise about 20 percent of the brain's dry weight and are critical for healthy brain development and function.²⁴ A deficiency of omega-3 fatty acids may result in neurological abnormalities and growth retardation.²²

Omega-6 fatty acids comprise another class of LC-PUFAs. Major food sources of each type of LC-PUFA are provided in Table 1.

Long-chain PUFAs	Name	Abbr.	Structure	Food Source#
Omega-3	alpha-linolenic acid	ALA	18:3n-3	Walnuts, flaxseed oil, soybean, and canola oil
	eicosapentaenoic acid	EPA	20:5n-3	Fatty fish* and fish oils
	docosahexaenoic acid	DHA	22:6n-3	Fatty fish* and fish oils and algal oils
Omega-6	linoleic acid	LA	18:2n-6	Corn, safflower, soybean, cottonseed, and sunflower oils
	gamma-linolenic acid	GLA	18:3n-6	Evening primrose oil, borage oil, and black current seed oil
	arachidonic acid	ARA	20:4n-6	Meat, poultry, and eggs

Not a representation of all sources.
* Examples of fatty fish include herring, salmon, mackerel, and tuna.

Omega-3 Fatty Acids in the Diet and Innovations in the Food Supply

ALA is the most prominent omega-3 fatty acid in the human diet.² It is found primarily in vegetable oils and plant products such as nuts, seeds, legumes, grains and fruits.^{2,22} The highest sources of EPA and DHA come from fish, fish oils and algal oils.^{2,25-26}

New food and beverage products with added omega-3 fatty acids have emerged in the marketplace because of the mounting evidence of the overall health benefits associated with omega-3 fatty acids.^{2,27-29} The US Food and Drug Administration (FDA) has allowed a number of fish and algal oils to be generally recognized as safe (GRAS) for food fortification.³⁰ Algal oil is useful for those concerned with fish consumption and those who do not include fish in their diet, such as some vegetarians.² Examples of foods being fortified with omega-3 fatty acids include milk-based products, juices, table spreads, salad dressings, sauces, breakfast cereals, baked goods, sauces, infant formulas, baby foods and juices, among others.^{27, 29} Omega-3 fatty acids in the form of dietary supplements are also available.

Additional strategies for increasing the omega-3 fatty acid content of some foods include bio-delivery and biotechnology. Biodelivery involves adding omega-3 fatty acids to animal feed so that their tissues become enriched. Some examples of foods that have been enriched with omega-3 fatty acids in this manner include eggs, beef, and pork products.² Biotechnology involves cultivating varieties of plants containing greater levels of ALA or fatty acids closer to EPA and DHA.³¹ However, these plant varieties are currently in development and have not yet been introduced into the marketplace.

Health Effects of Omega-3 Fatty Acids

The cardiovascular benefits from omega-3 fatty acid consumption have been attributed to their anti-inflammatory and anti-clotting effects, as documented in several prospective studies and randomized clinical trials.⁵⁻⁹ Moderate fish consumption and fish oil supplementation raised blood levels of DHA and slowed down the progression of abnormal thickening of artery walls due to fatty deposits (a condition that restricts blood flow to the heart, called atherosclerosis).⁵⁻⁶ A lower incidence of irregular heartbeats was another protective effect attributed to omega-3 fatty acids.⁷⁻⁹ Among patients with diabetes and metabolic syndrome—conditions that increase the risk for developing cardiovascular disease—omega-3 fatty acid consumption helped lower blood levels of triglycerides and cholesterol.¹⁴⁻¹⁵

Other additional health benefits may be derived from consuming omega-3 fatty acids, such as the lowered incidence of depression and other related conditions. Cross-sectional and community studies have shown that high intakes of fish are associated with lower prevalence of depression.¹²⁻¹³ Iceland, where fish consumption averages about 225 lbs of fish per year per person, has a lower prevalence of seasonal affective disorder compared with countries where fish is consumed less often (about 50-70 lbs/year/person).¹² Current research supports the theory that omega-3 fatty acid supplementation may be useful as an adjunct to current antidepressant therapy or alone, but further studies are needed to determine which source is best and at what dose.¹³

Omega-3 fatty acids are also shown to be beneficial at various stages of the lifecycle. Among women, high fish intakes resulted in lower prevalence of postpartum depression as well as higher levels of DHA in breast milk.¹³ It has been proposed that additional DHA from supplements during pregnancy and lactation may improve an infant's cognitive and visual development.¹⁸⁻²¹ Various infant formulas contain DHA along with arachidonic acid (ARA) to more closely mimic breast milk, and infants fed with DHA-supplemented formulas had some improvement in visual acuity.¹⁹

Emerging evidence also suggests that a higher level of omega-3 fatty acid consumption may be associated with reducing the risk of bone loss, certain cancers and neurological disorders such as Alzheimer's disease (DHA is the most abundant fatty acid in the gray matter of the brain).^{10-11,16-17}

Recommendations for Omega-3 Fatty Acid Intake

The Institute of Medicine (IOM) recommends an adequate intake (AI) level of ALA at 1.6 grams/day and 1.1 grams/day for men and women (excluding those who are pregnant and lactating), respectively.²² Since there is not enough evidence yet to determine specific requirements for omega-3 fatty acids, this AI is based on the highest median intakes of healthy US populations. EPA and DHA can contribute up to 10 percent of the AI for ALA. Some domestic and international health organizations and government bodies have developed standards for the combined consumption of EPA and DHA (See Table 2).

The American Heart Association (AHA) recommends the consumption of two servings (about 8 ounces) of fish, especially oily fish, a week.²⁵ Note that nearly all fish contain trace amounts of mercury. While most people's fish consumption poses no health concern, certain groups in the population—pregnant/lactating women and children—are advised to consume fish that are lower in mercury. The FDA and Environmental Protection Agency recommend that women who may become pregnant, pregnant women, nursing mothers, and young children consume up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish.³²

More detailed information about mercury's effects and consumption advice are available on FoodInsight.org and the FDA Web site.

Supplements may also be considered under medical supervision; individuals with high blood triglycerides may consider up to 2-4 grams of EPA and DHA per day provided as capsules.²⁵ The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP-III) notes that high amounts of omega-3 fatty acids from foods or fish oil supplements may reduce the risk of coronary events, but the panel also states the need for more definitive clinical trials are needed before they can recommend relatively high intakes (1-2 grams/day) of omega-3 fatty acids for either primary or secondary prevention.³³

Scientists continue to delve deeper into the health effects of the different types of fatty acids. Ongoing study of optimal amounts of polyunsaturated fats in the diet has led to questioning whether a balance of omega-6 and omega-3 fatty acids is necessary for maximizing the benefits of these fats.³⁴⁻³⁶ However, there is limited data to support that lowering intake of omega-6 fatty acids, reduces risk for CHD.³⁴ Rather than the ratio, the more important issue to focus on may be to ensure an adequate intake of omega-3 fatty acids to maintain cardiovascular health.³⁴⁻³⁶

Table 2. Guidelines for EPA and DHA Intake by Different Organizations

Organization	Recommendation
American Heart Association	0.5-1.0 g/day
British Nutrition Foundation Task Force	1.0-1.5 g/day
UK Department of Health	0.2 g/day
World Health Organization	0.7 g/day
Institutes of Medicine Dietary Reference Intakes	0.11-0.16 g/day

*Note: Ranges tend to vary based on the existing body of scientific evidence at the time the recommendations were made and the target population.

The Bottom Line

Omega-3 fatty acids may have beneficial effects on heart health and potentially other disease conditions such as cancer, diabetes, and neurological disorders. People at special stages in the lifecycle, such as pregnant/lactating women, infants, and children, may also benefit from consuming omega-3 fatty acids in adequate amounts. The current food supply offers a wide variety of sources for dietary ALA, EPA, and DHA. Sustained innovations and a growing body of scientific evidence to support dietary recommendations for omega-3 fatty acids may help the public achieve optimal health.

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