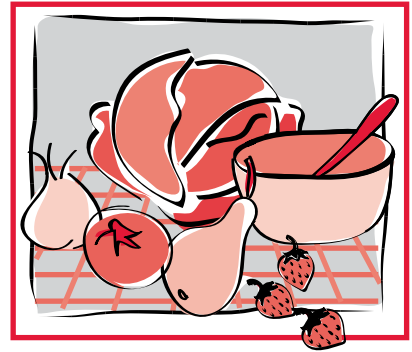


Omega-3 Fatty Acids

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by L. Bellows, J. Clifford, K. Niebaum, and M. Bunning (6/2015)

What are Omega-3 Fatty Acids?

Omega-3 fatty acids are components of fats in foods we eat. The term omega and number three refer to the chemical structure of the fatty acid.

There are three main omega-3 fatty acids:

1. Alpha-linolenic acid (ALA) is the most common omega-3 fatty acid in the western diet. It comes from plants, and is found in vegetable oils, primarily flaxseed, walnut, canola and soybean oils. ALA is a dietary essential fatty acid; we must eat it because our bodies require ALA but cannot make it and use it to form the functionally essential omega-3 fatty acids, EPA and DHA. Although the American diet contains the recommended amount of ALA, it is not well converted to EPA and DHA. Therefore, preformed EPA and DHA are required for optimal health in most people, especially during periods of rapid growth and development such as pregnancy and in the first year of life.

2. Eicosapentaenoic acid (EPA) and 3. docosahexaenoic acid (DHA) are known as the “long-chain” or marine omega-3 fatty acids since they are mainly found in fish and fish oils. EPA and DHA have the most potent health benefits of the omega-3 fatty acids. Unfortunately, they are especially low in the American diet, and since conversion of ALA to EPA and DHA is poor, increasing intake of EPA and DHA has the potential to significantly improve health.

What are the benefits of including omega-3 fatty acids in your diet?

Strong evidence for heart health

The biggest benefits from including omega-3 fatty acids in your diet relate to heart disease. Omega-3s protect the heart

by decreasing arrhythmias, blood clot formation, blood triglycerides, growth rate of atherosclerotic build-up, blood pressure and inflammation, not to mention they may improve the function of artery cells. The 2010 U.S. Dietary Guidelines Advisory Committee concluded moderate evidence shows that consumption of two servings of seafood per week (4 oz per serving), which provide an average of 250 mg per day of long-chain n-3 fatty acids, is associated with reduced cardiac mortality from coronary heart disease or sudden death in persons with and without heart disease.

Primary prevention of coronary heart disease

For healthy adults without prior heart disease, omega-3 fatty acids (EPA + DHA) may reduce the risk of death from cardiac events. ALA also appears to have a protective effect for the heart. Higher ALA intake is associated with a reduced risk of heart disease, especially in populations with low levels of fish consumption.

Secondary prevention of coronary heart disease

For adults with established coronary heart disease who have a high risk of subsequent cardiovascular events, omega-3 fatty acids (EPA + DHA) may reduce the risk non-fatal heart attacks, non-fatal strokes and death from cardiovascular disease. The strongest evidence relates to the prevention of sudden cardiac death (due to arrhythmias), which claims approximately 500,000 lives per year in the United States. Omega-3 fatty acids stabilize the heart’s rhythm and prevent potentially fatal, erratic rhythms.

Lowering blood triglycerides.

It is well established that omega-3 fatty acids from fish lower blood triglycerides. Triglycerides (TG) are fats in your blood; their presence in blood is normal.

Quick Facts

- The three main omega-3 fatty acids are: alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).
- ALA comes from plants. EPA and DHA come from fish. DHA may be available in certain fortified foods (eggs, milk).
- The most potent health benefits come from EPA + DHA (a combination of EPA and DHA). Evidence is compelling for heart health and infant brain development. Emerging research suggests benefits for many other conditions including perinatal depression and protection against dementia in the elderly.
- Consuming 1-2 servings of fish per week (4 ounces/serving), supplementing with fish oil and choosing fortified foods are the best ways to add EPA + DHA to your diet.

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High levels (TG \geq 150 mg/dL), however, may be a risk factor for heart disease, especially in combination with high LDL (bad) cholesterol or low HDL (good) cholesterol. EPA and DHA lower triglycerides in your blood by decreasing your body's ability to make triglycerides.

High levels (TG \geq 150-499 mg/dL) call for diet and lifestyle modifications, including eating two servings of oily (dark meat) fish per week. Very high triglycerides (TG \geq 500 mg/dL) require an amount of fish oil that is difficult to achieve with diet, and supplementation is needed. A dose of 2-4 grams of EPA + DHA per day given as capsules may lower very high triglycerides by 20 percent to 50 percent. Triglycerides can come down significantly as well as quickly. All treatment should be provided under medical supervision.

Hypertension.

Hypertension is the diagnosis of high blood pressure (blood pressure 140/90 mmHg); it is an independent risk factor for heart disease. Studies show that a high level of supplementation with EPA + DHA (4-6 g/day) slightly reduces blood pressure. Since dietary and lifestyle modifications as well as medications are effective at lowering blood pressure, omega-3 supplementation may have a limited role in managing hypertension.

DHA and Maternal/ Infant Nutrition and Infant Development

DHA is important for the structure, growth and development of the fetal central nervous system and retina. Comprising roughly 30 percent of the fetal brain's weight, DHA is a major part of fetal neural tissue, and it maintains good

Table 1. Dietary Recommendations

Omega-3 fatty acid	AND (Academy for Nutrition and Dietetics)	AHA (American Heart Association)
ALA (g/2000 cal)	1.3 - 2.7 g	-
EPA + DHA (mg/day)	500 mg	2 fish servings*/week (equals about 500 mg/day)

*A serving is considered 4 ounces.

Table 2. Recommendations for Populations: AHA Scientific Statement*

Population	AHA Recommendation
People without documented heart disease	Eat a variety of fish (preferably oil) 2x/week, include oils and foods rich in ALA
People with documented heart disease	Consume ~1 g EPA + DHA per day, preferably from fish; use supplements with physician supervision
People who need to lower triglycerides	Table 2-4 g EPA + DHA per day provided as a capsule under physician supervision

*Kris-Etherton, Harris, Appel, Circulation, 2002;106:2747-2757.

neurotransmitter function. DHA is also a major fatty acid in the retina.

Infants acquire DHA from their mothers. It accrues rapidly in the brain during the third trimester and the first six weeks of life. DHA naturally occurs in human milk, and omega-3 supplementation during pregnancy and lactation increases levels of DHA in breast milk as well as the infants. Since FDA approval in 2001, infant formula is supplemented with DHA to support optimal brain and eye development.

The significance of DHA for brain and eye development is widely recognized, and evidence has emerged to demonstrate that DHA supplementation during pregnancy, lactation or infancy improves mental and visual development in infants.

Emerging research suggests that DHA supplementation reduces the risk for early premature birth.

The Institute of Medicine (IOM) recommends a daily intake of 1.4 g/day of alpha-linolenic acid during pregnancy and lactation but currently there is not a Recommended Dietary Intake for EPA or DHA. However, the European Perilip Group of clinicians and experts in omega-3 research, currently recommend at least 200

mg of DHA per day during pregnancy and lactation.

Emerging Research for Many Other Health Benefits

Emerging research indicates that the benefits of omega-3 fatty acids may extend well beyond heart health and maternal/infant health. Omega-3 fatty acids may be of benefit in conditions ranging from rheumatoid arthritis and lupus, from major depression and bipolar disorder to crohn's disease and ulcerative colitis, from Alzheimer's disease and schizophrenia to eczema and cancer. A few notable and promising areas are highlighted below.

DHA and Alzheimer's Disease.

Alzheimer's disease is the most common cause of dementia in elderly adults. Research suggests that lower DHA levels are a risk factor for Alzheimer's, possibly because DHA may inhibit the progression of the disease. It is unknown, however, if DHA supplementation can help treat the disease in humans. On-going clinical trials are investigating the effect of DHA supplementation on the genesis and progression of Alzheimer's.

Rheumatoid Arthritis.

Rheumatoid arthritis is a chronic disease that involves inflammation of the joints. Studies have demonstrated

Table 3. What are the best sources of omega-3 fatty acids?

Oils, Nuts, Seeds and Other*					
Content of ALA in commonly consumed oils, nuts, and other foods					
Oil	ALA (g/Tbsp)	Nuts	ALA (g/oz)	Seeds	ALA (gTbsp)
Flaxseed	7.2	Walnuts	2.5	Flaxseeds	2.4
Walnut	1.4	Pecans	0.3	Pumpkin Seeds	0
Canola	1.3	Peanuts	0	Sunflower Seeds	0
Soybean	0.9	Pistachios	0		
Corn	0.2	Almonds	0		
Olive	0.1	Cashews	0	Other	
Sunflower	0	Hazelnuts	0	Tufu (1/2 cup)	0.4-0.7
		Pine Nuts	0	Soybeans (1/2 cup)	0.5

Table 4. Fish

Content of EPA + DHA in 37 commonly consumed types of fish*			
Fish	mg/3 oz serving	Fish	mg/3 oz serving
Atlantic Salmon (farmed)	1825	Blue Crab	403
Pacific Herring	1807	Halibut	395
Atlantic Herring	1712	Oysters (farmed)	374
Atlantic Salmon (wild)	1564	King Crab	351
Bluefin Tuna	1279	Walleye	338
Pink Salmon (wild)	1094	Dungeness Crab	335
Coho Salmon (farmed)	1087	Scallops	310
Sockeye Salmon (wild)	1046	Skipjack Tuna	278
Mackerel (canned)	1046	Mixed Shrimp	267
Chum Salmon (canned)	999	Clams	241
Rainbow Trout (farmed)	981	Yellowfin Tuna	237
Coho Salmon (wild)	900	Light Chunk Tuna	230
Sardines	835	Catfish (wild)	201
White Tuna	733	Catfish (farmed)	151
Shark (raw)	711	Cod	134
Swordfish	696	Mahi-Mahi	118
Sea Bass	648	Tilapia	115
Pollock	460	Orange Roughy	26
Flat Fish	426		

*Harris et al., 2008. Curr Atheroscler Rep. 10:503-509

Table 5. Common Fortified Foods and Omega-3 Content

Fortified food and serving size	Total omega-3 fatty acids (mg)	ALA (mg)	EPA (mg)	DHA (mg)
Milk (8 oz)	32			32
Orange Juice (8 oz)	50		30	20
DHA Egg (1 egg)	100-150	48	2	100-150
Yogurt (4 oz)	16-32			16-32
Smart Balance Spread	352	320	32 (EPA + DHA)	

that fish oil supplementation decreases the number of painful/tender joints, pain intensity, duration of morning stiffness and even the need for anti-inflammatory medication. Due to weaknesses in the current research, however, better studies are needed to confirm these benefits.

Fortified Foods

Many foods in the marketplace are being fortified with omega-3 fatty acids. Keep in mind the following:

- What kind of omega-3 fatty acids have been added to the food is important. You are interested in alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA) and docosapentaenoic acid (DHA). Since omega-3 fatty acid source and content varies by brand, make sure to read labels carefully or contact the manufacturer.
- How much ALA, EPA and/or DHA is in the food is also significant. Look at the label to determine exactly how many milligrams you are getting per serving. Know the serving size portion. Fortified foods frequently have surprisingly small quantities of omega-3 fatty acids.
- Consider whether any additional cost is worth the kind and amount of fortification.
- Your goal should be to meet the dietary recommendations of ALA, EPA and DHA. Often the best way to do this is to eat the foods that are naturally high in these omega-3 fatty acids, such as fatty fish.

Fish Oil Supplementation

Similar to fortified foods, it is important to read the label to understand how many milligrams of EPA and DHA are in each capsule.

Another useful measure of the quality of the supplement is the concentration of omega-3s in each capsule. A concentration of <50% is low; you may not be getting a good value for your money and consuming unneeded additional calories. A concentration ≥ 50% is better. Determining the concentration is best illustrated by example:

- In a typical fish oil supplement, the serving size is 1 - 2 softgels.

- If two softgels contain 780 mg EPA and 400 mg DHA, then each softgel contains 390 mg EPA and 200 mg DHA, for a total of 590 mg omega-3s per capsule.
- The front of the supplement indicates that each capsule is 1000 mg; 410 mg of other fats have been added to 590 mg omega-3s to make a 1000 mg softgel. Therefore, the concentration of omega-3s in each capsule = $(590 \text{ mg}/1000 \text{ mg}) \times 100 = 59\%$.

For vegetarians, EPA and DHA supplements made from algae are available. Many of these softgels are gelatin capsules, but several true vegan brands are available (check the label). They tend to be more expensive than other brands of DHA and/or fish oil.

Safety

Concerns exist about environmental toxins, including mercury, polychlorinated biphenyls (PCBs) and dioxins, that may contaminate seafood. Fish and shellfish are an important part of a healthy diet. They contain high-quality protein, essential nutrients, and are low in saturated fats and high in omega-3 fatty acids. It is recognized that nearly all fish and shellfish contain mercury. While the low levels are not a concern for the majority of healthy people, there are a few species of fish that contain higher levels that may harm an unborn baby or young child's nervous system. Therefore, the EPA and FDA advises women who may become pregnant, pregnant women, nursing mothers and young children to do the following:

- Avoid eating shark, swordfish, king mackerel and tilefish (also known as golden bass or golden snapper) since they contain high levels of mercury.
- Limit albacore ("white") tuna to 6 ounces per week; albacore has more mercury than canned chunk light tuna.
- Eat up to 12 ounces a week of various fish and shellfish that are lower in mercury, such as shrimp, canned light tuna, salmon, pollock and catfish.

- Check local advisories about the safety of recreationally caught fish for environmental contaminants, such as PCBs and dioxins, which occur in polluted waterways. Removing skin and surface fat (especially back fat) before cooking seafood will minimize the exposure to these contaminants. Information on advisories can be found at www.epa.gov/fishadvisories/.

Fish oil supplements are typically purified and free of harmful levels of mercury, PCBs and dioxins. Cod liver oil is not the best supplement for pregnant mothers due to high levels of vitamin A.

Overall, the benefits of eating fish and shellfish have been shown to far outweigh potential risks. Consumers can safely eat cooked seafood regularly, provided they eat a variety and follow local advice for recreationally-caught fish.

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