

# OMEGA 3 AND OMEGA 6 FATTY ACIDS SOURCES AND HEALTH BENEFITS - A LITERATURE REVIEW

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**Abstract:** Omega-3 fatty acids are polyunsaturated fatty acids. The fish-derived omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are helpful in development, cardiovascular function, and Alzheimer's disease. However, because our bodies do not efficiently produce some omega-3 fatty acids from marine sources, it is necessary to obtain adequate amounts through fish and fish-oil products. EPA and DHA, when deficient may affect many aspects of cardiovascular function including inflammation, peripheral artery disease, major coronary artery disease.

**Keywords:** Omega-3 fatty acids, Omega-6 fatty acids, Polyunsaturated Fatty Acids [PUFA], alpha linolenic acid [ALA], eicosapentaenoic acid [EPA], and docosahexaenoic acid, cardiovascular disease, essential fatty acids.

## Introduction:

Omega-3(n-3) and Omega-6(n-6), belong to the family of essential fatty acids. These fatty acids have to be obtained from the diet as they cannot be synthesised in the body. Normal functioning of the body requires both Omega-3 and Omega-6 fatty acids. They are called polyunsaturated fatty acids [PUFA] because they are not saturated with hydrogen atoms and contain more than a double bond between their atoms. They are mostly of plant and fish origin. These essential fatty acids when taken in adequate amounts results in numerous health benefits. They are of three types alpha linolenic acid [ALA], eicosapentaenoic acid [EPA], and docosahexaenoic acid. They play an important role in maintaining the metabolism of the body. Additionally they also have industrial uses also.

Other commonly used names for omega-3 fatty acids

- n-3 fatty acids
- fish oil
- eicosapentanoic acid (EPA)
- docosahexanoic acid (DHA) [1,2,3,4,5,6]

## Sources of 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 [7].

### **1.) Alpha-linolenic acid (ALA):**

It is present most commonly in the western diet. It can be obtained from plants, and is also found in vegetable oils, primarily flaxseed, walnut, canola and soybean oils. . ALA is a dietary essential fatty acid; it's essential for our body because our bodies require ALA but cannot make it and use it to form the functionally essential omega-3 fatty acids, EPA and DHA.[1]. 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.[7]

### **2.) Eicosapentaenoic acid (EPA) and, 3.) Docosahexaenoic acid (DHA):**

These 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. Increasing intake of EPA and DHA has the potential to significantly improve health.[8]Types of fishes that are rich in Omega-3 fatty acids: Anchovies, Herring, Mackerel, Salmon Albacore tuna, sablefish, sardines Bluefin tuna, trout Halibut, swordfish Fresh water bass, oysters Sea bass Shrimp, Pollock. [9]



### **Sources of Omega-6 fatty acids:**

Omega-6 fatty acids are consumed in the diet from vegetable oils as linoleic acid (LA). Linoleic acid is converted in the body to the long-chain polyunsaturated fatty acids gamma-linolenic acid (GLA) and arachidonic acid (AA). AA can also be consumed directly from meat, and GLA can be ingested from several plant-based oils.[1,10,11].

Omega-6 fats are found in leafy vegetables, seeds, nuts, grains, and vegetable oils (corn, safflower, soybean, cottonseed, sesame, sunflower). Other omega-6 fatty acids, such as gamma-linolenic acid (GLA), can be found in more rare oils, including black currant, borage, evening primrose, and hemp oils. Most diets provide adequate amounts of omega-6 fatty acids.[11].



### **Health benefits of Omega-3 fatty acids and Omega-6 fatty acids:**

A sufficient intake of polyunsaturated fatty acids (omega-3 and omega-6 fatty acids) is important as they play an important role in

- development and maintenance of proper brain function
- the vision process
- immune and inflammatory responses
- production of hormone-like molecules.

### **Disease prevention:**

#### **Impaired neural and visual development:**

-Since the last trimester of pregnancy is the critical period in which DHA gets accumulated in the brain and retina, preterm infants are at a higher risk of suffering from insufficiency of DHA during neural and visual development.

- Although preterm infants can synthesise ALA and DHA, they can't synthesise high levels of ALA and DHA that are lost in plasma and cellular levels without external dietary intake. [6,13]

### **Pregnancy and breast-feeding:**

As the mother is the sole source of omega-3 fatty acids (e.g., docosahexaenoic acid, DHA) for the fetus and exclusively breast-fed infant, a sufficient intake during pregnancy and breast-feeding is thought to be essential to meet the infant's requirements.[14].

Results of studies assessing effects of long-chain polyunsaturated fatty acids (PUFA) on pregnancy duration as well as the physical and mental development of children born to supplemented mothers were mixed. Although some results are promising, more studies are needed to determine potential beneficial effects of PUFA .[1,15].

**Heart disease:**

Studies have shown that higher intake levels of long-chain omega-3 fatty acids (eicosapentaenoic acid, EPA, and docosahexaenoic acid, DHA) will aid in lowering the risk factors for heart disease, most importantly high blood pressure ('hypertension') and high blood triglyceride levels. Studies of heart attack victims have found that supplementing the diet with omega-3 fatty acids daily can reduce the risk of stroke, follow-on heart attacks, and death. [1,20,21]

**Cancer:**

The balance between omega-3 and omega-6 fatty acids appears to play an important role in the development and growth of some cancer forms, such as breast, colon, and prostate cancer. While further research is still needed to understand the effect that omega-3 fatty acids may have on cancer prevention or treatment, researchers speculate that omega-3 fatty acids in combination with other nutrients (e.g. vitamin C, vitamin E, beta-carotene, and coenzyme Q10) may be of particular value in the prevention and treatment of breast cancer.

Some studies have shown slowing or reversing in the progression of colon cancer with daily consumption of long-chain omega-3 fatty acids (eicosapentaenoic acid, EPA, and docosahexaenoic acid, DHA).

One animal study has shown that in rats with spreading colon cancer, omega-3 fatty acids (specifically the omega-3 fatty acid alpha-linolenic acid, ALA) in fact promoted the growth of cancer cells in the liver. The reason for this is not clear and needs further investigation. [1,22].

Both population studies as well as clinical studies suggest that omega-3 fatty acids may inhibit the growth of prostate cancer. While in one study, the omega-3 fatty acid alpha-linolenic acid (ALA) has been seen in higher levels in individuals with prostate cancer, suggesting ALA may have a cancer-promoting role, more recent studies that were specifically designed to look for prostate cancer risk factors in humans and a systematic review found no such link. [1,23,24]

**Age-related eye disease:**

A clinical study comparing people with age-related macular degeneration, a serious eye condition that can progress to blindness, to individuals without the eye disease found that those with a healthy dietary balance of omega-3 and omega-6 fatty acids and higher intake of fish in their diets were less likely to have this particular eye disorder.

Another larger clinical study confirms that consuming long-chain omega-3 fatty acids (eicosapentaenoic acid, EPA, and docosahexaenoic acid, DHA) from fish four or more times per week may reduce the risk of developing macular degeneration. Notably, however, this same study suggests that omega-3 fatty acid alpha-linolenic acid (ALA) may actually increase the risk of this eye condition; the reason for this is not clear. [1,25].

**Alzheimer's disease:**

An insufficient intake of long-chain omega-3 fatty acids (docosahexaenoic acid, DHA) may be a risk factor for Alzheimer's disease and other types of dementia, but it is not yet known whether DHA supplementation can help prevent or treat such cognitive disorders. [1,26].

**Heart disease:**

There is some evidence that omega-3 fatty acids may treat and even prevent atherosclerosis by inhibiting the development of plaque and blood clots which can clog arteries. [1,27]

**Diabetes:**

Individuals with diabetes tend to have high blood fat (triglyceride) levels. Studies have shown that omega-3 fatty acids from fish oil can help to lower triglycerides, so people with diabetes may benefit from eating foods or taking supplements that contain long-chain omega-3 fatty acids (eicosapentaenoic acid, EPA, and docosahexaenoic acid, DHA).

The omega-3 fatty acid alpha-linolenic acid (ALA) may not have the same benefit as DHA and EPA because some people with diabetes lack the ability to efficiently convert ALA to a form of omega-3 fatty acids that the body can use readily. There have been slight increases reported in fasting blood sugar levels in patients with type 2 diabetes while taking high doses of fish oil supplements. [1,28].

**Inflammatory diseases:**

Several studies investigating the use of omega-3 fatty acid supplements for inflammatory joint conditions (e.g., rheumatoid arthritis) concluded that the supplements reduce tenderness in joints, decrease morning stiffness, and allow for a reduction in the amount of medication needed for people with rheumatoid arthritis. In addition, some studies suggest that diets rich in omega-3 fatty acids (and low in the inflammatory omega-6 fatty acids) may benefit people with other inflammatory disorders, such as Crohn's disease and asthma. [1,29].

**Mental disorders:**

Omega-3 fatty acids are important components of nerve cell membranes; they help nerve cells communicate with each other, which is an essential step in maintaining good mental health. In particular, the long-chain omega-3 fatty acid docosahexaenoic acid (DHA) is involved in a variety of nerve cell processes. Levels of omega-3 fatty acids were found to be measurably low and the ratio of omega-6 to omega-3 fatty acids were particularly high in a clinical study of patients hospitalized for depression. In a clinical study of individuals with depression, those who ate a healthy diet consisting of fatty fish 2-3 times per week for 5 years experienced a significant reduction in feelings of depression.

Children with attention deficit/hyperactivity disorder (ADHD) may have low levels of certain essential fatty acids (including EPA and DHA) in their bodies[26]. A clinical study using omega-3 and omega-6 fatty acid supplementation in children with ADHD found improvements in reading, spelling, and behavior in the children. [24]. More studies, including comparisons with drug therapies, are needed to evaluate these results.

Clinical studies suggest that men and women with the eating disorder anorexia nervosa have lower than optimal levels of polyunsaturated fatty acids (including omega-3 fatty acid alpha-linolenic acid, ALA, and long-chain omega-6 fatty acid gamma-linolenic acid, GLA.)To prevent the complications associated with essential fatty acid deficiencies, some experts recommend that treatment programs for anorexia nervosa include polyunsaturated fatty acid-rich foods such as fish and organ meats. [1,30].

### **Osteoporosis:**

Studies suggest that long-chain omega-3 fatty acid eicosapentaenoic acid (EPA) may help increase calcium levels in the body, deposit calcium in the bones, and improve bone strength. In a study of women over 65 with osteoporosis, those given EPA and long-chain omega-6 fatty acid gamma-linolenic acid (GLA) supplements experienced significantly less bone loss over a three-year period than those who were given a placebo. [1,31].

### **Weight loss:**

Clinical studies suggest that overweight people who follow a weight loss program that includes exercise tend to achieve better control over their blood sugar and cholesterol levels when fish rich in omega-3 fatty acids (such as salmon, mackerel, and herring) is a staple in their low-fat diet.[31].

### **Other disorders:**

While further research is needed, some evidence suggests that omega-3 fatty acids may also prove helpful in protecting against some infections and treating a variety of additional conditions including emphysema, glaucoma, menstrual pain, migraine headaches, multiple sclerosis, lupus, Lyme disease, panic attacks, preeclampsia, preterm delivery, psoriasis, stress, and ulcers. [32].

### **Intake quantities:**

European health authorities have established intake recommendations for polyunsaturated fatty acids for adults:

- an omega-3 fatty acid intake of 2 g/day alpha-linolenic acid (ALA) and 250 mg/day long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)
- an omega-6 fatty acid intake of 10 g/day linoleic acid (LA). Scientists have suggested a minimum daily intake of 500 mg EPA and DHA combined for healthy individuals.

Adequate intakes for adults have been set at  
 1.6 g omega-3 fatty acids (ALA) per day for men,  
 1.1 g/day for women respectively, And,  
 17 g omega-6 fatty acids (LA) per day for men (19–50 years of age),  
 12 g/day for women (19–50 years of age) respectively.

The American Heart Association recommends eating fish (particularly fatty fish such as mackerel, lake trout, herring, sardines, albacore tuna, and salmon) at least twice a week. It is advised that pregnant women and mothers, nursing mothers, young children, and women who might become pregnant not eat several types of fish, including swordfish, shark, and king mackerel, which have higher levels of contaminants (e.g., mercury). They are advised to consume polyunsaturated fatty acid supplements. It is important to maintain an appropriate balance of omega-3 and omega-6 in the diet, as these two substances work together to promote health. Omega-3 fatty acids, for example, help reduce inflammation, and most omega-6 fatty acids tend to promote inflammation.

An inappropriate balance of these essential fatty acids contributes to the development of disease whereas a proper balance helps maintain and even improve health. A healthy diet should consist of roughly 2–4 times more omega-6 fatty acids than omega-3 fatty acids. [6]. The typical diet in developed countries ('Western diet') tends to contain 14–25 times more omega-6 fatty acids than omega-3 fatty acids, and many researchers believe this imbalance is a significant factor in the rising rate of inflammatory disorders.[10]. In contrast, the 'Mediterranean diet' consists of a healthier balance between omega-3 and omega-6 fatty acids, and many studies have shown that people who follow this diet are less likely to develop heart disease. [1,32,33].



Adequate intake (AI) for omega-6 fatty acids:

Life Stage	Age	Source	Males: (g/day)	Females: (g/day)
Infants	0–6 months	Omega-6 PUFA*	4.4	4.4
Infants	7–12 months	Omega-6 PUFA*	4.6	4.6
Children	1–3 years	LA	7	7
Children	4–8 years	LA	10	10
Children	9–13 years	LA	12	10
Adolescents	14–18 years	LA	16	11
Adults	19-50 years	LA	17	12
Adults	≥ 51 years	LA	14	11
Pregnancy	All ages	LA	-	13
Lactation	All ages	LA	-	13

\*The various omega-6 polyunsaturated fatty acids (PUFA) present in human milk can contribute to the AI for infants.  
Key: LA = linoleic acid

Adequate intake (AI) for omega-3 fatty acids:

Life Stage	Age	Source	Males: (g/day)	Females: (g/day)
Infants	0–6 months	ALA, EPA, DHA*	0.5	0.5
Infants	7–12 months	ALA, EPA, DHA*	0.5	0.5
Children	1–3 years	ALA	0.7	0.7
Children	4–8 years	ALA	0.9	0.9
Children	9–13 years	ALA	1.2	1.0
Adolescents	14–18 years	ALA	1.6	1.1
Adults	≥ 19 years	ALA	1.6	1.1
Pregnancy	All ages	ALA	-	1.4
Lactation	All ages	ALA	-	1.3

\*All omega-3 polyunsaturated fatty acids present in human milk can contribute to the AI for infants.  
Key: ALA = alpha-linolenic acid; EPA = eicosapentaenoic acid; DHA = docosahexaenoic acid.

**Deficiency of essential fatty acids:**

Essential fatty acid deficiency has been found to occur in patients with a chronic poor absorption of fat from food, some patients nourished intravenously, and in patients with cystic fibrosis.

Because the last three months of pregnancy are a critical period for the accumulation of the omega-3 fatty acid docosahexaenoic acid (DHA) in the brain and retina, preterm infants are thought to be particularly vulnerable to adverse effects of insufficient DHA.

Therefore, it has been proposed that preterm infant formulas be supplemented with enough DHA to bring blood and cellular DHA levels of formula-fed infants up to those of breast-fed infants.

Symptoms of omega-3 fatty acid deficiency include extreme tiredness (fatigue), poor memory, dry skin, heart problems, mood swings or depression, and poor circulation. Infants who do not get enough omega-3 fatty acids from their mothers during pregnancy are at risk of developing vision and nerve problems. [33].



The child on the left side of the picture is suffering from deficiency of essential fatty acids.

The deficiency of essential fatty acids also leads to phrynoderma or toad skin, characterised by the presence of horny eruptions on the posterior and the lateral parts of the limbs, on the back and the buttocks, other symptoms include loss of hair and poor wound healing

The picture shows horny eruptions on the surface of the knee.



**Conclusion:**

Adequate intake of essential fatty acids can promote cardiovascular health, ensuring the proper growth and development of children, or relieving pain. A vegetarian can obtain these essential fatty acids rich from fruits, vegetables, nuts, seeds, and legumes. Non vegetarians and people who eat mixed diets can add fish to their daily food. Apart from diet Fish oil supplements also can be take. Omega-3 and Omega- 6 fatty acids have various health benefits ranging from mental growth of a person till prevention of cardiovascular diseases. Omega fatty acids are an important component of the body if they are deficient Alzheimers disease will occur. Omega fatty acids help in curing inflammatory joint diseases, mental disorders, prevents osteoporosis and aids in weight loss.

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