

Fish Oil's Beneficial Effects to Human Health: A Review

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ABSTRACT

Since our body cannot de novo synthesise fatty acids, they be consumed by diet. Fish oil is a major source of essential fatty acids, Omega 3 (ω -3) and Omega 6 (ω -6). This fatty acid prevents major heart diseases, cancer, diabetes, mental disorders, arthritis, and many other health problems. Fish oil therefore contributes a large number of beneficial effects to us. It must be used according to the recommended dosage. Consumption of 1.0g of fish oil per day will help the human being fight coronary heart disease. Fish oil supplements have many advantages over the direct consumption of fish.

KEY WORDS: FISH OIL, CORONARY HEART DISEASE, POLYUNSATURATED FATTY ACIDS (PUFA), EICOSAPENTAENOIC ACID (EPA), DOCOSAHEXAENOIC ACID (DHA).

INTRODUCTION

Fatty acids are aliphatic single-carboxylic acids derived in animal or vegetable fat (oil or wax) or contained in esterified form. One type of fatty acid is Essential Fatty Acids (EFA). In our body, they cannot be de novo synthesised. Because our body lacks the enzymes needed to make certain fatty acids, they must be obtained from plant or animal sources through a diet. However, as they are involved in important biological processes, they are very important to us. The essential fatty acids, ω -6 EFAs and ω -3 EFAs, are polyunsaturated and grouped into two families. For instance, the body can convert one ω -3 to another ω -6, but cannot create a ω -3 from ω -6 or saturated fats. Essential fatty acids are so called because we can't survive without them. From the tissues of oily fish, fish oil is derived. For a healthy diet, it is recommended because it contains ω -3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid

(DHA), precursors to eicosanoids that reduce inflammation throughout the body, as reported by Sargent (1997). For optimum health benefit, cellular metabolism and normal physiological functions, fish oils must be added in minute quantities (Sau and Paul, 2004).

In the early 1970s, when Danish doctors observed that, despite consuming a high-fat diet, Greenland Eskimos had an exceptionally low incidence of heart disease and arthritis, scientists learned about many advantages of fish oils. Intensive research soon found that EPA and DHA, two of the fats they consumed in large quantities, were actually extremely beneficial. There are numerous beneficial effects of fish oil on the human body. Atherosclerosis, angina, heart attack, congestive heart failure, arrhythmias, stroke and vascular peripheral disease are prevented. Clinical studies have shown that many disorders, including rheumatoid arthritis, diabetes, cancer, etc., are also effective in treating (Connor and William, 2000). It is observed that due to imbalance of intake of ω -3 and ω -6 fatty acids a number of serious diseases occur. So by changing dietary habits by taking fish oil these problems can be avoided.

Omega-3 Fatty Acids (ω -3): EPA and DHA are important two ω -3 fatty acids. They have vital biochemical functions. EPA is converted into biochemical intermediates that are anti-inflammatory. DHA can be produced from EPA and is the most abundant ω -3 fatty acid in most tissues,

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present in the brain and retina in large amounts. For brain development and function, central nervous system growth, and optimum visual acuity, DHA is required. In a series of enzymatic steps, alpha-linolenic acid (ALA) is converted to EPA and DHA (Steffens and Wirth, 1997).

Omega-6 Fatty Acids (ω -6): Although sometimes ω -6 fatty acids are seen as pro-inflammatory mediators, the physiological effect depends on the type and amount of omega-6 fatty acid consumed. With cardioprotective benefits, linoleic acid is an essential fatty acid. In adipose tissue, the linoleic acid content was found to be inversely associated with the risk of cardiovascular disease; the greater the linoleic acid content, the lower the risk of cardiovascular disease. Through enzymatic steps, linoleic acid converts to arachidonic acid, which is the major omega-6 fatty acid.

Ratio of ω -3 and ω -6 fatty acids: A dietary equilibrium between the two fatty acids must exist. In inhibiting inflammatory responses, the ratio of ω -3 to ω -6 fatty acids appears to be critical. Depending on enzyme activity, the body has the capacity to convert ω -3 fatty acids into anti-inflammatory mediators. Because ω -6 fatty acids require the same enzymes for their prostaglandin and thromboxane equivalents to be converted. Sargent (1997) reported that the fatty acid ratio of ω -3: ω -6 should be 5:1. Nevertheless, diets with a ratio of about 1:1-6 were consumed by early ancestors with a ratio of about 1:1-3. (Simopons, 1991).

Bio chemistry of PUFA: The mechanism of action of fish oil reflects the action of these EFAs, since fish oil contains ω -3 and ω -6 fatty acid types. Both must be obtained by diet, because vertebrates do not synthesise them de novo. Major physiological and developmental processes can be supported by both types. Eicosanoids can be formed, such as prostaglandins, leukotrienes, lipoxins, etc. It is possible to esterify these ω -3 and ω -6 fatty acids. A variety of highly unsaturated fatty acids can be metabolically elongated and desaturated and hydrolyzed from tissue glycerolipids and (Hazra et al., 2003). The conversion slowly occurs. A competition exists between alpha linolenic and linoleic acids. High-level linoleic acids inhibit the conversion of alpha linolenic to its long-chain derivatives. These fatty acids with a longer chain are very important. Because they are eicosanoid precursors. Eicosanoids are capable of influencing platelet aggregation, blood pressure, blood clotting, inflammation, etc. In cases of inflammation, platelet aggregation, eicosanoids from ω -3 fatty acids are less potent than ω -6 fatty acids. As a component of the cell membrane, ω -3 and ω -6 fatty acids compete with each other for incorporation into it. Since there is a competition between the two fatty acid families, their intake must be properly balanced.

Advantages of consumption of fish oil over whole fish:

- Fish oil supplements have numerous advantages over directly consuming fish. Fish oil can be consumed directly by eating fish or by drinking fish oil, often

in the form of supplements such as tablets, capsules, pills, soft gels, etc. Some of the fish oil benefits are listed here:

- Regular consumption of fish oil can lead to a decrease in the body's antioxidants such as vitamin E. As they contain added vitamin E in them, certain fish oil supplements help us to address this problem.
- Sometimes in severe cases, when a large dose of fish oil is required for treatment and when we try to eat fish oil by eating fish, we have to eat a lot of fish. Fish oil supplements offer us this convenience because they contain a concentrated form of fatty acid.
- Supplements with fish oil are very handy. We just have to open the jar, pick a tablet and gulp it if we want to consume fish oil on a daily basis. Cooking fish, on the other hand, becomes quite troublesome every day.
- What's more, we need to know the exact dosage of fish oil.

Positive Effects of Fish Oil:

A. Cardiovascular disease: It is well established that populations with high oily fish consumption have a lower incidence of heart disease, and several studies have confirmed that the protective components are EPA and DHA fish oils. Omega-3s are effective in reducing the incidence of heart disease (CVD). Therefore, fish oil, which is abundant in ω -3 fatty acids, reduces the risk of heart diseases and arrhythmias of the heart. It helps to maintain the elasticity of the artery walls, to prevent blood clotting, to lower blood pressure, to stabilise the rhythm of the heart and to help fight inflammation. It lowers the levels of bad cholesterol, which is LDL cholesterol, and raises the levels of good cholesterol, which is HDL. Fish oil prevents triglyceride accumulation and reduces the levels of excess triglycerides further. Silver carp arachidonic acid has a significant effect on blood pressure, serum lipid function, and platelet function (Wirth et.al., 1992).

Fish oil can therefore be used to prevent atherosclerosis in patients with coronary artery disease, and it can also be effective in the treatment of heart strokes and the regular use of fish oil can help prevent numerous sudden cardiac deaths. To maintain a healthy heart, an adequate daily intake (about 1 gramme) of EPA and DHA is vital. Fish oil is believed to have the ability to enhance blood circulation along with reducing levels of triglycerides and serum cholesterol. Patients with haemodialysis have an exceptionally high incidence of death due to cardiovascular problems. It is due to lipid and platelet abnormalities. Eskimos have a low incidence of myocardial infarction and a high dietary intake of fish rich in ω -3 polyunsaturated fatty acids (Rylance, 1986). Thus, fish oil prevents myocardial infarction as well. The risk of stroke and heart attack is increased by atherosclerosis, because part of the plaque on the inner wall of the arteries can dislodge and block the heart's smaller arteries and thus cut off the vital oxygenated blood supply.

Strokes are caused by a blood clot or a blood vessel that has burst. Consumption of fish and fish oils was first associated with a decreased risk of cardiovascular disease nearly 50 years ago. A number of epidemiological studies have since evaluated whether their intake is specifically linked to stroke. In general ecological/cross-sectional and case-control studies have shown an inverse association between fish and fish oil consumption and stroke risk (Skerrett and Hennekens, 2003). The anti arrhythmic effects of fish oils help prevent blood clotting. Supplementation with fish oil will enhance the stability of plaque and thus help prevent heart attack and stroke. So the consumption of fish oil helps protect against stroke.

B. Brain development: One of the largest consumers' of DHA is the human brain. 15 to 20 percent of the cerebral cortex and 30 to 60 percent of the retina are made up of DHA. So it is absolutely necessary for the foetus and baby to develop normally. An adequate intake of DHA and EPA is vital during pregnancy and lactation. During this time, the mother must provide DHA and EPA for all the baby's needs. This is because it can not synthesise these essential fatty acids on its own. There is some evidence that the risk of premature birth and abnormally low birth weight may be increased by insufficient intake of ω -3 fatty acids. Experts recommend that during pregnancy and lactation, females get at least 500-600 mg of DHA every day.

The easiest way is to get a good supplement of fish oil every day. More than 20 grammes of DHA is contained in a normal adult human brain. Low levels of DHA have been associated with low levels of serotonin in the brain, which is again associated with an increased tendency to depression, suicide, and violence. A high intake of fish has been associated with a significant decrease in age-related memory loss and impairment of cognitive function and a lower risk of Alzheimer's disease (Kalmijn et al., 1997). A recent study found that patients with Alzheimer's who received an omega-3-rich supplement had a substantial improvement in their quality of life.

C. Diabetes: Fish oil has been associated with glucose reduction and the level of insulin is controlled by it. People with type II diabetes often have high triglyceride levels in the blood and are therefore susceptible to coronary heart disease (McManus, et al., 1996). Fish oils are known to be effective in reducing levels of triglycerides, but concern has been expressed that they may also increase levels of low-density lipoprotein (LDL) and is harmful to the control of glucose. Type 1 diabetes is an illness that occurs frequently during childhood. In this high-risk group of children, ω -3 fatty acids could safely prevent the development of type 1 diabetes.

D. Immunity: Fish oil has the potential to improve humans' immune system. Regular fish oil consumption increases our immunity. It therefore helps to withstand the incidence of common diseases such as cold, cough and flu. Fish oil is also beneficial to patients suffering from lupus, which is a disease characterised by the

attacks of the body's immune system on different organs and tissues. ω -3 fatty acids present in fish oil benefit the immune system by affecting cytokines and eicosanoids present in our body. Fish oil helps to reduce the pain and swelling of the joints, eyes, kidneys, heart, blood vessels, lungs, nerves, etc. It also helps to reduce the fever, skin rashes and fatigue that are associated.

E. Prevent Cancer: Cancer has now become the most dangerous illness. A huge number of people die each year from different types of cancers, such as kidney, colon, pancreas, etc. Several in vitro and animal experiments have clearly shown that the main components of fish oil, the long chain ω -3 polyunsaturated fatty acids (PUFAs), EPA and DHA, help inhibit cancer promotion and progression. In hormone-dependent cancers such as breast and prostate cancer, their beneficial impact is particularly pronounced. The steps that follow are how cancer is prevented:

1. They suppress arachidonic acid's synthesis of proinflammatory eicosanoids and thus produce an overall anti-inflammatory effect.
2. They have a positive effect on the expression of genes or on the activities of signal transduction molecules involved in cell growth control, apoptosis differentiation, angiogenesis and metastasis.
3. During chronic inflammation, they suppress excessive production of nitrogen oxide (NO) and thus help avoid DNA damage and impaired DNA repair.
4. They reduce the production of oestrogen and thus decrease the oestrogen- stimulated growth of hormone-dependent cancer cells.
5. Fish oils improve the sensitivity of insulin and cell membrane fluidity and, through these effects, may help prevent metastasis.

Other studies have shown that a daily intake of EPA + DHA in excess of 2.3 grammes reduces the production of a potent cancer promoter, superoxide. In addition to fish oil, the risk of colon cancer is reduced by lowering the level of COX-2 enzymes, which leads to colon cancer over-expression. In order to improve the quality of life and survival of patients with end-stage cancer, chemotherapy and other conventional medical treatments have proven ineffective. Greek medical scientists now report that supplementation with fish oil significantly increases the survival time of cancer patients with generalised malignancy. In cancer patients with end-stage metastatic disease, supplementation with dietary ω -3 polyunsaturated fatty acids, particularly fish oils containing antioxidants such as vitamin E, may provide significant palliative support.

F. Inflammation: Fish oil has anti-inflammatory properties; it is therefore, effective in reducing blood and tissue inflammation. For those suffering from chronic inflammatory diseases, regular consumption of supplements, tablets, pills and capsules of fish oil is helpful. In the treatment of gastrointestinal disorders, sprue, short bowel syndrome and inflammatory bowel disease (IBD), including Crohn's Disease and ulcerative colitis, which are typical intestinal disorders, fish oil is

effective. The absorption of vitamins, fats and essential supplements is difficult for patients suffering from Crohn's disease. For such patients, fish oil supplements are an effective diet. In the case of ulcerative colitis, fish oil prevents leukotriene from accumulating in the colon. It should be noted that fish oil's anti-inflammatory properties are restricted to reducing inflammation. Fish oil has little influence on the prevention of inflammation. In addition to other dietary supplements and drugs, research is also being conducted to enhance the anti-inflammatory action of fish oil.

G. Arthritis: In the treatment of arthritis, rheumatism, Raynaud's symptoms and similar conditions, fish oil is useful (Sales et al., 2008). In the case of osteoarthritis, fish oil can help reduce the impact of cartilage-depleting enzymes. The production of inflammatory eicosanoids is suppressed by ω -3 fatty acid. So they are in a position to reduce pain.

H. Mental disorder: Phospholipids, sphingolipids, gangliosides, and cholesterol are found in the brain. These are involved in the brain's structure and function of cell membranes. A high proportion of polyunsaturated fatty acids contain glycerophospholipids in the brain (PUFA). It is derived from alpha-linolenic acid and linoleic acid. Docosahexaenoic acid (DHA), alpha-linolenic acid, arachidonic acid and docosatetraenoic acid are the main PUFA in the brain. DHA is derived from ω -3 fatty acids. Experimental animal studies have shown that diets lacking ω -3 PUFA lead to significant neural function disruptions (Sinclair et al., 2007). The inclusion of ω -3 PUFA in the diet can restore this neural dysfunction. There has been an emerging interest in the treatment of omega-3 PUFA for neuropsychological disorders (depression and schizophrenia) over the past 10 years. Fish oil is good for relieving depression, sadness, anxiety, restlessness, mental fatigue, stress, decreased sexual desire, suicidal tendencies and other nervous disorders because of the presence of ω -3 fatty acids. In the treatment of Alzheimer's disease, fatty acids are effective. It helps with Alzheimer's disease, since fish oil is one of the best sources of essential fatty acids, including EPA and DHA.

I. Asthma: Asthma involves airway inflammation (pharynx, larynx and lungs). Epidemiological studies have shown that there is a lower incidence of inflammatory diseases such as asthma in populations with a high intake of fish oil. In the Western world, asthma is an increasingly common affliction. Between 20 and 25 per cent of all children are estimated to suffer from one or more asthma symptoms at some point. In many patients, dietary intake of polyunsaturated fatty acids (PUFAs) may be effective in reducing the symptoms of asthma. A viable asthma therapy may be dietary supplementation with fish oils or other enriched sources of ω -3 PUFAs.

J. Eye Disorder: Fish oil is well known to be good for its ability to enhance vision. Macular degeneration is one of the most prevalent degenerative eye diseases. It also

assists in preventing macular degeneration associated with age. When it comes to continued eye health, as a person ages, DHA in fish oil may be the most significant nutrient. A major component of the retina is ω -3 fatty acids. As it accounts for 60% of the fatty acids in the retina, DHA is very important.

K. Pregnancy: Fish oil is very useful for pregnant women as it helps the development of the baby's eyes and brain with DHA present in it. It helps to prevent premature births, low birth weight, and miscarriages. Women who do not have a sufficient intake of EPA and DHA in their diet are also believed to suffer from depression after birth as some amount of brain mass is transferred from the mother to the child in the last stages of pregnancy. Low birth weight can be avoided if the right amount of fish oil is consumed at the time of pregnancy. There is some evidence that a lack of ω -3 fatty acid intake may increase the risk of premature birth and low birth weight.

Fish oil and Vitamin: Fish oil is a rich source of vitamin A and vitamin D, especially one obtained from the liver such as cod liver oil. Excessive dosage of such oils, however can lead to hypervitaminosis, the accumulation of excessive vitamins in the body that can cause side effects. Interrelationship between fish oil and vitamin E:

- The moment it is removed from the fish, fish oil is highly susceptible to oxidation and will go rancid very quickly if preventive measures are not taken. The number of free radicals roaming around in the body can increase by taking an inferior fish oil that has started to become rancid, counteracting any health benefits from the fish oil itself. Good fish oil must contain a strong fat-soluble antioxidant such as tocopherol (vitamin E) to protect the oil from becoming rancid, to protect it and keep it fresh both within the capsule and in the body (Sau et al., 2004 and Paul et al., 2004).
- The excessive dosage of fish oil in the human body leads to a decrease in vitamin E. It is necessary to supplement this loss of vitamin E with external vitamin E supplements.
- In the treatment of many cancers and cardiac diseases, the combination of fish oil and vitamin E may have added to the benefits of being used separately.

Source and requirement: Although the use of fish oil supplements provides the body with many health benefits, the wrong dosage can also have harmful effects. For patients with coronary heart disease, the American Heart Association recommends the consumption of 1g of fish oil daily, preferably when eating fish. The optimal dosage has to do with body weight. In the human diet, nearly all the polyunsaturated fat is from EFA. The fatty acids ω -3 and ω -6 are obtained from alpha linolenic acids. Fish oil and various oily fish are the richest source of very long-chain ω -3 fatty acids. Mackerel, rainbow trout, lake trout, halibut, herring, sea bass etc are the various types of fish which can be a good source of fish

oil. In addition to this, many cyprinid species, such as silver carp, grass carp and common carp, have higher levels of essential fatty acids, especially ω -3 PUFA (Steffens and Wirth, 1997). The summary requirement is given below for fatty acids.

Population	Recommendation
Patients with Coronary heart disease	They should eat 1 g per day of EPA+DHA, preferably from oily fish. In consultation with the physician, EPA+DHA supplements could be considered.
Patients needing triglyceride lowering	Under the advice of a physician, two to four grammes of EPA+DHA per day are given as capsules.

CONCLUSION

There are a number of beneficial effects that fish oil has. Fish oil is an excellent and usually uncontaminated source of EPA and DHA that is used by the body to make ω -3 fatty acids "calming" and to keep the brain and heart healthy. The positive effect on cardiovascular health of ω -3 fatty acids is most consistently linked to the use of fish oil. In individuals with known cardiovascular diseases, fish and fish oil supplements should be recognised as a potential treatment choice. Eating a modest amount of fish oil ensures that EPA and DHA are directly supplied. In conclusion, we must say that the consumption of 1.0 g of fish oil every day will help human beings to fight coronary heart disease. Generally, fish oil supplements are safe. But it is very crucial that fish oil is processed and packaged. A balance between the intake of ω -3 and

ω -6 fatty acids must be achieved. We can conclude that fish oil provides us with a healthy life. To maximise therapy and extract the maximum benefit from fish oil, health professionals need to educate people about the benefits, side effects, and dosage, duration, and drug-drug interactions.

REFERENCES

- Connor, W.E. and Willion (2000) *Am.J.Clin.Nutr.* 71:171-175
- Hazra, A.K. et al (2003) *Sci Culture.* 69:326-329
- Kalmijn S. et al, (1997) *Am.J.Epidemiol.*, 145:33-41
- McManus Ruth M. et al (1996) *Diabetes Care.*, 19: 463-467
- Mori, T.A. et al (1997), *Arterioscler Thromb Vasc Biol.*, 17: 279-286
- Paul, B.N. et al (2004) *Aquaculture.*, 242:529-536
- Rylance, P.B. (1986) *Nephron.*, 43:196-202
- Sales, C. et al (2008) *Reumatismo.*, 60:174-179
- Sargent, J.R. (1997) *British J. Nutr.*, 78: Suppl.1, S5-S13
- Sau, S.K. et al (2004) *Aquaculture.*, 240:359- 368
- Sau, S.K. and Paul, B.N. (2004) *Fishing Chimes.*, 24:28-30
- Skerrett, P.J. and Hennekens C.H. (2003) *Prev Cardiol.*, 6:38-41
- Simopolons, A.P. (1991) *J.Clin.Nutr.* 54:438-463
- Sinclair, A.J. et al (2007) *Asia.Pac.J.Clin.Nutr.*, 16:391-397
- Steffens, W. and Wirth, M. (1997) *Asian Fisheries Sci.*, 10:83-90
- Wirth, M. et al (1992) *Sym.on Omega-3 Fatty Acids: Metabolism and Biological Effects*, 15-19th Sept. 1992. Oslo Abst.158.