



Salahaddin university-Erbil

The Role Of Omega-3 Fatty Acids In Heart Health

Submitted to the department (chemistry) in partial of the
requirements for the degree BSC in (chemistry)

By:

Sara Sabr Muhammad shkur

Supervised:

Ass. Prof. Lutfia Mohammad Hassan

April - 2023

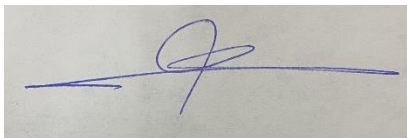
Supervisor recommendation

I am the student's supervisor, Ass. Prof. Lutfia Mohammad Hassan I support that the student has completed all the requirements for submitting the research drawn entitled -----The role of omega-3 fatty acids in heart health ----- according to the numbered administrative order 3/1/5/1972 on 9th oct. 2022 in accordance with the instructions of Salahaddin university quality assurance and it is ready for discussion.

Supervisor

Ass. Prof. Lutfia Mohammad Hassan

4/5/2023



Research project lecturer
Dr. Dler D. Kurda

Abstract

Cardiovascular disease is one of the main causes of death in developed countries. Several factors are involved in its appearance and progress, among which nutrition enjoys a certain protagonism. Until recently, the dietetic criteria for preventing and controlling cardiovascular disease were mainly restrictive (at least in terms of energy and fat intake), but such advice is difficult to follow, and without careful monitoring can lead to deficiencies that might negatively affect quality of life and perhaps even life expectancy. Several investigations show that some components of the lipid fraction of the diet, such as omega-3 fatty acids, are beneficial with respect to cardiovascular disease, and these have become the centre of much attention. This paper reviews the results of some of these studies and evaluates the benefit of these fatty acids in the prevention of coronary heart disease. The sources of omega-3 fatty acids, their recommended consumption, possible mechanisms of action and potential adverse effects are discussed.

Content

Introduction	4
History	5
Classification	5,6
Type of omega-3	6
Structure	7
Metabolism	8
Biological activity	10
Vision	11
Nervouse system	11
Sourse of omega-3	12
Are you getting enough omega-3	16
Omega-3 difficiency	17
Heart	21
Beneficial effect of omega-3	22
How do omega-3 fatty acid effaect on health	24
Improve risk facture	26
Discuttion	28
Refrence	29

1. Introduction

Omega-3 PUFA are important structural components of cell membranes. When incorporated into phospholipids, they affect cell membrane properties, such as fluidity, flexibility, and the activity of membrane. In addition to endogenous metabolism, dietary consumption of fatty acids can modify the composition and molecular structure of cellular membranes. Thus, increasing omega-3 fatty acid intake increases the omega-3 content of red blood cells, immune cells, atherosclerotic plaques, cardiac tissue, and other cell types throughout the body. Lifestyle intervention such as consistent aerobic exercise and a diet high in fruits and vegetables promotes cardiovascular health. A heart-healthy lifestyle decreases the risk of coronary heart disease and heart attack. Although it may seem intuitive that dietary fat is bad for the heart and that it must be avoided, certain unsaturated fats are heart healthy, and other saturated fats are not good for the heart. These heart-healthy unsaturated fats are known as omega-3 fatty acids. The 3 main omega-3 fatty acids that are beneficial for cardiovascular health are α -linoleic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is primarily found in plant-based foods such as olive, soybean, canola, walnut, and flaxseed oils, and in walnuts and flaxseeds, as well. EPA and DHA are primarily found in marine-based foods that include the variety of fatty fish, such as tuna, salmon, mackerel, herring, trout, halibut, and cod. This Cardiology Patient Page will present the beneficial effects of omega-3 fatty acids on cardiovascular health, explain the possible mechanisms for these effects, and offer recommendations that can be implemented into a healthy lifestyle to further promote good cardiovascular health (Nagy and Tiuca, 2017)

1.1 History

The discovery of polyunsaturated fatty acids' (PUFA) essentiality for human health opened the 20th century and has now outlasted it. The late biochemist Ralph Holman was among the great scientific bridges between the first generation of “vitamin F” researchers and the present generation of professionals in the science and technology of the “omegas.”.

The first evidence that fish oil fatty acids might have a beneficial effect on coronary heart disease came from the discovery that Greenland Eskimos, who have a diet high in n-3 fatty acids, have a lower mortality from coronary heart disease than do Danes and Americans. Long-chain polyunsaturated fatty acids are essential in our diets and can be classified in 2 groups: n-6 fatty acids found in plant seeds and n-3 fatty acids found in marine vertebrates. Further evidence of n-3 benefits to human health include a 1989 study demonstrating a 29% reduction in fatal cardiac arrhythmias among subjects with a recent myocardial infarction who had been advised to consume fish oil (Leaf, 2008)

1.2 Classification:

- Saturated fatty acid Saturated fatty acids (SFAs) are made up of a carbon chain with no double bonds. Because fatty acids are cell-membrane structural units, this saturated configuration contributes to

decreased cell-membrane fluidity. SFAs are not essential nutrients. They are mainly obtained through dietary intake of animal fats.

or

- unsaturated fatty acid : Unsaturated fatty acids have one more carbon-carbon double bonds The term unsaturated indicates that fewer than the maximum possible number of hydrogen atoms are bonded to each carbon in the molecule.

Unsaturated fatty acid:

Unsaturated fatty acids are fatty acids that contain one or more double/triple carbon-carbon bonds in the carbon chain. On this basis this class of lipids can be divided into:

Unsaturated fatty acids are a component of the phospholipids in cell membranes and help maintain membrane fluidity. Phospholipids contain a variety of unsaturated fatty acids, but not all of these can be synthesized in the body (Dhull et al., 2020)

1.3 Type of omega-3

The three main omega-3 fatty acids are alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is found mainly in plant oils such as flaxseed, soybean, and canola oils. DHA and EPA are found in fish and other seafood.

Omega-3 fatty acids are one of the "good" types of fat. They may help lower the risk of heart disease, depression, dementia, and arthritis.

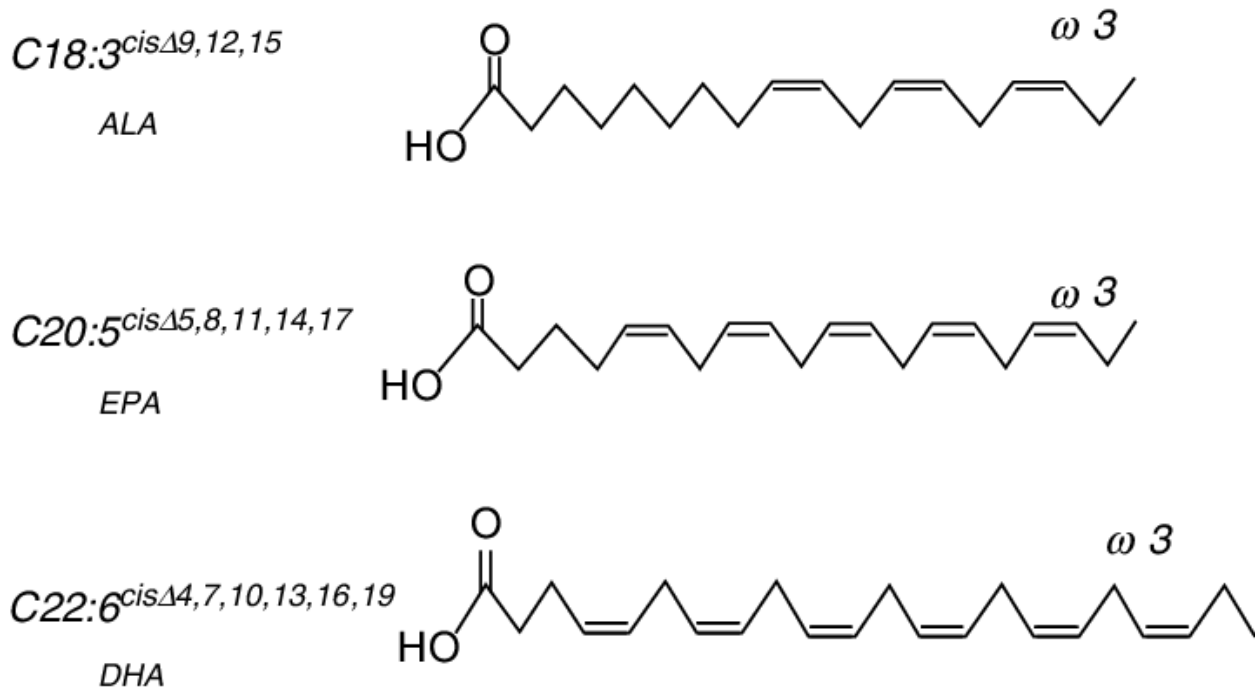
- monounsaturated fatty acids (MUFAs), if only one double bond is present;
- polyunsaturated fatty acids (PUFAs), if at least two double bonds are present;
- acetylenic fatty acids, if one or more triple bonds are present.

Omega-3 is polyunsaturated fatty acid (Dhull et al., 2020)

1.4 Structure

“Omega-3 refers to the position of the final double bond in the chemical structure, which is three carbon atoms from the “omega,” or tail end of the molecular chain. Since the human body can't produce omega-3s, these fats are referred to as “essential fats,” meaning that you have to get them from your diet.

Generally, a fatty acid consists of a straight chain of an even number of carbon atoms, with hydrogen atoms along the length of the chain and at one end of the chain and a carboxyl group (—COOH) at the other end. It is that carboxyl group that makes it an acid (carboxylic acid) (Kanicky and Shah, 2002)



The role of omega-3 in human body

What makes omega-3 fats special? They are an integral part of cell membranes throughout the body and affect the function of the cell receptors in these membranes. They provide the starting point for making hormones that regulate blood clotting, contraction and relaxation of artery walls, and inflammation

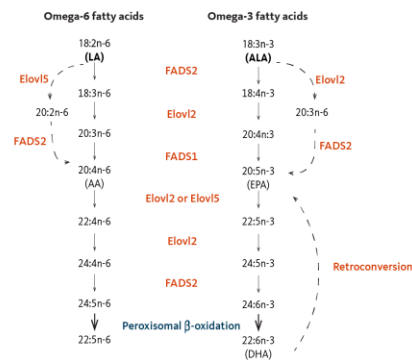
1.5 Metabolism and Bioavailability:

omega-3 PUFA is important structural components of cell membranes. When incorporated into phospholipids, they affect cell membrane properties, such as fluidity, flexibility, permeability, and the activity of membrane-bound enzymes and cell-signaling pathways. In addition to endogenous metabolism, dietary consumption of fatty acids can modify the composition and molecular structure of cellular membranes. Thus, increasing omega-3 fatty acid intake increases the omega-3 content of red blood cells, immune cells , atherosclerotic plaques cardiac tissue , and other cell types throughout the body.

Omega-6 and omega-3 PUFA are important structural components of cell membranes. When incorporated into phospholipids, they affect cell membrane properties, such as fluidity, flexibility, permeability, and the activity of membrane-bound enzymes and cell-signaling pathways . In addition to endogenous metabolism, dietary consumption of fatty acids can modify the composition and molecular structure of cellular membranes. Thus, increasing omega-3 fatty acid intake increases the omega-3 content of red blood cells, immune cells , atherosclerotic plaques, cardiac tissue , and other cell types throughout the body acid (EPA), and docosahexaenoic acid (DHA).

Finally, DHA can be retro-converted to EPA and DPA at a low basal rate and following supplementation . After supplementing omnivores (n=8) and vegetarians (n=12) for six weeks with an EPA-free preparation of DHA (1.62 g/day), EPA, DPA, and DHA concentrations increased in serum and platelet phospholipid. Based on the measured changes, the estimated percent retro conversion of DHA to EPA was 7.4%-11.4% (based on serum phospholipid data) and 12.3%-13.8% (based on platelet phospholipid data), with no significant difference between omnivores and vegetarians. Due to this nontrivial retro conversion efficiency, DHA supplementation may represent an alternative to fish oil to increase blood and tissue concentrations of EPA, DPA, and DHA (Ibarguren et al., 2014)

Figure 3. Desaturation and Elongation of Essential Fatty Acids



Humans can synthesize longer omega-6 and omega-3 fatty acids from the essential fatty acids LA and ALA through a series of desaturation (addition of a double bond) and elongation (addition of two carbon atoms) reactions that occur in microsomes. Delta-6 desaturase (FADS2) is considered the rate-limiting enzyme in this metabolic pathway. Retroconversion of DHA to EPA in peroxisomes occurs at low basal rates and following DHA supplementation (4, 5). FADS2, delta-6 desaturase; FADS1, delta-5 desaturase; Elov12, Elov15, elongases.

1.6 Biological Activities:

Membrane structure and function

omega-3 PUFA is important structural components of cell membranes. When incorporated into phospholipids, they affect cell membrane properties, such as fluidity, flexibility, permeability, and the activity of membrane-bound enzymes and cell-signaling pathways . In addition to endogenous metabolism, dietary consumption of fatty acids can modify the composition and molecular structure of cellular membranes. Thus, increasing omega-3 fatty acid intake increases the omega-3 content of red blood cells, immune cells , atherosclerotic plaques , cardiac tissue , and other cell types throughout the body.DHA is selectively incorporated into retinal cell membranes and postsynaptic neuronal cell membranes, suggesting it plays important roles in vision and nervous system function. In fact, DHA represents the predominant PUFA in the retina and neuronal cells (Ofosu et al., 2023)

1.7 Vision:

DHA is found at very high concentrations in the cell membranes of the retina; the retina conserves and recycles DHA even when omega-3 fatty acid intake is low . Animal studies indicate that DHA is required for the normal development and function of the retina. Moreover, these studies suggest that there is a critical period during retinal development when inadequate DHA will result in permanent abnormalities in retinal function. Research indicates that DHA plays an important role in the regeneration of the visual pigment rhodopsin, which plays a critical role in the visual transduction system that converts light hitting the retina to visual images in the brain (Niemoller et al., 2009)

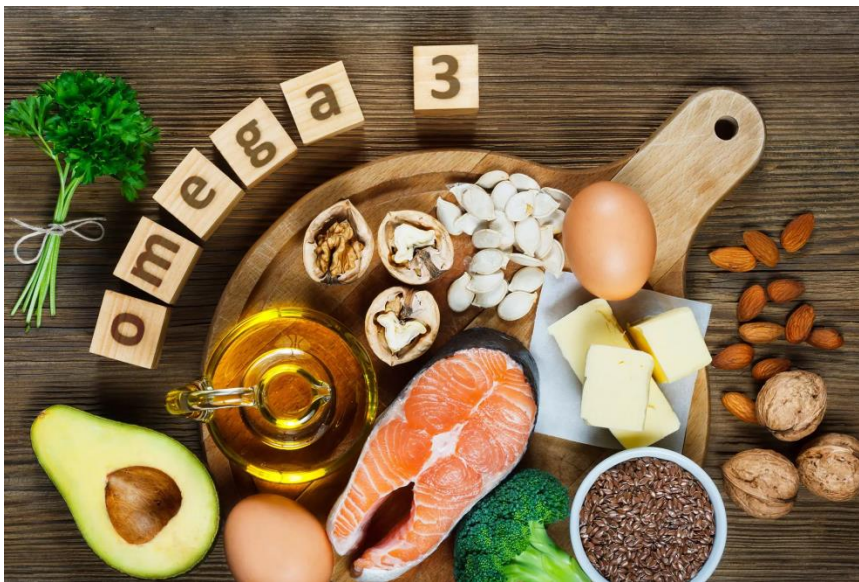
1.8 Nervous system:

The phospholipids of the brain's gray matter contain high proportions of long-chain PUFA, suggesting they are important to central nervous system function . AA stimulates glucose uptake by cortical astrocytes, meaning that it is important for energy metabolism . AA and DHA also increase the release of acetylcholine, which enhances synaptic plasticity and memory, thereby improving learning abilities . Although trials of PUFA supplementation during pregnancy and/or early infancy failed to show cognitive improvements in offspring (see Disease Prevention), the availability of omega-3 fatty acids to the fetus and infants is essential for the growth of their brain and development of brain functions. There is compelling evidence to suggest that PUFA are essential to neuronal growth and synapse formation, and for appropriate neurotransmission (Niemoller et al., 2009)

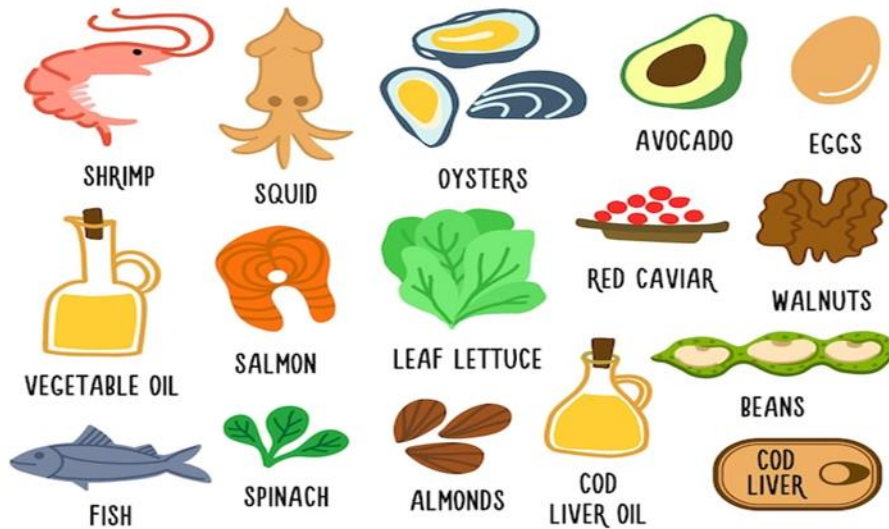
1.9 Source of omega 3 fatty acids from our diet

There is a particularly substantial dose of Omega 3 in seafood, with many of the most beneficial foods being oily fish such as mackerel, salmon, and herring. But really, any sea-based food will have a decent quantity, from

algae to the best Russian caviar. Although much of the evidence is anecdotal, there are famously low rates of dementia in Mediterranean communities where much of the local diet is based around fish. It's not just seafood, though. Nuts and legumes also offer high levels of Omega 3, particularly flax seeds, chia seeds, and walnuts. Although it is most plentiful in fish, there is no reason anyone should go without, regardless of your dietary preferences or restrictions.



FOODS HIGH IN OMEGA-3



-Eggs: All eggs contain some omega-3 fats from the chickens' natural feed, roughly 25 mgs each of DHA and ALA. Given that the studies about omega-3 benefits suggest the consumption of 500 to 1000 mg DHA and EPA combined, the amount in eggs is inconsequential. To increase the content the chickens are fed flaxseed.

-sharimp: Shrimp is also a good source of omega-3 fatty acids -salmon:Fatty fish contain the most omega-3 fatty acids and seem to be the most beneficial to heart health. Good omega-3-rich fish options include: Salmon. Sardine.

-spinach: Spinach contains 1.7 milligrams of omega-3 fatty acids per gram – more than mustard greens, red leaf lettuce and butter crunch lettuce, according to a Biological Research study. It also has 5 grams of protein per cooked cup, making it a smart lunchtime, or anytime, choice. -vegetable oil: Alpha-linolenic acid (ALA), the most common omega-3 fatty acid in most Western diets, is found in vegetable oils and nuts (especially walnuts), flax seeds and flaxseed oil, leafy vegetables, and some animal fat, especially in grass-fed animals.

-walnut: Walnuts are significantly higher in omega-3 fat than any other nut, Walnuts are loaded with healthy fats and ALA omega-3 fatty acids. In fact, walnuts are composed of about 65% fat by weight More research is still

needed in this area since animal studies cannot be applied to humans. Just one serving of walnuts can fulfill an entire day's requirements of omega-3 fatty acids, with a single ounce (28 grams) providing 2,570 mg (). Add walnuts to your homemade granola or cereal, sprinkle them on top of yogurt, or simply snack on a handful to increase your ALA intake. -red caviar: Caviar is the eggs, or roe, harvested from certain sturgeon fish. Besides being a delicacy, it's highly nutritious, providing great amounts of omega-3 fatty acids, vitamin B12, and selenium, among other vitamins and minerals — even in small serving sizes.

-squid: Squid is not only a sustainable source of seafood; research shows that, when prepared in the right way, it's a pretty good source of omega-3 fatty acids. A 100g serving of squid can contain up to 0.6g of omega-3 fatty acids out of the recommended 7 to 11g you should be consuming each week.

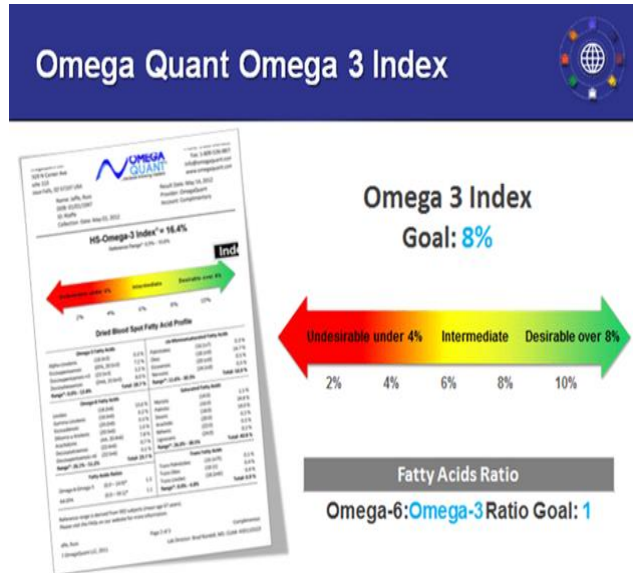
-oysters: Oysters are a good source of omega-3 fatty acids. Omega-3 fatty acids play an essential role in brain function and normal growth and development. They reduce inflammation and also may protect against heart disease, cancer and arthritis.

-avocado: Avocados have a very high fat content, but they are also very high in omega 3 fatty acids in the form of alpha- linolenic acid. This is considered “good” unsaturated fat and accounts for about three-quarters of the calories in an avocado.

-fish: The omega-3 content of fish varies widely. Cold-water fatty fish, such as salmon, mackerel, tuna, herring, and sardines, contain high amounts of LC omega-3s, whereas fish with a lower fat content—such as bass, tilapia and cod—as well as shellfish contain lower levels .

-cod liver and cod liver oil: As with most fish oils (from other sources), cod liver contains omega-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), which is a type of healthy fat that has been linked with cardiovascular health, immunity and brain development (Tur et al., 2012)

1.10 What is the normal range of omega-3 fatty acids?



(9)

So you've ordered an Omega-3 Index test, collected your blood sample, and submitted it to the Omega Quant lab. Now you've received your results and you're wondering what they mean and how you can take action if you need to raise your score.

In this blog, we will address several of the most common questions posed by people who received their results and want a better understanding of what they mean.

First, let's review what the Omega-3 Index actually is. The Omega-3 Index is a measure of the fatty acids called EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) in your red blood cell membranes. What we do is measure all of your fatty acids in a red blood cell membrane and then take the amount of EPA and DHA over all of the fatty acids and get a percentage. So your result could be 4% or 6% or 8% and so on. For example, if your result is 6%, then that means 6% of your fatty acids are represented by EPA and DHA. Research has consistently shown that an Omega-3 Index level of 8-12% is linked to better health outcomes for general wellness, as well as for your heart, brain, eyes, and joints. However, most people globally have an Omega-3 Index below 8%. Let's understand why.

Not surprisingly, most people eating a low-fish Western diet (i.e., typical American diet) have a low Omega-3 Index. In fact, according to Omega Quant research, the average American has an Omega-3 Index of around 5%. Younger people tend to have lower levels than older people and men tend to have lower levels than women. Not being at 8% doesn't mean you are unhealthy — it's not a magic number. Having an Omega-3 Index of 6% is better than 4%. If you are at 7%, woo hoo! You're better than 90% of people we have tested! (El-Badry et al., 2007)

1.11 Are You Getting Enough Omega-3s?

If you want to rely on fish to improve or maintain your Omega-3 Index level, make sure you are using the fish table provided in your omega-3 results report to choose fish with higher levels of EPA and DHA.

It's possible to eat fish frequently but not choose fish with lots of EPA and DHA and have a lower Omega-3 Index. Even fish that are supposed to be high in omega-3s, like Atlantic farmed salmon, can have varying levels based on their own diet. While eating fish is more of a guessing game than taking supplements, it is also more delicious. However, the only way to truly know if the fish you are choosing are impacting your blood level is to take an Omega-3 Index test

1.12 Omega-3 Deficiency

A deficiency of essential fatty acids—either omega-3s or—can cause rough, scaly skin and dermatitis. Plasma and tissue concentrations of DHA decrease when an omega-3 fatty acid deficiency is present.

1- Skin irritation and dryness

If your body lacks omega-3 fats, one of the first places you may notice it is in your skin. For instance, sensitive, dry skin, or even an unusual increase in

acne may be a sign of omega-3 deficiency in some people. Omega-3 fats improve the integrity of skin barriers, preventing the loss of moisture and protecting it from irritants that can lead to dryness and irritation (1Trusted Source, 2Trusted Source). One small study gave women a daily dose of 1/2 teaspoon (2.5 mL) of ALA-rich flaxseed oil for 3 months. The women who took it experienced decreased skin roughness and increased skin hydration by nearly 40%, compared with those who received a placebo .A 20-week study gave omega-3-rich hempseed oil daily to people with atopic dermatitis, also called eczema, a condition that causes dry and irritated skin. Participants experienced reduced dryness and itchiness and needed less topical medication . Additionally, experiencing more acne than normal may be an indirect indication of omega-3 deficiency in some people. Studies have shown that omega-3s reduce inflammation, which scientists believe may trigger acne .Furthermore, some research has shown that taking omega-3 supplements can help reduce acne breakouts and skin inflammation .Interestingly, some studies have also found that taking EPA and DHA supplements may reduce how sensitive your skin is to ultraviolet light In one study, participants who took 4 grams of EPA daily for 3 months experienced a 136% increase in their resistance to sunburn.Overall, omega-3 fats are important for maintaining optimal skin health, so if they're lacking in your diet, you may notice changes in your skin.

2-Depression

Omega-3 fats are an essential component of the brain and known to have neuro protective and anti-inflammatory effects .They may even help treat neurodegenerative diseases and brain disorders, such as Alzheimer's disease, dementia, and bipolar disorder. Many studies show a correlation between a low omega-3 status and a higher incidence of depression. One analysis of 26 studies that included 2,160 participants found that taking omega-3 supplements had a beneficial effect on depressive symptoms .Specifically, an omega-3 supplement that contained at least 60% EPA, taken at a dosage of 1 gram or less per day, appeared to be helpful Another

systematic review and analysis of 6 studies and 4,605 participants concluded that an average intake of 1.3 grams of omega-3s per day reduced mild to moderate depression symptoms among older adults, compared with a placebo. Additionally, one animal study found that a lifelong inadequate intake of omega-3 fats caused changes in neuronal pathways of the brain, resulting in depression. While many factors contribute to the development of mental health disorders, a diet high in omega-3s may help reduce the risk of some mental health conditions. Consult your healthcare provider to be screened for depression and determine appropriate treatment strategies.

3. Dry eyes

Omega-3 fats play a role in eye health, including maintaining eye moisture and possibly even tear production. For this reason, many healthcare providers prescribe omega-3 supplements to help relieve [dry eye syndrome](#). Symptoms of this often include eye discomfort and even disturbances in vision. One high quality study in 64 adults with dry eye looked at the effects of taking omega-3s. One group of participants consumed two daily capsules, each containing 180 mg of EPA and 120 mg of DHA. The other group of participants took a placebo. After 30 days, those who had taken omega-3 supplements experienced less tear evaporation, improved dry eye symptoms, and more tear production. Furthermore, in one analysis of 17 studies involving 3,363 people, researchers found that taking omega-3 supplements significantly reduced symptoms of dry eye compared with taking a placebo. In contrast, other studies have found that taking omega-3 supplements made no difference in dry eye symptoms compared with taking an olive oil placebo. If you've noticed an increase in eye dryness, this may be an indication that your diet lacks omega-3 fats. That said, many health conditions can contribute to dry eye symptoms. As such, it's important to speak with your healthcare provider if you're experiencing dry eyes or other eye-related symptoms.

4. Joint pain and stiffness

It's common to experience joint pain and stiffness as you get older. This may be related to a condition called osteoarthritis, in which cartilage covering the bones breaks down. Alternatively, it may be related to an inflammatory autoimmune condition called rheumatoid arthritis (RA). Some studies have found that taking omega-3 supplements helps reduce joint pain and increase grip strength. Research also shows that PUFAs may help with osteoarthritis, though more human studies are needed .

5. Hair changes

Just as omega-3 fats help retain moisture in the skin, they also help keep your hair healthy. Changes in hair texture, integrity, and density may indicate a low omega-3 status. One 6-month study gave 120 female participants omega-3s, along with omega-6 fats and antioxidants, in a daily supplement . At the end of the study, those who had taken the supplement experienced reduced hair loss and increased hair density compared with the control group. One study in dogs found that taking EPA and DHA improved fatty acid composition in the animals' blood and hair. The fatty acid composition they found is associated with better hair quality. If you're experiencing increased hair loss or have noticed that your hair is thinning or feeling dry and brittle, taking omega-3 supplements may help (Gilbard, 2004)

1.13 Heart

What is the heart? The heart is a fist-sized organ that pumps blood throughout your body. It's the primary organ of your circulatory system. Your heart contains four main sections (chambers) made of muscle and powered by electrical impulses. Your brain and nervous system direct your heart's function.

Lifestyle intervention such as consistent aerobic exercise and a diet high in fruits and vegetables promotes cardiovascular health. A heart-healthy lifestyle decreases the risk of coronary heart disease and heart attack. Although it may seem intuitive that dietary fat is bad for the heart and that it must be avoided, certain unsaturated fats are heart healthy, and other saturated fats are not good for the heart. These heart-healthy unsaturated fats are known as omega-3 fatty acids. The 3 main omega-3 fatty acids that are beneficial for cardiovascular health are α -linoleic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA). ALA is primarily found in plant-based foods such as olive, soybean, canola, walnut, and flaxseed oils, and in walnuts and flaxseeds, as well. EPA and DHA are primarily found in marine-based foods that include the variety of fatty fish, such as tuna, salmon, mackerel, herring, trout, halibut, and cod. This Cardiology Patient Page will present the beneficial effects of omega-3 fatty acids on cardiovascular health, explain the possible mechanisms for these effects, and offer recommendations that can be implemented into a healthy lifestyle to further promote good cardiovascular health (Contreras, 2002)

1.14 Beneficial Effects of Omega-3 Fatty Acids on the Heart

Several studies have shown that individuals who consumed fatty fish a few times per week had almost one-half the risk of death from coronary heart disease and almost one-third the risk of death from a heart attack in comparison with those who consumed no fish.¹ In 1 study, the risk of death from coronary heart disease was 21%, 29%, 31%, and 34% lower in those who consumed fish 1 to 3 times per month, once per week, 2 to 4 times per week, and >5 times per week, respectively, in comparison with those who consumed no fish.² Similarly, ALA consumption has also been shown to reduce the risk of death from coronary heart disease and from heart attack.

Regarding omega-3 fatty acid supplement capsules, in the largest randomized controlled trial to date, consisting of 11 324 patients with coronary heart disease, those who took fish oil and ALA capsules daily had a 15% reduction in death, heart attack, and stroke incidence, a 20% reduction in death from any health-related cause, and a 45% reduction in sudden death from a heart attack in comparison with placebo over 3.5 years of follow-up. In addition, triglyceride levels decreased by 4%. This suggests that consuming omega-3 fatty acids may reduce the risk of death from heart disease for both men and women. Omega-3 fatty acid consumption has also been shown to reduce resting blood pressure modestly and to decrease body fat levels, both of which can improve heart health (Freeman, 2010)

1.15 How Do Omega-3 Fatty Acids Affect the Heart?

There are several potential mechanisms for the favorable effects of omega-3 fatty acids on overall cardiovascular health . Omega-3 fatty acids lower triglyceride levels and increase high-density lipoprotein (good cholesterol) levels. They may also decrease platelet aggregation, which can prevent the coronary arteries from occluding (occlusion would prevent or decrease blood flow to the heart). Aspirin also prevents platelet aggregation. Omega-3 fatty acids may decrease the chance of the heart having an abnormal rhythm. Omega 3- fatty acids may also increase compliance of arteries, decrease atherosclerosis through their effects on metabolism, and reduce inflammatory markers in the body. Many studies have shown that omega-3 fatty acids reduce cardiovascular disease and improve outcomes. Although it is unclear whether plant-derived omega-3 fatty acids (ALA) or fish-derived omega-3 fatty acids , DHA, EPA) are more important for the heart, both should be a part of a healthy diet. Evidence suggests that 0.5 to 1.8 g/d of combined EPA and DHA, either as fatty fish or through supplement capsules, is recommended; 1.5 to 3 g/d of ALA is also beneficial, either through plant-based foods or supplement capsules. **Table 2** lists various food sources of omega-3 fatty acids and their omega-3 fatty acid content. The American Heart Association dietary guidelines recommend including at least 2 servings of fatty fish per week in a healthy diet. Including vegetable oils, such as soybean, canola, walnut, flaxseed, and foods such as walnuts and flaxseeds, all of which are good sources of ALA, is also

recommended.⁴ When possible, omega-3 fatty acids should be consumed through food sources. However, when this is not feasible, for vegetarians, and for convenience, consumption of high-quality omega-3 fatty acid capsules may also be beneficial. Patients should consult with their physicians before taking these supplements. It is important to know that any potential long-term adverse effects of these capsules are not yet known (Chaddha and Eagle, 2015)

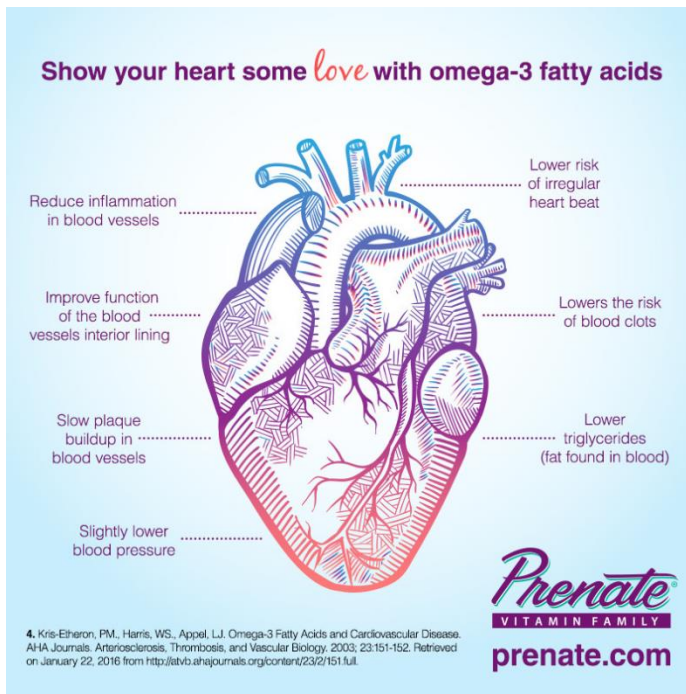


Table 2. Foods With Omega-3 Fatty Acids and Their Omega-3 Fatty Acid Content (Rough Estimates)

ALA Content of Various Vegetable Oils, Nuts, and Seeds	grames per table spoon
Oil olive	0.1
Soybean	0.9
Canola oil	1.3
Walnut oil	1.4
Flax seeds	2.2

HEALTH BENEFITS OF OMEGA 3

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat.



improves bone and
joint health



improves sleep



fights depression
and anxiety



alleviates menstrual pain



improves eye health



reduces fat in liver



improves mental
disorder



prevents heart diseases

How to confirm an omega-3 deficiency

It's uncommon for healthcare providers to routinely evaluate a person's omega-3 status. There's no standard test to diagnose an omega-3 deficiency. However, there are ways to analyze omega-3 levels, if necessary. First, healthcare providers can take a blood sample and analyze levels of omega-3s in the blood fats or blood plasma, which are expressed as a percentage of total phospholipid fatty acids by weight. Healthcare providers can also assess omega-3 status indirectly by analyzing the fatty acid composition of red blood cells. This approach looks at the long-term dietary intake of fats over several months and may provide an idea of overall omega-3 intake. Still, it's important to note that the amount of fatty acids in the blood can vary significantly depending on what you ate last and when. This is why most healthcare providers require a person to fast overnight before giving a blood sample to assess the lipids in their blood. The Western diet is known to be high in saturated fat and low in unsaturated fat, including omega-3 fats. Among populations that eat more fish, there's less concern about omega-3 deficiency. You may be at a higher risk of omega-3 deficiency if you don't consume fish, seafood, and dietary sources of ALA or take a supplement that contains EPA and DHA (Kidd, 2007).

1.16 Risks and complications

You shouldn't take more omega-3 than your doctor recommends as it can be harmful to your health. Too much of the fatty acids in omega-3s may have a negative effect on your health. These negative effects include:

- increased LDL cholesterol
- difficulty controlling blood sugar levels
- higher risk of bleeding

Children and pregnant women may be at risk from mercury in some fish and shouldn't take fish oil or eat certain types of fish without first talking to their doctor. When consuming certain fish, there's a higher risk of mercury poisoning. These types of fish include:

- albacore tuna
- mackerel
- swordfish
- tilefish

If you're allergic to shellfish, you should talk to your doctor before taking fish oil supplements. There hasn't yet been enough research done to determine if they'll affect your allergy or not. Fish oil and omega-3 supplements may also interact with some medications — including some that are over-the-counter. Talk to your doctor before starting any new supplements or vitamins (Skulas-Ray et al., 2019)

1.17 improve risk factors for heart disease

Heart attacks and strokes are the world's leading causes of death. Decades ago, researchers observed that fish-eating communities had very low rates of these diseases. This was later linked to omega-3 consumption. Since then, omega-3 fatty acids have been tied to numerous benefits for heart health .

These benefits include:

- **Triglycerides:** Omega-3s can significantly reduce levels of triglycerides (20Trusted Source).
- **HDL cholesterol:** Some older studies suggest that omega-3s could raise HDL (good) cholesterol levels

Blood clots: Omega-3s can keep blood platelets from clumping together. This helps prevent the formation of harmful blood clots, according to some older research

- **Inflammation:** Omega-3s reduce the production of some substances released during your body's response .For some people, omega-3s can also lower LDL (bad) inflammatory cholesterol. However, evidence is mixed, as some studies find increases in LDL cholesterol levels .Despite these beneficial effects on heart disease risk factors, there is no convincing evidence that omega-3 supplements can prevent heart attacks or strokes and many studies find no benefit

Could reduce symptoms of metabolic syndrome

Metabolic syndrome is a collection of conditions.It includes central obesity — also known as belly fat — as well as high blood pressure, high triglycerides, high blood sugar, and low HDL (good) cholesterol levels It is a major public health concern because it increases your risk of many other illnesses, including heart disease and diabetes .Some research suggests that omega-3 fatty acids could help improve blood sugar levels, inflammation, and heart disease risk factors in people with metabolic syndrome (Hooper et al., 2004)

Conclusion

It is evident that an important cardiac-regulating function exists that is affected and could provide simple and safe protection against ω -3 PUFAs, influenced by simple dietary choices, and that has largely escaped the attention of researchers and cardiologists. ω -3 PUFAs have always been an essential component of human diets. Different types of cardiovascular disease are the main cause of death in developed countries (American Heart Association, 1995). These PUFAs may therefore provide significant public health benefits. Suggestive and provocative data now purport a role for dietary ω -3 PUFAs, particularly EPA and DHA. These appear important not only in cardiovascular disease management but also in risk reduction for autoimmune disease, certain forms of cancer, diabetes and arthritis. Increasing intakes of ω -3 fatty acids, particularly the longer chain forms found in fish, could improve population health at low cost and little risk. Taking omega-3 supplements can help reduce skin-related inflammation, moisture loss, and sun sensitivity. On the flip side, dryness, increased acne, and redness of the skin may indicate an omega-3 deficiency. Many people with depression have low omega-3 status, and studies show that taking omega-3 supplements may help improve mental health symptoms in some people. Omega-3 fats are important for brain function, so it's essential to get adequate intake. Omega-3 fats play an important role in eye health and may help reduce dry eye symptoms. If you've noticed unusual eye dryness and irritation, you may need to increase your omega-3 fat intake. Taking omega-3 supplements has shown promise in helping decrease joint pain and stiffness, though scientists need to do more research in humans to investigate this. Omega-3 fats help maintain the density, texture, and strength of hair. Taking omega-3 supplements may help with hair loss, thinning, and dryness.

Reference

- CHADDHA, A. & EAGLE, K. A. 2015. Omega-3 fatty acids and heart health. *Circulation*, 132, e350-e352.
- CONTRERAS, F. 2002. *Healthy Heart: An Alternative Guide to a Healthy Heart*, Charisma Media.
- DHULL, S. B., PUNIA, S. & SANDHU, K. S. 2020. *Essential Fatty Acids: Sources, Processing Effects, and Health Benefits*, CRC Press.
- EL-BADRY, A. M., GRAF, R. & CLAVIEN, P.-A. 2007. Omega 3–omega 6: what is right for the liver? *Journal of hepatology*, 47, 718-725.
- FREEMAN, L. M. 2010. Beneficial effects of omega-3 fatty acids in cardiovascular disease. *Journal of Small Animal Practice*, 51, 462-470.
- GILBARD, J. P. 2004. Dry eye and the role of nutrition. *Optom Today*, 34-41.
- HOOVER, L., HARRISON, R. A., SUMMERBELL, C. D., MOORE, H., WORTHINGTON, H. V., NESS, A., CAPPS, N., SMITH, G. D., RIEMERSMA, R. & EBRAHIM, S. 2004. Omega 3 fatty acids for prevention and treatment of cardiovascular disease. *Cochrane Database of Systematic Reviews*.
- IBARGUREN, M., LÓPEZ, D. J. & ESCRIBÁ, P. V. 2014. The effect of natural and synthetic fatty acids on membrane structure, microdomain organization, cellular functions and human health. *Biochimica et Biophysica Acta (BBA)-Biomembranes*, 1838, 1518-1528.
- KANICKY, J. R. & SHAH, D. O. 2002. Effect of degree, type, and position of unsaturation on the pKa of long-chain fatty acids. *Journal of colloid and interface science*, 256, 201-207.
- KIDD, P. M. 2007. Omega-3 DHA and EPA for cognition, behavior, and mood: clinical findings and structural-functional synergies with cell membrane phospholipids. *Alternative medicine review*, 12, 207.
- LEAF, A. 2008. Historical overview of n– 3 fatty acids and coronary heart disease. *The American journal of clinical nutrition*, 87, 1978S-1980S.
- NAGY, K. & TIUCA, I.-D. 2017. Importance of fatty acids in physiopathology of human body. *Fatty acids*. IntechOpen.
- NIEMOLLER, T. D., STARK, D. T. & BAZAN, N. G. 2009. Omega–3 Fatty Acid Docosahexaenoic Acid Is the Precursor of Neuroprotectin D1 in the Nervous System. *Omega-3 fatty acids, the brain and retina*, 99, 46-54.

- OFOSU, J., NARTEY, M. A., MO, X., YE, J., ZHANG, Y., ZENG, C., ZHANG, M., FANG, Y. & ZHOU, G. 2023. Ram sperm cryopreservation disrupts metabolism of unsaturated fatty acids. *Theriogenology*.
- SKULAS-RAY, A. C., WILSON, P. W., HARRIS, W. S., BRINTON, E. A., KRIS-ETHERTON, P. M., RICHTER, C. K., JACOBSON, T. A., ENGLER, M. B., MILLER, M. & ROBINSON, J. G. 2019. Omega-3 fatty acids for the management of hypertriglyceridemia: a science advisory from the American Heart Association. *Circulation*, 140, e673-e691.
- TUR, J., BIBILONI, M., SUREDA, A. & PONS, A. 2012. Dietary sources of omega 3 fatty acids: public health risks and benefits. *British Journal of Nutrition*, 107, S23-S52.