Comprehensive Guide to Omega-3 Fatty Acids: Benefits, Sources and Implications

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Abstract

The human body needs omega-3 fatty acids because they serve as foundations for cellular structure while managing fundamental physiological operations. The human body cannot produce Omega-3 fatty acids, making supplementation or dietary intake essential for obtaining their anti-inflammatory and cardiovascular benefits and protection of cognitive functions. Fatty fish and algal oil from marine sources deliver high amounts of EPA and DHA, yet plant-based options such as walnuts and flaxseeds contain ALA with restricted conversion potential to long-chain forms. Supplement products help compensate for nutritional gaps primarily affecting two specific population groups: pregnant parents and elderly individuals, along with vegetarians. Science-based optimal supplementation needs doses that meet health goals with strict adherence to product standards while factoring in side effects and potential interactions. Advancements in Omega-3 treatments combine personalized dosing with new delivery methods, which intend to boost accessibility and intervention effectiveness. Various diet patterns meet successfully with scientifically proven supplemental approaches to reach maximal Omega-3 fatty acid health advantages. The benefits of Omega-3s become maximized through healthcare professional partnerships, which enable knowledgeable implementation of these fatty acids across disease management and prevention techniques.

Keywords: Omega-3 fatty acids, Alpha-linolenic acid (ALA), Docosahexaenoic acid (DHA), Eicosapentaenoic acid (EPA), Health Benefits, Cardiovascular Benefits.

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Introduction

Omega-3 fatty acids are a polyunsaturated fat that play a crucial role in human body maintenance. Due to its essential elements and bioactive properties, such as anti-inflammatory and involved in the neurological, cardiovascular, and immune system, research and public interest have increased over the last few decades (Calder, 2017). For 90 years, fatty acids have been involved in research, and it has been intensified in recent years. As essential components of plasma membrane phospholipids, fatty acids play unique functions in metabolism, healthy operation, and cell signaling. Numerous biological functions may be impacted by the amount and composition of certain fatty acids. The fluidity, permeability, and overall shape of the membrane, which allow the cell to regulate what enters and exits, are all maintained by the fatty acid compositions of different cells (Calder, 2015). The additional unsaturated fats may be obtained via diet or provided within our systems. The basic unsaturated fats (linoleic and α-linolenic) are obtained from food. Among the 20 distinct types of unsaturated fats that individuals often eat are soaked, monounsaturated, and polyunsaturated fats. Omega-3 unsaturated fats are the supreme nutritional component for improving health and preventing illness (Lee and Lip, 2003; Whelan and Rust, 2006). Omega-3 unsaturated fats are often abundant in fish oil supplements and fatty seafood, such as salmon and fish. To improve their health benefits, small amounts of omega-3 unsaturated fats are being added to a growing group of food types, such as dairy and cooked products (Whelan and Rust, 2006). Meats like chicken, pig, and hamburger often include small amounts of omega-3 unsaturated fats, but fish oil supplements typically contain 30% to 50% of these unsaturated fats by weight. Meat also contributes to the total intake of these unsaturated fats due to its extensive usage in Western nations (Taber et al., 1998).

The omega-3 (o-3 or n-3) family of long-chain, profoundly unsaturated fats (HUFA) includes Eicosapentaenoic acid (EPA), Docosapentaenoic acid (DPA), and docosahexaenoic acid (DHA). EPA and DPA are 20 and 22-carbon molecules with five twofold links (D5,8,11,14,17, and separately), while DHA is a 22-carbon molecule with six twofold bonds (D5,8,11,14,17,20). The existence of their underlying twofold security at the third position, counting from the particle's terminal methyl bunch, is what distinguishes all unsaturated fats (FAs) of the omega-3 family (Haris, 2004). The absence of omega-3 unsaturated fat is linked to a study conducted in Greenland in 1970. Because of their traditional diet of salmon and other fish, the Eskimo people of Western Greenland have a very low incidence of cardiovascular sickness (Bang et al., 1980). The prevalence of heart-related problems has also decreased among populations in Japan and the Frozen North

with comparable weight-loss programs. Determining the potential of omega-3 unsaturated fats for health requires knowledge of the synthetic makeup of certain unsaturated fats. The most prominent omega-3 unsaturated lipid identified in the human diet is alpha-linolenic acid (ALA). Long-chain polyunsaturated fats (LC-PUFAs) are omega-3 unsaturated fats. These LC-PUFAs make up around 20% of the dry matter in the cerebrum, and their absence in the body may be harmful to the mind functions and generate ideas (Belz et al., 2007). The earliest clarification of the meaning of PUFAs was given by research conducted on rodents, where an absence of PUFAs prompted the improvement of numerous difficult issues (Spector and Kim, 2015). Different sources of fish oils have different measures of EPA and DHA since most of the commercially available fish oils have EPA and DHA parts of 2:1 (Ghasemi et al., 2019). The other two omega-3 unsaturated fats, EPA-20:5 and DHA-22:6, are plentiful in fish, fish oil, and algal oils. Unsaturated fats with omega-3 EPA and DHA are fundamental for keeping up with cardiovascular, brain, eye, and reproductive health, among numerous other health benefits (Mozaffarian and Rimm, 2006). Linoleic and α-linolenic acids make up around 20% and 0.3% of the unsaturated fat components in human plasma phospholipids, respectively (Stanley et al., 2012). Among the many organic beginnings are a variety of nuts, seeds, and plant oils that are abundant in Los Angeles. The seed assortments include sunflower, safflower, and pumpkin seeds and oils, and also include soybean oils. Soybean oil, flax seeds, pecans, pumpkin seeds, and flaxseed oil are other excellent sources of ALA. In young healthy individuals, the amount of dietary ALA converted to EPA and DHA varies. Increasing ALA use may help prevent cardiovascular problems by regulating endothelial function, reducing circulatory strain, lowering cholesterol, preventing coronary failures, and having antithrombotic and mitigating qualities (Sokoła-Wysoczańska et al., 2018). Projects of nutrient-dense foods improved with unsaturated fats have recently been examined since it has been shown that these fats, particularly omega-3, are essential for human health (Mititelu et al., 2024). For instance, LC omega-3 deficiency is one of the top 10 preventable reasons for death in the US. One more issue is the underconsumption of LC omega-3s, which is much of the time brought about by unfortunate dietary habits or a lack of access to the supplements (Papanikolaou et al., 2014). Moreover, direct utilization is the best method for utilizing DPA, EPA, and DHA. In light of the examination of EPA and DHA in various substantial cells, the Omega-3 record is a dependable metric that addresses a person's EPA and DHA levels (Harris, 2004; von Schacky, 2020).In people, omega-3 unsaturated fats are fundamental and should advantageously affect neurological conditions, diabetes, and malignant growth, among other diseases. At the point when individuals consume sufficient omega-3 unsaturated fats in their diet, they might benefit from it. Various methodologies for further developing products containing omega-3 unsaturated fats are proposed by contemporary biotechnologists (Mititelu et al., 2024). The objectives of this chapter are to critically evaluate the therapeutic potential of omega-3 fatty acids based on existing literature and to examine their primary dietary sources. Furthermore, the chapter aims to assess the nutritional significance of omega-3 fatty acids within the broader framework of public health interventions, highlighting their role in promoting population health and preventing diet-related chronic conditions.

Types of Omega-3 Fatty Acids

Omega-3 family comprises the three main fatty acids, these are given below;

- Alpha linolic acid (ALA)
- Eicosapentaenoic acid (EPA)
- Docosahexaenoic acid (DHA)

ALA is generally found in plant-based sources, and it is indicated in the long-chain fatty acids Omega-3 family. Pecans, chia seeds, and flaxseeds are the basic dietary sources for the Omega-3 fatty acids, and also spinach and other green salads have less quantity available (Calder et al., 2015). Marine sources such as fatty fish, krill oil, and algae are the main sources of EPA. Well-known for its anti-inflammatory qualities, EPA is essential for immune system function, cardiovascular health, and mental wellness (Calder et al., 2015). DHA is an essential component of cell layers, particularly in the retina and brain. Where it supports synaptic function and visual acuity. It is extraordinarily concentrated in marine resources, with algal oil supplying a vegetarian (Calder et al., 2015).

Sources of Omega-3 Fatty Acids

There are two main sources of Omega-3 fatty acids given below;

- Marine sources
- Plant-based sources

Pecans, chia seeds, and flaxseeds are the basic dietary sources of the Omega-3 fatty acids, and also spinach and other green salads have less quantity available (Calder et al., 2015). Marine sources such as fatty fish, salmon, mackerel, sardines, krill oil, herring, and algae are the main sources of Omega-3 fatty acids.

The variety of Omega-3-rich foods, both marine and plant-based, is critical for meeting dietary desires, specifically for people with nutritional restrictions or specific health desires. This section explores the diverse assets of Omega-three fatty acids (Simopoulos, 2002; Calder, 2020). The most reliable and bioavailable sources of EPA and DHA are marine-based foods. Key marine sources include: Rich in EPA and DHA, high-quality protein, and essential vitamins like D and B12, fatty fish are nutritional powerhouses. Among the examples are: Salmon is among the richest sources of Omega-3s. Eight grams of EPA/DHA per 100 grams. Wild-caught salmon generally contains higher Omega-3 levels compared to farmed varieties (Table 1) (Nettleton, 1991). Algal oil is derived from marine algae and serves as a plant-based source of DHA, often with small amounts of EPA. Algal oil typically provides 250-300 mg of DHA per serving (Monteiro et al., 2024).

Plant-based sources are often the source of ALA, but humans' capacity to convert ALA into these bioactive molecules is limited, typically ranging from 5-15% (Calder et al., 2020). Despite this limitation, plant-based foods remain valuable components of an Omega-3-rich diet. Flaxseeds are among the richest sources of ALA, with 2.3 grams per tablespoon. They also provide fiber, lignans, and antioxidants. Flaxseed oil contains concentrated ALA, with approximately 7 grams per tablespoon, making it a convenient option for salads, smoothies, and other cold preparations. Chia seeds offer approximately 5 grams of ALA per ounce. Walnuts provide about 2.5 grams of ALA per ounce, along with heart-

healthy fats and antioxidants. Hemp seeds provide one gram of ALA per tablespoon and provide a respectable 3:1 ratio of unsaturated fats from Omega-6 to Omega-3 (Meyer et al., 2003).

Table 1: Omega-3 Fatty Acids content present in different food sources (DiNicolantonio & Land, 2023; Meyer et al., 2003).

Sr. No.	Food	Quantity	Omega-3 Fatty Acids
FISH			
1	Salmon	4-oz/113 g	2.3 g
2	Mackerel	4-oz/113 g	2.2 g
3	Swordfish	4-oz/113 g	1.7 g
4	Sardines	4-oz/113 g	1.8 g
5	Canned Tuna	4-oz/113 g	0.2 g
6	Lobster	4-oz/113 g	0.12 g
7	Cod	4-oz/113 g	0.6 g
VEGETABLES			
8	Spinach	1-cup/110 g	166 g
9	Kale	1-cup/110 g	0.1 g
10	Collard	1-cup/110 g	177 g
11	Chard	1-cup/110 g	5.3 g
12	Sauerkraut	1-cup/110 g	36 g
13	Brussels Sprouts	1-cup/110 g	270 g
NUTS and SEEDS			
14	Walnuts	1-oz/28 g	2.6 g
15	Flaxseeds	1-oz/28 g	6.3 g
16	Pecans	1-oz/28 g	0.3 g
17	Poppy Seeds	1-oz/28 g	0.1 g
18	Pumpkin Seeds	1-oz/28 g	0.1 g
19	Sesame Seeds	1-oz/28 g	0.1 g
20	Almonds	1-oz/28 g	0.002 g
21	Cashews	1-oz/28 g	0.017 g
22	Chia Seeds	1-0/28 g	4.9 g
23	Pistachios	1-oz/28 g	0.071 g
24	Sunflower Seeds	1-oz/28 g	0.021 g
25	Lentils	1-oz/28 g	0.0104 g
OILS and FATS			
26	Butter	1-Tbsp	0.83 g
27	Lard	1-Tbsp	0.1 g
28	Cod Liver Oil	1-Tbsp	1.3 g
29	Grain-Fed Tallow	1-Tbsp	0.2 g
30	Grass-Fed Tallow	1-Tbsp	0.8 g
31	Peanut Oil	1-Tbsp	Trace
32	Soybean Oil	1-Tbsp	0.9 g
33	Canola Oil	1-Tbsp	1.3 g
34	Walnut Oil	1-Tbsp	1.4 g
35	Sunflower Oil	1-Tbsp	0.0 g
36	Margarine	1-Tbsp	0.04 g
37	Peanut Butter	1-Tbsp	0.008 g
38	Almond Butter	1-Tbsp	0.04 g
39	Flaxseed Oil	1-Tbsp	6.9 g
40	Olive Oil	1-Tbsp	0.1 g
MEAT			
41	Ground Pork	6-oz/170 g	0.119 g
42	Chicken	6-oz/170 g	0.16 g
43	Grain-Fed Beef	6-oz/170 g	0.08 g
44	Grass-Fed Beef	6-oz/170 g	0.15 g
45	Domestic Lamb	6-oz/170 g	0.6 g
46	Grass-Fed Lamb	6-oz/170 g	2.2 g
47	Farmed Salmon	6-oz/170 g	4.5 g
48	Wild Salmon	6-oz/170 g	3.6 g

Role of Omega-3 Fatty Acids in Human Health

Omega-3 fatty acids are essential nutrients that are vital for numerous physiological functions and the maintenance of overall health. They

play a critical role in reducing inflammation, supportive heart and brain health, regulating immune function, and contributing to normal growth and development. As the human body cannot produce omega-3s efficiently, obtaining them through diet or supplements is crucial. Scientific research has consistently linked adequate omega-3 intake to a reduced risk of chronic diseases such as cardiovascular disease, neurodegenerative disorders, and certain inflammatory conditions, highlighting their significant importance in preventive and therapeutic health strategies.

Cardiovascular health: Cardiovascular diseases (CVDs) constitute a worldwide health crisis, accounting for an anticipated 18 million deaths annually. The growing occurrence of lifestyle-associated threat elements, which include poor weight loss plan, sedentary behavior, and continual pressure, has contributed drastically to this burden. Omega-3 fatty acids have emerged as an herbal and effective intervention for reducing the risk and progression of CVDs. Their multifaceted benefits encompass lipid regulation, blood pressure reduction, anti-arrhythmic outcomes, and anti-inflammatory actions, making them a cornerstone of preventive cardiology (Lai et al., 2015).

Hypertension is one of the main causes of cardiovascular events such as myocardial localized necrosis and stroke. Through enhancing endothelial function and reducing blood vessel solidity, omega-3 unsaturated fats influence vascular tone. Their impact on the renin-angiotensin system and calcium ion channels contributes to lower blood pressure, offering a natural alternative to pharmacological therapies (Appel et al., 2005). Chronic inflammation underlies many cardiovascular pathologies, including atherosclerosis and heart failure. Omega-3s inhibit the production of inflammatory cytokines such as interleukin-6 (IL-6) and cancer-promoting factor-alpha (TNF-α) and increase the combination of protective mediators such as prostaglandins and resolvin, which are made from EPA and DHA. These actions mitigate vascular inflammation and prevent plaque formation in arterial walls (Lai et al., 2015). Recent studies have increased our knowledge of how Omega-3s may benefit specific cardiovascular situations. Omega-3s enhance cardiac function in sufferers with heart failure via modulating myocardial energy metabolism and lowering ventricular remodeling (von Schacky & Harris, 2007). In Cushion patients, omega-3 unsaturated fats enhance endothelial function, lower oxidative pressure, and strengthen the microcirculatory bloodstream (Burr et al., 1989). Omega-3 supplementation before and after cardiac surgical procedure has been related to decreased post-operative atrial traumatic inflammation and advanced restoration effects (Calder et al., 2017)

Brain Health: DHA is one of the unsaturated lipids that make up over 60% of the human brain. Omega-3 unsaturated fats are essential for neuroprotection, mental health, and mental capacity. DHA may help prevent the onset of neurodegenerative diseases, including Parkinson's and Alzheimer's, according to growing evidence (Valenzuela et al., 2012). DHA does this via lowering the buildup of beta amyloid plaque and regulating neuroinflammation and oxidative stress. They are naturally classified into eight major classes: fatty acyls, glycolipids, glycerophospholipids, sphingolipids, movement lipid polyketides, isoprenoids, and sterols. Three basic lipids are detected by the focused sensory system: cholesterol, glycerophospholipids, and sphingolipids. The improvement of better mental capacities in monkeys is linked to a very distinct component of the lipids within the brain (Lange, 2020).

DHA, which makes up about 10–20% of its total unsaturated fat content, is the basic omega-3 unsaturated lipid in the brain. However, DHA, ALA, and EPA make up less than 1% of the cerebrum's total unsaturated fat makeup. When compared to other animals, such as mice, rats, and primates, the amount of soaking, monounsaturated, and polyunsaturated fats in the post-mortem human brain is often preserved. For example, DHA concentrates in the brains of adult rats and primates fed a diet high in ALA, which contains around 20% of total unsaturated fats (Freemantle et al., 2006). Correlations between cardiovascular and psychiatric diseases provide more evidence of a possible underlying vascular component to mental illness (Sinn and Howe, 2008). High quantities of phosphatidylserine (PS) and DHA in the EPG, are characteristics of the human brain that may account for as much as 35% of the unsaturated lipids in synaptic layers (Innis, 2008).

Eye/Vision Health: The eyes are a number of the most sensitive and metabolically active organs within the human body, requiring a consistent delivery of vitamins to maintain top-rated health. Omega-3 fatty acids, particularly, play a fundamental role in eye fitness. DHA is a structural lipid that constitutes a great part of the retinal membrane phospholipids. The unique properties of Omega-three fatty acids make them essential for stopping and handling diverse ocular situations (Calder et al., 2015). Omega-3 unsaturated fats have been widely regarded as a healing option for DES treatment, with advantages including: Omega-3 supplementation complements the excellent composition of tears using influencing the lipid layer of the tear film. This helps lessen tear evaporation and keep ocular hydration (Johnson & Murphy, 2004).

EPA and DHA decrease echelons of pro-inflammatory cytokines on the ocular surface, addressing the underlying inflammation that drives DES symptoms (Calder et al., 2015). The importance of DHA for eye health begins in utero. Throughout pregnancy, DHA is transferred from the mother to the unborn child, where it grows in the retina and brain throughout critical developmental phases. Adequate DHA levels are associated with: Infants born to mothers with high DHA consumption in the course of being pregnancy and breastfeeding show off stepped forward visual sharpness and contrast sensitivity (Reyes, 2016). To gain the vision-keeping benefits of Omega-3 fatty acids, incorporating them into the food plan or the use of supplements is critical. People who are at risk for AMD, DES, or other eye conditions are often advised to take omega-3 supplements that contain at least 500–1000 mg of combined EPA and DHA each day to reduce the effects of the eye conditions (Dave et al., 2022).

Role in Maternal Health during Pregnancy: Pregnancy represents a critical period for the most suitable nutrients, as maternal nutritional consumption without delay influences fetal growth, development, and long-term health effects. Among crucial vitamins, Omega-3 fatty acids, particularly DHA, are indispensable during gestation. These fats support the improvement of the fetal brain and eyes while additionally playing a protective role in maternal fitness. DHA and EPA are transferred from the mother to the fetus via the placenta, particularly during the first trimester when the fetal brain is developing quickly (Carlson et al., 2014). Omega-three fatty acids, mainly DHA, are critical building blocks of the fetal brain. Approximately 60% of the human mind is composed of fats, and DHA accounts for a considerable proportion of the polyunsaturated fatty acids discovered in neural material. During pregnancy, DHA contributes to the structural formation of neurons, enhancing the connectivity of neural pathways and supporting synaptic function (Innis, 2008). DHA plays a role in myelination, the manner of insulating nerve fibers to decorate the velocity and accuracy of signal transmission in the brain (Colombo et al., 2017).

Previous literature has shown that women who have greater levels of Omega-3 during pregnancy are less likely to suffer from PPD,

underscoring the importance of these fats for mental health (Koletzko et al., 2008). Infants who are breastfed by mothers with excessive DHA tiers show higher cognitive and motor abilities as compared to the ones receiving formula without Omega-3 fortification (Makrides et al., 2011). Despite their advantages, some pregnant ladies may have worries concerning Omega-3 intake: Choosing low-mercury fish and purified supplements can mitigate issues approximately heavy metal contamination. Algae-based DHA supplements provide a plant-primarily based solution for individuals fending off animal products (Oken et al., 2008). The role of Omega-3 fatty acids in pregnancy is still a focal point of scientific research. Emerging research is exploring. Experts are investigating whether elevated DHA levels during pregnancy may reduce the risk of disorder such as hyperactivity disorder (ADHD) and mental imbalance range disorder (ASD) (Colombo et al., 2017).

Table 2: Adequate Intakes (AIs) role for Omega-3 fatty acids at birth to older age (Sheppard and Cheatham, 2018; Fiber & Panel, 2005).

Sr. No.	Phase/Age	Male (In grams)	Female (In grams)	Pregnancy (In grams)	Lactation (In grams)
1	Birth – 6; M.	0.5 grams	O.5 grams	-	-
2	7 – 12; M.	0.5 grams	0.5 grams	-	-
3	1 – 3; Y.	0.7 grams	0.7 grams	-	-
4	4 – 8; Y.	0.9 grams	0.9 grams	-	-
5	9 – 13 Y.	1.2 grams	1.0 grams	-	-
6	14 – 18 Y.	1.6 grams	1.1 grams	1.4 grams	1.3 grams
7	19 – 50 Y.	1.6 grams	1.1 grams	1.4 grams	1.3 grams
8	51 – + Y.	1.6 grams	1.1 grams	-	-

***Note:** M. (Months), Y. (Years).

Role in Immune System Modulating: The behavior and properties of several immune cells are influenced by omega-3 fatty acids, which enhance their capacity to control infection. Omega-3 unsaturated fats intervene in the polarization of macrophages toward a calming M2 aggregate, which plays a role in tissue repair and disease prevention. M1 macrophages are associated with a favorable proinflammatory profile that contributes to some inflammatory disorders (Kolb, 2022). Omega-3s modulate T-cell responses by way of reducing Th1 and Th17 activity that are related to pro-inflammatory outcomes and promoting Treg cells, which have immunosuppressive and anti-inflammatory roles (Calder et al., 2020).

Neutrophils are among the first immune cells to respond to contamination or injury, and their excessive activity can exacerbate inflammation. Omega-3-derived resolvents beautify neutrophil clearance and promote apoptosis, reducing their contribution to persistent irritation. Because of their moderating qualities, omega-3 unsaturated fats are a useful strengthening treatment for chronic inflammatory illnesses. Unlike nonsteroidal anti-inflammatory drugs (NSAIDs) and corticosteroids, which goal inflammation but regularly have extensive side effects, Omega-3s offer a safer, long-term choice with broader fitness advantages. Recommended dosages vary depending on the condition; in any case, logical tests often use 2-4 grams of mixed EPA and DHA per day (Omachi et al., 2024). Conditions along with rheumatoid arthritis and psoriasis gain from doses ranging from 1-3 grams in line with day, which help lessen inflammatory markers and improve signs (Calder, 2020). Clinical studies have shown the significant benefits of Omega-3 supplementation for those with rheumatoid arthritis, a persistent immune system illness. Supplementation reduced discomfort, stiffness, and edema in the joints, often allowing for a decrease in the usage of NSAIDs (Calder et al., 2017).

Optimizing the Bioavailability of Omega-3 Fatty Acids

To maximize the benefits of dietary Omega-3s, consider the following tips: Omega-3 absorption improves when consumed alongside other vigorous paddings, such as lime grease or avocado. High heat can degrade Omega-3 fatty acids, particularly in plant oils. Look for fortified products, such as eggs, milk, and bread, which provide an additional source of Omega-3s in everyday diets. ALA consumption of 1.1-1.6 grams in line with day is suggested, with supplementation of DHA from algal oil to ensure good enough long-chain Omega-3 levels. Nutritionists recommend that the ratio of omega-6 to omega-3 unsaturated fats be maintained at 4:1 or less. Reducing consumption of processed oils (e.g., corn, soybean, and sunflower oils) while growing Omega-3-rich ingredients can help restore stability. To support cardiovascular health, mental health, and general well-being, experts recommend that most healthy persons consume 250–500 mg of mutual EPA and DHA daily. This dosage is steady with guidelines from fitness companies (Mozaffarian et al., 2005).

Recommendations

Based on the previous literature and current evidence, individuals regularly take Omega-3 fatty acids from high-quality diet sources, and supplementation is necessary (Table 2). The more important fatty acids should be consumed as fatty fish, plant sources, and fortified food, recommended to meet the daily requirements. However, enhancing the absorption of the Omega-3 fatty acids strategies, such as healthy fat intake and choosing in the form of triglyceride supplements, should be chosen to maximize the health benefits. The awareness should be aimed at the public health initiative program starts and provide guidelines for the Omega-3 fatty acids, playing a vital role in the body to prevent chronic diseases and promote cognitive function promoted to supporting overall well-being and healthy disorders. Further studies give a chance to encourage the dose supplemented guideline and understand the genetic impacts on absorption and explore the emerging therapeutic application.

Conclusion

Omega-3 fatty acids are a necessary dietary source for maintaining optimal body health in human beings. These are present in flaxseeds and fatty fish in general and have an impact on heart health, brain health, irritability, and cerebrum function. This study supports the evidence

for their role in cardiovascular health benefits, neurological disorders, immune system regulation, and inflammatory control. Despite their benefits, proven in modern diets, regularly decreasing the adequate provision of Omega-3 fatty acids highlights the requirements of dietary choice and essential supplements. Understanding the critical sources, role, absorption, and therapeutic applications plays an important role in maximizing their health benefits. Moreover, the integration of Omega-3 fatty acids in broader public health policies and plans for individualized nutrition systems plays a significant role in disease control and overall human wellness.

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