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The Science Behind Fish Oil Supplements — Learn About Fish Oil's Efficacy for a Variety of Conditions and Stages of Life

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Omega-3 fatty acids, one of two major classes of polyunsaturated fatty acids (PUFAs), have been a topic of study for some time. Researchers have been investigating their contribution to the prevention and treatment of many conditions, including cardiovascular disease (CVD) and dementia.

Alpha-linolenic acid (ALA), EPA, and DHA are the three types of omega-3 fatty acids that occur naturally in foods and are most frequently studied. When ALA is consumed, the body must first convert it to EPA and then to DHA before it can be used in other bodily processes.1 EPA is metabolized to produce certain anti-inflammatory eicosanoids that help protect against inflammatory diseases, heart attacks, and stroke. It shares a metabolic pathway with arachidonic acid, an omega-6 fatty acid that generally produces eicosanoids involved in inflammatory responses. DHA is the omega-3 fatty acid that's important for brain development and function. It's thought to play a role in signal transmission along neurons and in anti-inflammatory actions in the brain.1

Research has shown that dietary consumption of more omega-3 fatty acids than omega-6 fatty acids tends to support overall health. Most Americans, however, consume at least 10 times more omega-6 fatty acids than omega-3 fatty acids, indicating a need for nutrition education and intervention.1

Dietary Sources of Omega-3 Fatty Acids

Omega-3 fatty acids are considered essential because the body is unable to synthesize them on its own. They must be consumed in the diet via food or supplements. ALA is found primarily in plants, including flaxseeds, pumpkin seeds, walnuts, soybeans, soybean products, and various plant-based oils.2 EPA and DHA mainly come from fatty fish and shellfish, but marine algae have been identified as viable vegetarian sources of DHA.3

General Intake Recommendations

An Adequate Intake (AI) and an Acceptable Macronutrient Distribution Range (AMDR) were set for omega-3 fatty acids in 2002. The ALA AI to achieve nutritional adequacy or

to avoid deficiency symptoms is 1.6 g per day for healthy men and 1.1 g per day for healthy women aged 19–50. The AMDR for omega-3 fatty acids is 0.6% to 1.2% of total energy consumed, with roughly 10% of that AMDR coming specifically from EPA or DHA. It's been recognized that eating patterns including omega-3 intakes above the AI may result in additional health benefits, such as reduced risks of CVD and obesity. There's insufficient research, however, to change the AI or establish a recommended dietary allowance.4

Research suggests that healthy individuals should consume a variety of nuts, seeds, and leafy greens as sources of ALA and about 8 oz per week of a variety of seafood to reach the recommendations for EPA and DHA. This should provide an average of about 250 mg per day of EPA and DHA.5

The Significance of Fish Oil

The American Heart Association recommends consuming two 3.5-oz servings of fatty fish per week to meet omega-3 fatty acid requirements.6 The 2015–2020 Dietary Guidelines for Americans recommend consuming 8 oz per week of a variety of seafood.5 This includes foods such as salmon, herring, lake trout, sardines, and Pacific oysters. Certain barriers to seafood consumption exist, including taste, cost, lack of preparation knowledge, sustainability concerns, and dietary restrictions. When these barriers are present, it can be difficult to consume the recommended amounts of omega-3 fatty acids via food sources. In addition, individuals with coronary artery disease and high triglycerides may benefit from even higher doses of omega-3 fatty acids that can be a challenge to obtain through diet alone.6

Fish oil supplements rich in EPA and DHA may help individuals overcome these barriers and meet omega-3 fatty acid requirements. Several studies have been conducted over the past few decades investigating the effect of fish oil supplementation on numerous conditions including pregnancy outcomes, childhood allergies, dementia, CVD, inflammatory bowel disease (IBD), and postresistance exercise muscle soreness.

Pregnancy Outcomes and Child Development

Brain growth in the fetus during the last trimester of pregnancy and the first year of life happens quickly and is dependent on maternal nutrition. During these times, PUFAs accumulate in the brain tissue of the fetus and infant to support optimal cognitive development. A 2007 observational cohort study found that maternal seafood intake of less than 340 g per week, or roughly 12 oz, was associated with a higher risk of a child being in the lowest quartile for verbal IQ as well as other developmental outcomes.7 Researchers continue to explore whether omega-3 supplementation during pregnancy and breast-feeding can benefit the health of the child or mother in the same way that seafood consumption may, but without the risk of mercury contamination. Outcomes such as language development, child weight, psychomotor development, attention span, and postpartum depression all have been studied, with consistently mixed results.8

The DHA to Optimize Mother Infant Outcome study aimed to identify whether supplementation of 800 mg per day of DHA during the last half of pregnancy would reduce the risk of postpartum depression and improve neurodevelopmental cognitive or language outcomes in early childhood. The results showed no significant difference in any of the measured outcomes between the control and experimental groups.9 A 2016 review article analyzed randomized controlled trials to evaluate the evidence for omega-3 supplementation during pregnancy on preterm birth, preeclampsia, intrauterine growth restriction, gestational diabetes, perinatal mortality, small for gestational age, birth weight, infant eye and brain development, and postpartum depression. The authors concluded that there wasn't enough evidence to support routine supplementation for improving these outcomes. They acknowledged several limitations and suggested further research and studies with longer follow-up.10

The current AI for ALA during pregnancy is 1.4 g per day and 1.3 g per day during lactation.11 Of this amount, 200 to 300 mg of DHA per day is recommended. The American College of Obstetricians and Gynecologists and the FDA suggest women meet this intake by consuming two 6-oz servings of low-mercury seafood per week. If recommendations are unmet via seafood consumption, daily fish oil supplements with at least 200 mg of DHA may be appropriate to avoid deficiency, but conclusive evidence supporting supplementation during pregnancy and lactation as a replacement to seafood consumption is scarce.12

Childhood Allergies

Allergic diseases are thought to develop very early in life, likely during fetal development. Nutrition may have the potential to reduce allergic outcomes, making the maternal diet before and during pregnancy and during lactation an opportunity for intervention.13 It's been speculated that fish oil supplementation throughout pregnancy may help reduce or prevent allergies in childhood and that omega-3 fatty acids may influence immune system development in the fetus; this could reduce inflammatory responses and, therefore, decrease the occurrence of certain allergic phenotypes.14

A 2016 review included analysis of five randomized controlled trials and 10 prospective cohort studies investigating the effect of prenatal omega-3 fatty acid supplementation on eczema, rhino-conjunctivitis, asthma, and sensitization in subjects' offspring.14 One study reported a reduction in eczema severity, and pooled results showed decreased incidence of atopic eczema at 12 months. Another study found a reduction in "sensitization to egg" and "sensitization to any food" at 12 months. Aside from these findings, no significant differences were discovered.14 Two other reviews published a year earlier found similar results; one suggested the need for larger, longer, and more carefully designed research that also takes into account the intake of omega-6 fatty acids in the study population.13,15

On par with these suggestions, one study conducted a six-year follow-up with the offspring of mothers who participated in the DHA to Optimize Mother Infant Outcome

trial.16 The researchers found no difference in incidence of allergic disease symptoms, including eczema, wheeze, rhinitis, or sensitization. Another study followed the offspring of the mothers for 24 years in a randomized controlled trial from 1990 to investigate the effects of supplementation on the risk of asthma and allergic respiratory disease.17 The researchers found that members of the fish oil group had a significantly reduced probability of having had asthma medication prescribed, indicating that maternal fish oil supplementation may have a role in asthma prevention. The researchers also noted an insignificant reduction in the incidence of allergic rhinitis.

The reviews and studies published thus far have produced some supportive results that warrant further research on fish oil supplementation during pregnancy for the reduction of childhood allergic disease. At this point, the evidence is still too inconsistent and inconclusive to recommend the use of fish oil supplements specifically for reducing childhood allergies.

Dementia Prevention

The known role of omega-3 fatty acids, specifically DHA, in brain development and function has led to research investigating omega-3 supplementation's effects on numerous cognitive conditions. Amongst them, dementia has been one of the more thoroughly researched. Prevalence of dementia is rising at an alarming rate, and this fact has made the condition a public health priority. It's thought that the underlying mechanisms that eventually lead to dementia begin 10 to 15 years before clinical symptoms.18 Thus, nutrition intervention before and after diagnosis could be a viable method of prevention and treatment.

A review of randomized controlled trials was conducted to assess the effect of omega-3 fatty acid supplementation on dementia prevention. In the majority of studies, the intervention lasted at least six months and the participants were aged 60 or older without dementia or cognitive impairment. Main outcomes assessed to determine cognitive function and screen for dementia included everyday mental skills—word learning, digit span, and verbal fluency. The review reported that the trials analyzed showed no significant effect on cognitive function in cognitively healthy older adults.19

In a study published in 2016, cognitively healthy participants aged 50–75 took 2,200 mg per day of omega-3 fatty acids for 26 weeks. These individuals recalled object locations significantly better than did their counterparts in the placebo group. In contrast to the summary of findings from the previous review discussed, the results of this study support the hypothesis that omega-3 fatty acid supplementation could help maintain memory function in healthy older adults.20 These results suggest a need for further research with consistent intervention methods and longer follow-up to provide insight for future recommendations. Until then, the evidence for omega-3 fatty acid supplementation to prevent dementia is insufficient for any conclusive recommendations.

CVD

Researchers began to notice a relationship between omega-3 fatty acids and cardiovascular health in the 1970s, when epidemiologic studies revealed low cardiovascular mortality among populations with high fish consumption. Further research led to the current recommended intakes of omega-3 fatty acids via dietary sources, such as fatty fish, for general health and primary CVD prevention in healthy individuals.1 For a decreased risk of CVD, it's recommended that healthy individuals consume on average roughly 500 mg per day of EPA and DHA. Exact amounts of EPA and DHA vary by fish type, but individuals can meet this recommendation by consuming approximately two 6-oz portions of fish per week.4

Research has since provided further evidence that consumption of omega-3 PUFAs via fish and fish oil supplements can reduce all-cause mortality, cardiac and sudden death, and stroke. The strength of this evidence varies and appears to be stronger for secondary vs primary CVD prevention,21 so supplementation may be beneficial for individuals who have experienced some sort of cardiovascular condition or have elevated serum triglycerides. Based on the current literature supporting this statement, the American Heart Association recommends that individuals with coronary heart disease consume 1 g per day of EPA and DHA via fish oil supplementation under physician supervision.22 It doesn't make any recommendations for the use of fish oil supplements in healthy individuals.

Fish oil supplementation has been shown to help lower serum triglyceride levels in people with hypertriglyceridemia, a known risk factor for various cardiovascular complications.23 Prescribed doses of 2 to 4 g per day have successfully lowered levels in clinical trials, but research is lacking on how other confounding factors, such as individuals' underlying health status and inherent CVD risk, along with the duration and amount of omega-3 fatty acid consumption, could affect this relationship.1

Omega-3 PUFAs' role in heart remodeling and recovery after a heart attack also has been a topic of interest for researchers. A recently published randomized trial provided evidence that 4 g daily of prescription omega-3 fatty acids from fish oil for six months after an acute myocardial infarction resulted in significant improvements in left ventricular end-systolic volume and noninfarct myocardial fibrosis. Both of these endpoints measure how well the heart recovers after potential damage to its shape and function from a heart attack.24 Researchers administered the treatment with meals in four 1-g doses throughout the day in addition to current guideline-based postmyocardial infarction therapies. The results suggest that adding omega-3 fatty acids to treatment guidelines could help improve survival for those who already have suffered from a heart attack.25

An important point is that prescription omega-3 fatty acids from fish oil used in clinical trials and treatment for CVD or hypertriglyceridemia aren't the same as over-the-counter dietary fish oil supplements. Prescription drugs are regulated and must be tested to ensure they don't contain unwanted ingredients, toxins, or differing amounts of ingredients than those stated on the label. Furthermore, fish oil supplementation at

levels greater than 3 g per day can have adverse side effects and always should be monitored by a physician. For these reasons, it can be dangerous to substitute dietary fish oil supplements for prescription fish oil supplements for the treatment of CVD.26

Some conflicting research exists regarding the benefit of omega-3 fatty acid intake from fish or fish oil supplements and heart disease. A 2003 study by Burr and colleagues, published in the European Journal of Clinical Nutrition, measured the effect of dietary advice on mortality among men under age 70 with angina. One group was advised to either consume two portions of oily fish per week or up to three fish oil capsules; another was advised to consume more fruits, vegetables, and oats; a third group was given both types of advice; a fourth group received no specific advice. The study assessed mortality after three to nine years. Unexpectedly, the authors found that the group advised to eat fish or consume fish oil supplements had higher mortality from cardiac and sudden death. This result was more significant among the participants who were given fish oil capsules than in those who chose to consume fish. The authors offered several potential explanations for these findings, including the possibility that taking fish oil may have decreased patient compliance with other medications. Patients also may have increased risk-taking behaviors in relation to diet and lifestyle due to a perception that fish oil capsules greatly reduced their danger of complications from heart disease. The authors also acknowledged that fish or fish oil consumption might increase the risk of cardiac or sudden death specifically in patients who experience angina. Further studies are needed.

A 2017 meta-analysis of randomized controlled trials and prospective cohort studies aiming to understand the relationship between EPA and DHA consumption and coronary heart disease (CHD), published by Alexander and colleagues in Mayo Clinic Proceedings, included the conflicting research mentioned above. The analyses still concluded that the evidence showed there's a CHD risk reduction with higher intake of EPA and DHA, but it's only significant among higher risk populations with elevated triglycerides and LDL cholesterol. Further analysis showed an association with increased EPA and DHA intake and decreased risk of any CHD event. Although conflicting research exists, the majority of results suggests a CVD risk reduction benefit associated with increased intake of omega-3 fatty acids.

IBD

Fish oil supplementation also has been studied as a possible treatment for IBD. Crohn's disease and ulcerative colitis, the two main types of IBD, occur when the intestine can no longer distinguish pathogenic from commensal bacteria in the gut, a situation that leads to overproduction of proinflammatory factors and a perpetually inflamed intestine. People with IBD suffer from irregular bowel habits, pain, bleeding, and an increased risk of bowel cancers. There's a known genetic component to the disease, but researchers speculate that environmental factors such as diet may contribute to the exponential rise in IBD observed over the past 50 years.27

Immunosuppressive drugs are commonly used to treat IBD, a situation that can result in an increased risk of infection. This risk has led to research for alternative therapies. Fish oil supplements may help reduce or prevent further complications associated with IBD due to their anti-inflammatory properties and potential ability to ameliorate oxidative stress.28 Many studies use the maintenance of remission as an outcome to test the efficacy of omega-3 fatty acids in treating this disease.

Two randomized, double-blinded, placebo-controlled studies measured the effect of 4 g per day of omega-3 fatty acid treatment on clinical relapse of Crohn's disease, without any other treatment, for up to 58 weeks. The studies were fairly large, including a total of roughly 380 participants in each. The authors didn't observe a significant difference in relapse rates at one year between the omega-3 and placebo groups in either trial. They concluded that omega-3 fatty acid treatment wasn't effective in the prevention of Crohn's disease relapse.29

Another review analyzed four randomized placebo-controlled trials to determine the efficacy of omega-3 fatty acids for maintenance of remission specifically in Crohn's disease. Participants had to be in remission at the time of recruitment, were followed for at least six months, and received specified doses of fish oil or omega-3 fatty acids. The authors found a nonstatistically significant benefit on maintaining remission. When they performed a subgroup analysis on the studies that used enteric-coated capsules vs gel capsules, they found this benefit was significant and concluded that enteric-coated omega-3 capsules may be effective for maintenance of remission. Again, however, further research is necessary.30

Until science sheds more light on the relationship between omega-3 fatty acids and IBD, there's insufficient evidence to recommend fish oil supplementation as an effective treatment for the condition.

Postexercise Muscle Soreness and Inflammation

The anti-inflammatory effect of omega-3 fatty acids is being investigated as a method to inhibit muscle damage after exercise. If it's effective, decreased muscle damage could reduce postexercise muscle soreness and improve performance during subsequent bouts of activity.31

One repeated measures intervention trial tested exercise-induced inflammation markers after a 14-day control trial in which participants followed a low-omega-3 diet and performed an eccentric biceps curl exercise with one arm. For the experimental trial, participants consumed 2 g EPA and 1 g DHA per day for seven days while following the same omega-3 restricted diet. They then performed the biceps curl with the arm opposite to that used in the control trial. Inflammation markers were tested 48 hours after exercise in both trials. The results showed a significant decrease in muscle soreness in the experimental trial and a significant increase in eccentric exercise repetitions completed in set one and two by the experimental group.32

A more recent randomized, double-blinded, placebo-controlled study by Corder and colleagues on healthy 20- to 60-year-old women tested the effect of 3 g per day of DHA on postexercise muscle soreness, swelling, stiffness, skin temperature, and salivary C-reactive protein. The women consumed the supplements for seven days before, the day of, and two days after the assigned strength exercise. The DHA supplementation group had 23% lower soreness ratings than did the placebo group, and significantly more women in the DHA group could perform a full elbow extension two days after the maximal-effort eccentric biceps curl exercise. These findings support previous research demonstrating a beneficial effect of fish oil supplementation on postexercise markers in groups of men and women. It's one of few studies to test an entirely female group of participants as well as a supplement containing only DHA.33

These findings offer compelling evidence for the use of fish oil supplements as viable alternatives to NSAIDs for relief of inflammation and pain after strenuous exercise. This information could be useful when counseling athletes or individuals initiating strenuous exercise. That being said, limitations in the research include small sample sizes and difficulty controlling dietary intake, warranting the need for further, more conclusive research.

Risks and Precautions

There are some risks associated with fish oil supplementation to be aware of when counseling clients. Fish oil can act as a blood thinner and increase the risk of excessive bleeding at levels greater than 3 g per day. For this reason, it's advised that supplementation with more than 3 g always should be supervised by a physician. This risk can become even greater when the use of fish oil is paired with blood-thinning medications such as warfarin or aspirin.22

Always ask clients whether they have fish or shellfish allergies and if so, how severe are their allergies. It's still uncertain whether individuals with these allergies tolerate fish oil supplements. It may be best to err on the side of caution or to recommend alternative omega-3 fatty acid supplements that are sourced from marine algae instead of fish.22

Minor gastrointestinal side effects have been reported from consumption of fish oil supplements. These symptoms include belching, indigestion, and diarrhea.34 Suggest that clients consume supplements with or after a meal to help avoid or reduce any discomfort.

Because supplements aren't regulated by the FDA, they may contain unlisted contaminants or different amounts of the key ingredients than those listed on their labels. Recommend that clients look for supplements with labels containing seals of approval from independent certification programs from organizations such as ConsumerLab.com, US Pharmacopeial Convention, and National Science Foundation.

Dietary Recommendations

When counseling clients who are suffering from or are at risk of the conditions discussed, the best approach is to evaluate their intake of omega-3 fatty acids first to determine whether it's adequate to avoid deficiency. If clients aren't meeting their requirements, dietitians should discuss dietary strategies first. If certain individuals, such as those with hypertriglyceridemia, may benefit from prescribed omega-3 supplementation, RDs can contact their physicians or suggest patients contact their physicians to discuss the options.

A majority of the preventive benefits from omega-3 fatty acids of healthy individuals have the most scientific support when the fatty acids are consumed via dietary sources. Therefore, consumption of fish, shellfish, and plant sources should be the first line of action to meet omega-3 fatty acid recommended intake levels for healthy individuals. As mentioned previously, certain obstacles make it either difficult or impractical for some individuals to meet recommendations via food. If clients don't consume enough omega-3 fatty acids in their diets due to obstacles they can't avoid, it may be appropriate to recommend fish oil supplementation to avoid deficiency. For vegetarians or vegans, a marine algae omega-3 supplement is an option.

When determining an appropriate supplemental amount for clients, remember that the AI for ALA is 1.1 g per day for women and 1.6 g per day for men, while the AMDR is 0.6%–1.2% of total energy intake. Roughly 10% of the AMDR is recommended as EPA or DHA. Although there isn't an established upper limit for omega-3 PUFAs, potential risks are associated with intake greater than 3 g per day, so advise clients to stay within the intake range of 1 to 3 g daily.

The research supporting fish oil supplementation for the prevention and treatment of the majority of the diseases mentioned in this course isn't as strong or consistent as needed to make firm recommendations about its use. Furthermore, any supplementation for the treatment of disease always should be monitored by a physician and often involves the use of prescribed supplements vs dietary supplements.

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Quiz

1. How is alpha-linolenic acid (ALA) different from EPA and DHA?
A. It's an omega-6 fatty acid, while EPA and DHA are omega-3 fatty acids.
B. It occurs naturally in fatty fish and shellfish.
C. It must be converted to EPA and DHA in the body to be used for other bodily processes.
D. It promotes proinflammatory responses while EPA and DHA promote anti-inflammatory effects.

2. Why is maternal intake of omega-3 fatty acids during pregnancy important?
A. EPA helps prevent inflammation while the fetal brain is developing.
B. DHA plays a role in fetal brain development.
C. Evidence suggests that fish oil supplements will improve children's IQ.
D. Research has proven that fish oil supplements reduce postpartum depression.

3. What conclusions can be drawn from the current research on fish oil supplementation and childhood allergies?
A. The evidence supports it during pregnancy, indicating that it reduces the outcome of all allergic disease in childhood.
B. The results are mixed, so RDs may advise clients to take a supplement to be safe.
C. Research shows no indication that it can reduce allergies.
D. Some research shows that it may reduce allergic symptoms, such as asthma or sensitization to egg, but the evidence isn't strong enough to support firm recommendations.

4. What were the results of the 2016 study on fish oil supplementation and memory function in healthy older adults discussed in this course?
A. Fish oil supplementation of 2,200 mg per day may help preserve memory function in healthy older adults, but further consistent results with longer follow-up are necessary to make conclusive recommendations.
B. The study showed there was no significant effect on memory function between the supplement group and the placebo group.
C. The results showed fish oil supplementation significantly improved word learning, digit span, and verbal fluency in the supplement group vs the placebo group.
D. The study proved fish oil supplementation helps prevent dementia in older healthy adults.

5. In regard to cardiovascular disease (CVD), which statement about fish oil supplementation has the most scientific support?
A. Fish oil supplementation is most beneficial for secondary prevention of CVD.
B. Fish oil supplementation is most beneficial for primary prevention of CVD.
C. Prescription fish oil doses of 2 g per day improve heart recovery after a heart attack.
D. Regardless of other confounding factors, fish oil has been shown to reduce serum triglycerides.

6. Why are researchers interested in omega-3 polyunsaturated fatty acid (PUFA) supplementation as an alternative treatment for inflammatory bowel disease (IBD)?

A. The current treatment options have no side effects but are very expensive.
B. The current treatment options are less effective than fish oil supplementation on clinical relapse.
C. The current treatment options can lead to increased risk of infection, and omega-3 PUFAs' anti-inflammatory effects may reduce symptoms of the disease.
D. Omega-3 PUFAs have proinflammatory effects that may reduce symptoms of IBD.

7. Why was Corder and colleagues' study on supplementation and exercise significant?

A. It was the first study of its kind to include men and women as well as an EPA-only supplement.
B. The study was the first to find that omega-3 PUFAs significantly decreased inflammation markers and muscle soreness after resistance exercise.
C. The authors found no significant effect of omega-3 PUFAs on inflammation markers or muscle soreness.
D. It included only women and was the first to use a DHA-only supplement to analyze the effect of omega-3 PUFAs on inflammation markers and muscle soreness.

8. What major risk is associated with the use of more than 3 g per day of fish oil supplementation without physician supervision?

A. Consuming more than 3 g per day can cause excessive bleeding.
B. Belching, indigestion, and diarrhea are the major associated risks.
C. Consuming more than 3 g per day of omega-3 PUFAs can put an individual at risk of blood clots.
D. Consumption of more than 3 g per day can induce chronic inflammation.

9. Based on the research discussed in this article, in which situation would the individual described benefit most from prescribed fish oil supplementation?

A. A pregnant woman consuming a 6-oz serving of low-mercury seafood once per week.
B. Healthy individuals who don't eat seafood, but put walnuts and ground flaxseeds in their oatmeal every morning.
C. An individual with hypertriglyceridemia and a previous history of CVD who consumes walnuts daily, but doesn't eat fish.
D. A cognitively healthy 75-year-old man who consumes fish once per week and snacks on seaweed crisps, nuts, and edamame.

10. What dietary strategy is most likely to help an individual meet the recommended intakes of ALA, EPA, and DHA?

A. A lacto-vegetarian diet containing whole grain pastas, low-fat dairy products, plenty of fruit, and a 500-mg fish oil supplement per day.

B. A diet containing a variety of nuts and seeds, legumes, a fatty fish meal twice per week, and a vegetable dish at every meal.
C. A vegan diet that contains plenty of fruits and vegetables, legumes, and whole grains, but no seafood or omega-3 supplements.
D. A diet that contains mainly poultry, eggs, fruits and vegetables, and occasionally a seafood meal.