



FATS OF LIFE NEWSLETTER

Volume 6 • Issue 1

April 2011 Contents

HEART HEALTH

- High Red Blood Cell Omega-3s Linked to Lower Chance of Heart Attack..... 2
- Chance of Atrial Fibrillation Not Linked to Fish Consumption..... 3
- Lower Chance of Stroke Among Women Who Eat Fish Twice or More Per Week..... 4

MOTHERS AND INFANTS

- Lower Chance of Obesity at Age 3 Associated with Higher Omega-3 Intake in Pregnancy 5

IMMUNE FUNCTION

- Development of Childhood Allergies Sensitive to Maternal Polyunsaturated Fat Intakes 6

MENTAL HEALTH

Alzheimer's Disease

- Lower Chance of Dementia with Higher DHA Consumption..... 7
- Cognitive Decline Unaffected by DHA Supplements in Slightly Impaired Elderly 8

Brain Function

- Omega-3 Deficiency Erodes Vital Brain Signals Related to Mood and Emotion..... 9

VISUAL FUNCTION

- Eating Dark-Meat Fish Weekly Linked to 42% Lower Chance of Early AMD in Women 10
- Pilot Study in Dry Eye Suggests Improvements with Omega-3s..... 11

CLINICAL CONDITIONS

- Omega-3 and Omega-6 Fatty Acids Linked to Bone Health in Complex Ways 12
- Lower Breast Cancer Events in Survivors with Higher Omega-3 Consumption..... 13

FATS OF LIFE STAFF

Editor

Joyce A. Nettleton, DSc
sciencevoice@q.com

Communications Manager

Angela Dansby
angela@fatsoflife.com

Sponsor

DSM Nutritional
 Products, Inc.,
 Kaiseraugst, Switzerland
www.dsm.com

Letters and editorial comments should be submitted to Nettleton at sciencevoice@q.com and technical comments to Dansby at angela@fatsoflife.com.
 Subscribe to *Fats of Life* at www.fatsoflife.com.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

HEART HEALTH

High Red Blood Cell Omega-3s Linked to Lower Chance of Heart Attack

The omega-3 fatty acids in fish improve heart health and lower the chance of dying from heart disease. Individuals with higher levels of omega-3s in their red blood cells also have a lower risk of developing potentially fatal uncontrolled heartbeats.

risk of heart disease, heart attack, irregular heart rhythms and possibly other chronic health problems. Seafood omega-3s consumed regularly are taken up in the heart where they are available to promote stable electrical activity and tone down inflammation. They also improve how the heart's blood vessels function.

A group of investigators in Norway, Scotland and the U.S. were curious to find out whether the omega-3 status in individuals who suffered a heart attack or developed sudden cardiac arrest (where the heart stops beating) and recovered was related to their chances of developing ventricular arrhythmia. This condition is uncontrolled, rapid beating in the lower chambers of the heart, which if not corrected immediately, can be fatal. Because seafood omega-3s help stabilize the heart's electrical activity, there was good reason to think that having higher levels of omega-3s on board might reduce the risk of fatal arrhythmia after sudden cardiac arrest.

To study this tricky situation, the investigators examined the omega-3s in the red cells of three types of patients who were admitted to the hospital with heart problems. Patients included those who had sudden cardiac arrest with or without a heart attack (myocardial infarction)

plus those who had a heart attack without sudden cardiac arrest. For a final comparison, they looked at the omega-3s in a group of healthy individuals. They examined the omega-3s in the red blood cells of samples taken within the first 8 to 12 hours and again after 24 to 48 hours. The investigators monitored the patients for the development of ventricular arrhythmia within the first 48 hours after admission.



Although the patients had different backgrounds with respect to heart attack, several observations emerged that applied to all who were in the study. First, the long-chain omega-3s in the red blood cells remained stable throughout the first 48 hours. Second, the omega-3 status of patients was significantly lower than in the healthy controls. Third, patients who had a first or recurrent heart attack had lower omega-3 levels in their red blood cells compared with patients who experienced their first episode of arrhythmia. Finally, patients who experienced a heart attack, with or without sudden cardiac arrest, had lower omega-3 levels than those who had sudden cardiac arrest but no heart attack. Although it sounds confusing, these observations suggest that individuals with low omega-3 levels are more likely to suffer a heart attack than those with higher levels.

Individuals who experienced sudden cardiac arrest or a heart attack were nearly 60% less likely to develop potentially fatal arrhythmia if they had high concentrations of omega-3s in their red blood cells.

The investigators also determined that those patients who experienced their first myocardial infarction, but had higher levels of omega-3s in their red blood cells, had a nearly 60% lower chance of developing ventricular arrhythmia compared with similar patients with low omega-3 levels.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

These observations confirm earlier reports that the long-chain omega-3s in red blood cells are a good predictor of the likelihood of future undesirable heart events. They also suggest that the red blood cell omega-3 concentration obtained within the first 48 hours of a serious heart event is a good reflection of the individual's omega-3 status prior to the event.

This study, although involving only a small number of patients, provides additional evidence that people who boost the omega-3 level in their red blood cells are likely to lower their chance of having a heart attack or potentially fatal ventricular arrhythmia. With sudden cardiac death accounting for the great majority of heart disease fatalities, eating fish more often may be the easiest action a person can take to avoid such an event.

Chance of Atrial Fibrillation Not Linked to Fish Consumption

Omega-3s from fish might lower the chance of developing electrical disturbances in the heart. However, research results are mixed, with some reporting a lower chance of atrial fibrillation and others finding no effect. A new report from the Framingham Heart Study adds neutral findings.

of the heart. When this happens, blood is not sufficiently pumped into the lower chamber of the heart. The pooling of blood in the atria increases the chance that a clot can form, with the possible consequence of a stroke. A short video of atrial fibrillation describes the condition.

It is reasonable to think that omega-3s, which tend to stabilize heart rhythms, would facilitate normal heartbeats. The problem is, there are now several studies

reporting that these fatty acids have no effect on the chance of developing atrial fibrillation and just about as many others reporting that they are linked to a lower chance of the condition. Why are there such substantial differences among studies?

Even allowing for the considerable differences among patients, the various types of atrial fibrillation and the wide variance in the doses and duration of omega-3 treatments, these disparities suggest that something is missing or that they may not have any effect. Now, data from the famous Framingham Heart Study that followed the diet and health events of two generations of people living in Framingham, Mass., describes the relationships between fish consumption and the likelihood of developing atrial fibrillation over 4 years. The report is based on individuals who were 62 years of age on average.

The Framingham participants ate fish on average twice a week, which is more than most people in the U.S. They consumed an average of 265 mg of long-chain omega-3s per day, an amount considered by some experts sufficient to reduce the risk of heart disease mortality. That amount is more than twice the amount the average American consumes.

Over the 4-year follow-up, the researchers observed no association between the amount of fish or long-chain omega-3s consumed and the chance of developing atrial fibrillation. They did note, however, that moderate to heavy alcohol intake was linked to a 35% greater chance of the condition. When the investigators examined the

type of fish consumed, they were startled to find that individuals who consumed 4 or more servings per week of dark fish, such as salmon, swordfish, Atlantic bluefish, mackerel or sardines, were 6½ times more likely

The Framingham study found no link between total fish consumption and the chance of developing atrial fibrillation. Those who ate dark fish 4 or more times a week appeared to have a higher risk, but this was probably due to chance.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

to develop atrial fibrillation compared with those who ate less than 1 serving of these fish per week.

The authors suspect that this striking observation may be due to chance. That is likely because only 21 people in the study from a total of more than 4,500 ate that much dark fish and of these, only 5 developed atrial fibrillation. Those numbers are far too small to support any conclusion. There is one other report of a higher risk of atrial fibrillation with higher fish consumption, but that has not been confirmed in any other studies.

This report found no link between total fish consumption and the chance of developing atrial fibrillation in older adults who regularly ate more fish than the average American. In a very small number of participants who ate dark fish 4 times a week or more, the risk of atrial fibrillation was increased, but this observation was mostly likely a chance occurrence. It takes many more observations in heavy fish eaters to determine whether eating dark fish frequently affects the chance of atrial fibrillation.

Lower Chance of Stroke Among Women Who Eat Fish Twice or More Per Week

Some, but not all, studies have reported that fish consumption is linked to a lower chance of developing a stroke. A new study from Sweden reports that women who eat fish two or more times per week have a 16% lower likelihood of a stroke.

diabetes or high cholesterol levels and if they smoke. Many of these conditions can be managed with changes in lifestyle and good medical care. Healthful eating makes a difference too, because it can help lower

blood pressure, weight and blood cholesterol. There is another dietary strategy that may have an advantage: eating fish often.

Health educators have shied away from recommending greater fish consumption to reduce the chance of stroke because the evidence has been inconsistent. Eating fish helps reduce the chance of heart disease and mortality, but its contribution to stroke prevention has been debatable.

There are good reasons to suspect that fish consumption might moderate the likelihood of a stroke. That is because the omega-3 fatty acids (omega-3s) in fish improve the function and tone of blood vessels, have a modest blood-pressure-lowering effect and lower the tendency for blood clots to form. In this new report, investigators calculated the chance of developing a stroke in nearly 35,000 middle-aged to elderly women living in Sweden who were monitored for 10 years.

Swedish women who ate fish 4 or more times per week had a 28% lower chance of developing a stroke compared with women who ate fish less than once a week.

Fish consumption is common in Sweden and on average the women in this study ate fish twice a week. The investigators observed that the chance of developing a stroke decreased with higher fish consumption. Overall, women who ate fish twice or more per week were 16% less

likely to develop a stroke compared with women who ate fish less than weekly. Women who ate 4 or more meals of fish per week had an even lower chance (28%) of a stroke. In this population, there was no difference according to the type of fish consumed, fatty or lean. That unexpected observation might have been because people in Sweden frequently eat fatty fish in salted form. High intakes of sodium (from salt) increase the chance of high blood pressure and stroke.

It should be noted that these observations pertained to ischemic stroke, the kind resulting from impaired blood flow to the brain. This is by far the most common type of



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

stroke in the U.S. and many Western countries. Women who ate fish regularly were also more likely to eat more fruit and vegetables and consume alcohol compared with women who ate fish infrequently.

MATERNAL AND INFANT HEALTH

Lower Chance of Obesity at Age 3 Associated with Higher Omega-3 Intake in Pregnancy

New research suggests that the types of fat consumed in pregnancy may affect the offspring's chance of becoming obese.

Many of the reasons for the high rates of overweight and obesity around the world, especially in many western countries, are well understood. Inactivity, taking in more calories than one expends and the types of food consumed all contribute to weight gain.

Now, another aspect of the foods we eat is gaining attention. That is the low intake of omega-3 fatty acids found mainly in fish and seafood in the presence of large amounts of omega-6s found in most vegetable oils.

Animal studies have suggested that this relative imbalance in the types of fatty acids in the diet actually promotes the development of fat tissue. However, there are very few studies in humans that have assessed this possibility. A report that focused on childhood obesity and the mother's diet during pregnancy suggests that these two conditions might be related.

Researchers at the Harvard Medical School examined the relationship between the type of fat a mother consumed at mid-pregnancy and whether her child was



obese at age 3. To determine whether a child was obese, they used the child's body mass index, a commonly used measure that relates an individual's weight and height to standard norms. The researchers also evaluated the child's fatness by taking two skinfold measurements. Skinfold thickness is a more direct indication of body fatness than weight alone.

More than one-third of the mothers were overweight or obese before pregnancy. A fifth of them ate more than 2 fish meals per week at mid-pregnancy, but only about half of the women achieved the recommended intake of DHA, a long-chain omega-3 important for fetal and infant development. The recommended intake of DHA in pregnancy and lactation is 200 mg per day. This observation suggests that even though the women ate fish, they did not consume enough of the fatty species—such as salmon, tuna, mackerel, rainbow trout, sardines and herring—to meet the recommended DHA intake. An even greater concern was the observation that only 3% of the women consumed 200 mg/day of DHA in the last month of pregnancy. This is the time when large amounts of DHA are transferred from the mother to the infant to support its brain growth spurt.

The chance of a child becoming obese by the age of 3 was 32% lower if their mothers had higher intakes of omega-3 fatty acids during pregnancy.

The investigators calculated the odds for obesity in the offspring at age 3 according to the mother's omega-3 fatty acid intake and the level of omega-6s and omega-3s in cord blood at delivery. The odds of obesity in the 3-year-old offspring were 2 to 4

times higher when the amount of omega-6s relative to the amount of omega-3s in cord blood was high. A similar pattern was seen for dietary fatty acid intake and mid-pregnancy blood fatty acid values.

In contrast, the odds of obesity were 32% lower when the mother's consumption of omega-3s was higher or she had higher cord blood omega-3 fatty acids. The child's intake of fish was not related to the development of obesity. This study is the first indication in



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

humans that low intakes of omega-3s in the presence of large amounts of omega-6s during pregnancy might affect the chance of obesity in the offspring. These findings need to be confirmed by others. It will also be important to demonstrate that making deliberate changes to a woman's fat intake during pregnancy has desirable effects on weight and fatness in children.

IMMUNE FUNCTION

Development of Childhood Allergies Sensitive to Maternal Polyunsaturated Fat Intakes

Studies of maternal supplementation with omega-3s in pregnancy or lactation have had mixed results on allergies in the offspring. A new study reports that supplementation in pregnancy and lactation might make a difference.

and allergic rhinitis. These conditions are known as hypersensitivity disorders because they involve strong inflammatory responses and the production of antibodies called IgE. Many treatments aim to suppress the inflammatory responses associated with the symptoms. For that reason, researchers have examined the effects of omega-3 fatty acids from seafood in the development and treatment of these conditions.

The reason omega-3s have drawn attention in the field of allergy is their ability to dampen inflammatory responses. They do this through various strategies and can sometimes bring symptom relief. They do not cure the conditions. It has been thought that because the infant's immune system is not fully developed during fetal life, increasing the pregnant woman's intake of omega-3s might reduce the likelihood of a susceptible infant developing allergies. Some results have been

encouraging, others not so much. The lack of effect in some studies has been attributed partly to a high background intake of omega-6 fatty acids, the kind abundant in most vegetable oils.

Authors of a study in which pregnant women consumed 3 g/day of seafood omega-3s and experienced a decrease in the allergies of their offspring have just reported another study in omega-3-supplemented pregnant women. In this study, pregnant women



with at least one family member having a history of allergic symptoms consumed nearly 3 g/day of seafood omega-3s from mid-pregnancy through 15 weeks of lactation. They assessed the children for symptoms of allergies at frequent intervals for the first 2 years after birth.

The findings were quite interesting. Infants of mothers who had the highest blood levels of DHA, a key omega-3, had the lowest occurrence of IgE-associated allergic disease over the 2-year period. However, these infants were more likely to develop non-IgE-associated allergies. The opposite was true for infants whose mothers had relatively high levels of arachidonic acid (an omega-6 fatty acid) relative to the amount of EPA (one of the major seafood omega-3s). These infants

were the least likely to develop non-IgE-associated allergies, but were most likely to develop the IgE sort. There were no allergy associations with any other fatty acids of either type.

Infants whose mothers consumed 3 g/day of omega-3s in pregnancy and lactation were less likely to develop IgE-mediated allergic disease than infants of placebo mothers. Multiple allergic symptoms were also less likely in the infants of omega-3 mothers.

Conversely, infants of mothers in the lowest category of blood DHA level were more likely



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

to develop IgE-associated disease (40%) compared with infants of mothers in the highest category (10%). The investigators also observed that the occurrence of multiple allergic symptoms, for example, eczema and food allergy, was more frequent in the infants of mothers taking the placebo than in the omega-3 infants. Allergy severity was not related to the treatment group or fatty acid status of the mother.

Several features make this study compelling. One is the relatively large amount of seafood omega-3s the mothers consumed and the infant's exposure to these fatty acids in both fetal life and early infancy. This period coincides with the rapid development and maturation of the child's immune system. It is also useful that the investigators determined the type of allergic disease the infants developed and demonstrated a difference in the allergic response to different dietary fatty acid patterns. These aspects help distinguish which types of allergy might respond to changes in the mother's fatty acid intake during pregnancy and lactation. One hopes that others can confirm these observations in a similar study design.

MENTAL HEALTH

Alzheimer's Disease Lower Chance of Dementia with Higher DHA Consumption

There are many reasons to think that higher intake of fish or the omega-3 fatty acids (omega-3s) they provide may reduce the chance of developing Alzheimer's disease and other types of dementia. However, the evidence for that in humans is mixed. Animal and cell studies strongly suggest that DHA (docosahexaenoic acid), one of the

Animal and cell studies strongly suggest that DHA, a long-chain omega-3 fatty acid, is involved in protecting neurons from harm. Studies with DHA in the prevention or treatment of dementia have given mixed results. A new study is encouraging.

long-chain omega-3s, is involved in protecting brain neurons. Other work has demonstrated that omega-3s reduce the abnormal amyloid- β pathology and dendritic damage that characterize Alzheimer's disease. On the other hand, studies in which individuals with mildly impaired mental function were provided additional DHA or omega-3s did not report improvements in cognition. We do not know why.

A long-term study of elderly residents in California evaluated whether there was a relationship between fish or omega-3 consumption and the participants' chance of developing dementia or Alzheimer's disease. The individuals in the study were carefully screened for their mental performance with 5 tests and clinical evaluations so that only those considered at higher risk for dementia were included. The investigators examined the fish and omega-3 intakes of the participants as well as their blood levels of DHA. Measuring blood DHA is considered a more valid assessment of nutrient status than dietary estimates because the measurements are less variable, reflect long-term dietary intakes and are not subject to recall errors.

One striking observation was that nearly 60% of the participants reported that they never ate fish. Only 15% said they ate fish once a week or more. Thus, it would be expected that overall, these individuals would have low intakes of DHA and lower amounts of DHA in their blood.

The researchers found that those who developed dementia had lower fish intakes and less DHA in their blood than those without dementia. Those in the lowest third of blood DHA levels were 2.4 times more likely to become demented and 2.3 times more likely to develop Alzheimer's disease compared with those in the

Elderly individuals with low fish and DHA consumption or low levels of DHA in their blood were more than 2 times more likely to develop dementia than similar individuals with higher DHA in their blood.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

highest two-thirds of blood DHA. Similar findings were observed in terms of DHA intake, except that the odds of developing dementia and Alzheimer's disease were even greater.

This observational study is noteworthy because of its rigorous screening of participants, which means fewer were likely to be misclassified. Another detail was the assessment of DHA in both the diet and blood, with results from each being consistent. On the other hand, an observational study cannot show that DHA caused the lower chance of dementia, but these findings point in that direction.

Cognitive Decline Unaffected by DHA Supplements in Slightly Impaired Elderly

One in 8 Americans over the age of 65 or about 5 million people have Alzheimer's disease, the leading type of dementia. By 2050, that number may reach 11 to 16 million. So far, nothing prevents or stops this disease. Can DHA help?

There is an air of a race-against-time in the quest for treatments that might prevent or delay the onset of Alzheimer's disease. That is because there is nothing so far that might prevent this progressive degeneration of the brain that develops mainly in

individuals over the age of 65. Nothing halts the slow loss of mental function that precedes and accompanies the condition. And nothing stops the disease in its tracks once it starts, although the rate of progress varies. Right now, about 1 in 8 older Americans have the disease, making a total of about 5.4 million people in the U.S. with Alzheimer's. With the rapidly expanding population of individuals over the age of 65, it has been estimated that by 2050, the number of people with the condition in the U.S. may reach 11 to 16 million. No wonder there is a sense of urgency.

Several observations suggest that the long-chain omega-3s found mainly in fish might be useful in

preventing or slowing the march of this disease. One is that DHA (docosahexaenoic acid), one of the long-chain omega-3s, is the predominant polyunsaturated fatty acid in the brain and is critical for healthy nerve function. Healthy people who consume fish or omega-3s have a lower chance of developing Alzheimer's disease than people who do not eat fish.

Omega-3s have also been linked to a slower rate of cognitive decline in the elderly, though not all studies have observed this association. Third, people who die with Alzheimer's have less DHA in their brain than similar people without the condition. Fourth, DHA is the precursor of a substance in the brain called neuroprotectin D1 that helps neurons survive and protects them against injury.

Not surprisingly, some investigators have provided omega-3 supplements to individuals with the condition in the hope of slowing Alzheimer's progress. Unfortunately, most studies have reported no differences in the treated individuals compared with those given a placebo. There is some indication that individuals who have only mildly impaired cognition might benefit from consuming more DHA or omega-3s. Although not all studies are in agreement, it appears that individuals with only very mild mental decline might benefit from additional DHA or omega-3s.

A large, collaborative study covering 19 clinical centers in the U.S. explored the effect of providing 200 mg/day of DHA to individuals with probable Alzheimer's disease, but no diagnosis of dementia. They were considered to have mild or moderate cognitive impairment. Individuals receiving the treatment were asked to consume 2 g/day of DHA in capsule form for 18 months. Another group consumed placebo capsules. At the end of the study, they were given a battery of mental function tests to assess their change in various cognitive scores over the study period.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

Supplementation with DHA for 18 months did not benefit mental function in individuals with mildly impaired cognition. However, the loss of mental function was slower with DHA treatment in individuals not having the APOEε4 gene variant.

After 18 months, the assessments of Alzheimer's disease, clinical dementia or the rates of cognitive decline did not differ between the DHA-treated and placebo groups. However, when the investigators separated the participants according to the presence of a genetic variant known as *APOEε4*, they found that participants without this gene who consumed the DHA supplement had a significantly slower rate of cognitive decline compared with those carrying the gene. It has been known from previous research that having this gene variant increases the chance of developing Alzheimer's disease. In this study, carriers of the gene did not respond to the consumption of DHA.

Overall, the study did not demonstrate a benefit to mental function from supplemental DHA in elderly individuals with some impaired cognition. This study may not be the last word on this subject, however. It will be useful to evaluate seafood omega-3 consumption in healthy, elderly individuals with no sign of declining cognition to learn if additional omega-3s can help keep them that way. The challenge is to properly identify such individuals.

Omega-3 Deficiency Erodes Vital Brain Signals Related to Mood and Emotion

Certain brain signaling systems are sensitive to omega-3 and omega-6 fatty acids. Omega-3 deficiency impairs these signals in brain regions linked to emotion, mood and food intake.

After 18 months, the assessments of Alzheimer's disease, clinical dementia or the rates of cognitive decline did not differ between the DHA-treated and placebo groups. However, when the investigators separated the participants according to the

presence of a genetic variant known as *APOEε4*, they found that participants without this gene who consumed the DHA supplement had a significantly slower rate of cognitive decline compared with those carrying the gene. It has been known from previous research that having this gene variant increases the chance of developing Alzheimer's disease. In this study, carriers of the gene did not respond to the consumption of DHA.

physical activity. It is generally thought that high-fat diets promote weight gain and the accumulation of fat tissue, but how this might work is poorly understood. Recent studies have focused on the ways different fatty acids and their derivatives might influence these processes.

Of particular interest is the signaling process in the brain involved in emotion, obesity, substance abuse, addiction and memory called the endocannabinoid (EC) system. Triggers of this system have been linked to increased feeding, the sense of reward that goes with eating and the formation of fat tissue. Chemical products of the EC system have been related to abdominal fat. Substances that stimulate the EC system are derived from two polyunsaturated fatty acids, arachidonic acid (ARA) and docosahexaenoic acid (DHA). Dietary levels of these fatty acids affect the production of EC substances, with higher amounts of DHA leading to lower levels of ARA-derived ECs.

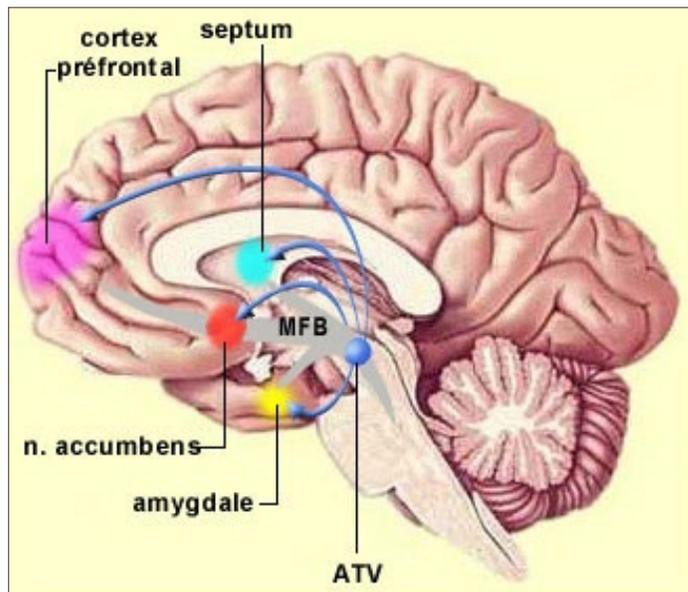


Figure. Brain regions involved in pleasure, reward and mood. The prefrontal cortex is shown in pink. Image source: Wikipedia.

Investigators in France turned their attention to the effects of omega-3 deficiency on the EC system in laboratory mice. They established that omega-3 deficiency



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

results in significantly lower levels of DHA and other omega-3s in the brain and prefrontal cortex (Figure), an area involved in emotional behavior, mood and the reward system among other things. In animals consuming sufficient omega-3s, stimulation of the cortex yielded normal neuronal responses—that is, sustained neural activity followed by a gradually weakened response. In the omega-3-deficient animals, cortical stimulation abolished the usual neural response.

Omega-3 deficiency impaired brain signals in regions involved in mood, emotion, reward and food intake. These findings have implications for mood and other disorders in humans.

The researchers were able to show that these responses were specific to the EC system and did not occur in other types of neuronal activity, such as those governing motor responses. They also evaluated other functional defects in the EC system that result from omega-3

deficiency. In one set of studies, they examined the behavioral activities of the fed and deficient animals, observing reduced exploratory activity and greater anxiety behaviors such as more litter scratching in the omega-3 deficient animals compared with the omega-3-fed mice.

Taken together, this set of studies suggests that omega-3 deficiency greatly interferes with the EC system and results in behaviors characteristic of mood and emotional disorders. Although the work did not focus on obesity, the emotional aspects of this condition could be affected by changes in the EC system reported here. The researchers described detailed changes in the function of the EC system resulting from the extreme imbalance between omega-3 and omega-6 precursors for the EC system. These changes occurred only in certain parts of the brain, namely the prefrontal cortex and regions in contact with it. This investigation makes it more plausible that dietary imbalances in these fatty acids may contribute to a variety of psychosocial problems observed in humans that are linked to the brain's EC system.

VISUAL FUNCTION

Eating Dark-Meat Fish Weekly Linked to 42% Lower Chance of Early AMD in Women

Substantial evidence has accumulated showing that individuals with higher intakes of fish or the omega-3s found in them are less likely to develop age-related macular degeneration (AMD) as they age. AMD is a gradual loss of central vision (Figure) important for reading and driving and it is the leading cause of vision loss after age 60.



Several studies have reported that higher intakes of omega-3s slow the progression of the disease to its more advanced stages. Because AMD can cost a person her eyesight, that is an important development for treating the condition. High intakes of other nutrients, particular antioxidant vitamins and zinc, also deter disease progression, so a combination of nutrients is needed to prevent advanced AMD. Less is known about discouraging early-stage AMD.

This article describes a recent report from the Women's Health Study in the U.S. in which some 38,000 women were monitored for their health for 10 years. Some of the participants had previously taken vitamin E supplements as part of an earlier project, but this treatment did not affect the results. The women provided dietary information that was used to assess their intakes of fish, omega-3s and other fatty acids.

Over the 10-year period, women who ate fish one or more times per week were 42% less likely to develop early signs of AMD compared with women who ate fish less than once a month. The fish-eaters ate mostly tuna and other dark-meat fish, such as salmon, sardines or rainbow trout.

The investigators examined the relationships between the intake of individual omega-3 and omega-6 fatty acids and the development of early AMD. Women in the highest



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

Middle-aged and older women who ate fish, especially dark fish, at least weekly were 40% less likely to develop early AMD.

third of individual and total seafood omega-3s were 40% less likely to develop early AMD compared with women in the lowest third of seafood omega-3 consumption. The plant-based omega-3, alpha-linolenic acid, was unrelated to AMD.

Intakes of the omega-6 linoleic acid were linked to a greater risk of the condition, but this relationship might have occurred by chance. However, in women whose omega-6 intakes were above the median, the effect of omega-3s on a lower risk of AMD was strengthened. The relationship between these two classes of fatty acids is not clear. In some cases they work together and in others, they conflict.

The most important aspect of this study is that it strengthens the suggestion that fish consumption, especially of fatty species, may prevent or delay the development of AMD in women. Few measures have been established for the prevention of early AMD and a relatively simple change in food habits might help retain clear vision for much longer.

Pilot Study in Dry Eye Suggests Improvements with Omega-3s

Omega-3s are being studied for their potential to improve the symptoms of dry eye. A small study reports positive results with dietary omega-3s.

is irritating and has the potential to damage the surface (cornea) of the eye. It is usually treated with eye drops. The condition has attracted research attention because of the frequency of eye surgery, which sometimes precedes dry eye, and other conditions related to its occurrence,

such as autoimmune diseases, and the desire to find out if it can be prevented.

How might dietary fatty acids relate to dry eye? One way is their effect on reducing inflammation. The omega-3s found mainly in seafood are associated with reduced production of substances that stimulate inflammatory responses and serve as precursors for substances that can halt inflammation. In one study of a dry eye model, dietary treatment with omega-3s partly prevented a decrease in mucin production, a secretion that coats the cornea and promotes the even distribution of tears. Another study reported that artificial tear solutions containing alpha-linolenic acid, a plant-based omega-3, improved the symptoms of dry eye and reduced inflammatory changes. These studies suggest that omega-3s might improve dry eye symptoms.

A recently published study in a small number of patients with dry eye syndrome examined whether dietary treatment with omega-3s for 3 months compared with placebo treatment



would affect the patients' symptoms. The treated patients received 750 mg of omega-3s from fish oil and 1,000 mg of flax oil. All participants were given lubricant eye drops to use throughout the study. After 3 months, 70% of patients who consumed the omega-3s (fish oil plus flaxseed oil) no longer experienced dry eye symptoms. That is nearly double the response that was observed in the patients who received the placebo capsules. In both groups, those who still had symptoms improved from a clinical rating of moderate symptoms to mild.

This pilot study reported that 3 months of omega-3 consumption eased the symptoms of 70% of patients with dry eye syndrome.

The study was too small to detect a change in tear production, but there was a tendency for greater tear secretion in the omega-3-treated group. These results are nonetheless encouraging

FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

as they showed that omega-3 treatment of patients with various causes of dry eye was linked to substantial improvement in their symptoms. The response rate of 70% was remarkably high for such studies. Boosting the consumption of omega-3s from supplements or foods would be one of the simplest ways to relieve this condition. A larger, randomized clinical trial that did not mix the types of omega-3s used in the treatment would be the best way to confirm these observations.

CLINICAL CONDITIONS

Omega-3 and Omega-6 Fatty Acids Linked to Bone Health in Complex Ways

Emerging research suggests that omega-3s may increase bone mineral density or slow the loss of bone in older adults. Results are different in men and women and may be linked to omega-6 intakes too.

Emerging research on bone health has suggested that omega-3 fatty acids may be beneficial in maintaining bone mineral density (BMD), a measure of the amount of mineral in bone. BMD is related to the risk of osteoporosis and bone fracture. In older adults, especially postmenopausal women, bones lose more mineral than they accumulate

and gradually become more porous and weaker. These changes make fracture more likely. A greater consumption of calcium, vitamin D and omega-3s might increase BMD and slow the rate of bone loss. Some studies have also suggested that higher intakes of omega-6 fatty acids, the kind that predominate in many vegetable oils, are linked to lower BMD and a greater risk of hip fracture. It is not well understood how fatty acids affect BMD and bone health.

Epidemiologists in the U.S. have been studying the relationships between dietary fatty acids and BMD or the risk of bone fracture in two different study populations. Boston-based investigators examined data on survivors from the Framingham Heart Study, looking at changes in BMD over a 4-year period. They found an interaction between omega-3 and omega-6 fatty acids and the

loss of BMD over the course of the study. Women with higher intakes of the omega-6 linoleic acid, the major polyunsaturated fatty acid in US diets, had lower BMD at the femoral neck over the 4-year study.

Men with higher intakes of seafood omega-3s lost significantly less bone mineral than those whose intakes were low. Their consumption of linoleic acid was unrelated to bone loss. However, those with higher intakes of the omega-6 arachidonic acid, who had the lowest consumption of omega-3s lost more BMD than men whose omega-3 intake was in the highest group.

In terms of fish consumption, men who ate dark meat fish or tuna 3 or more times per week actually increased their BMD compared with men who ate fish less often. In women, only those who consumed dark fish (mackerel, salmon, sardines, Atlantic bluefish or swordfish) 3

times a week or more experienced a gain in bone mineral density over the 4-year period. These changes were observed only at the femoral neck (Figure).

Thus in this study, the associations between BMD and fatty acid intakes differed between men and women and for omega-3s, were most pronounced in men. The relationships between omega-3 and omega-6 fatty acids and BMD remain to be clarified.

A second study looked at the risk of fracture in women who had participated in the Women's Health Initiative Study. The investigators determined the occurrence of fracture from health questionnaires collected over 7 to 8 years. Fatty acid consumption was obtained when the women enrolled in the study.



Figure. Illustration of the hip bones showing the femoral neck and greater trochanter. Image © 2003, Medical Multimedia Group LLC, reproduced with permission. www.eOrthopod.com.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

These researchers observed that women with higher intakes of saturated fatty acids were 30% more likely to have a hip fracture. Surprisingly, higher consumption of omega-3s was linked to a slightly higher risk of total fractures, but not with hip fractures. The investigators also noted that higher consumption of omega-6s was linked to

Eating dark fish 3 or more times per week was related to higher bone density in men and women. Men with higher intakes of omega-3s had less bone loss. Women with higher omega-6 intakes had fewer bone fractures. How omega-3s and omega-6s interact in bone health remains unclear.

a slightly lower chance of fracture at any site. This observation is at odds with an earlier study by these authors in which higher intakes of omega-6s were associated with a 3-fold greater risk of fracture.

These epidemiological studies suggest that close attention should be paid to the consumption of both omega-3 and omega-6 fatty acids in studying the risk of fracture or loss of bone mineral.

It is apparent that the effects of fatty acid consumption differ between men and women and that the type of fish consumed is important in analyzing the effect of omega-3s on bone health.

A caution to readers about these two studies is that dietary questionnaires used to determine fatty acid intakes are notoriously poor at estimating the intakes of small quantities of nutrients. The errors associated with their use could account for small differences in outcomes, even though the questionnaires have been thoroughly validated. Thus, the question of whether and how dietary polyunsaturated fatty acids affect bone health remains to be clarified.

Lower Breast Cancer Events in Survivors with Higher Omega-3 Consumption

Links between the chance of developing breast cancer and the consumption of fat or individual fatty acids

have been around for years, but the research findings have been all over the map. Animal and cell culture studies have often reported links between omega-3 fatty acids from seafood and lower growth and spread of breast cancer tumors, but these findings have not consistently carried over into human studies. Nevertheless, the topic continues to be investigated. A systematic review of the scientific literature a few years ago analyzed 10 studies in humans and concluded there was about a 30% lower risk of breast cancer in women with higher intakes of seafood omega-3s.



Investigators in California asked a different question about the possible links between fish or omega-3 consumption and breast cancer. They focused on breast cancer survivors. The researchers asked whether omega-3 intakes affect a woman's disease-free survival or subsequent breast cancer events after she has been treated for early-stage breast cancer. Participants in the study were enrolled in the Women's Healthy Eating and Living Study, which was designed to learn whether eating more vegetables, fruits and fiber affected the risk of recurrent or new primary breast cancer. The study included women from the ages of 18 to 70 who were monitored over a 7-year period.

Food intake information was obtained when the women entered the study. The women were assessed for their health outcomes and the development of any cancer at intervals from 1 to 6 years after the study began. At the beginning of the study, the women consumed an average of 186 mg per day of the long-chain omega-3s found

Investigators explored whether seafood omega-3 consumption might affect breast cancer prognosis in survivors who were treated for early-stage disease. The results were encouraging.



FATS OF LIFE newsletter

Research Summaries for Consumers About Healthy Fats

in seafood. This is nearly double the amount consumed by the general population.

After 6 years, their intake had increased to 237 mg per day, an increase of 27%. This change was unrelated to the study. Women's use of fish oil supplements also increased during that time from 4% to 10% of women. The investigators found that the increase in omega-3s was significant for women who did not experience additional breast cancer events, but not among those who had additional events. An "event" was considered to be a recurrent cancer or a new invasive breast cancer.

The key finding was that women in the upper two-thirds of long-chain omega-3 intakes experienced a 25% reduction in the likelihood of developing an additional breast cancer event. Higher omega-3 intakes ranged from a median of 73 to 365 mg per day. It made no difference whether the omega-3s came only from food or from food plus supplements. The investigators also noted that women in the highest third of omega-3 consumption

A study in survivors of early-stage breast cancer reported that women with higher intakes of seafood omega-3s had a 40% lower chance of mortality and a 25% lower risk of later breast cancer events over 7 years.

were 40% less likely to die from breast cancer compared with women in the lowest third of omega-3 consumption. The cutoff for the highest omega-3 intake was 153 mg/day or more.

These striking observations, while encouraging, deserve caution. Observational studies can only show links, not causes. The

study can't tell us whether higher intakes of omega-3s actually caused the improved prognoses and mortality, but they suggest they could have had something to do with them. At the very least, they mark omega-3s as potentially important variables in halting breast cancer progress. More work lies ahead.

