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

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Quarterly News for Consumers About Healthy Fats

HEART HEALTH

Omega-3s Give Mixed Results For More Stable Heart Rhythms After Heart Surgery

Seafood omega-3 fatty acids improve the electrical properties of the heart. Whether they lower the chance of developing abnormal heart rhythms is an unresolved question. There is evidence on both sides.

One way seafood omega-3 fatty acids (omega-3s) contribute to heart health is by improving the electrical properties of the heart. This has to do with the relay of electrical signals through the heart muscle and the regulation of heartbeats. When functioning properly, the flow of electrical signals ensures regular heartbeats that can adapt quickly and appropriately to changing circumstances.

Abnormalities in heart rhythm that develop in the upper chambers of the heart are known as atrial fibrillation (Figure). This condition reflects poor coordination between the heart's upper and lower chambers and unless corrected can impair the heart's pumping action, which may become fatal. Individuals with atrial fibrillation are more likely to develop stroke and heart failure. Atrial fibrillation is the most common type of arrhythmia in the elderly and is more frequent in men than women.

Figure. Illustration of atrial fibrillation. Image reproduced with permission from the Heart Rhythm Society.

Several studies have reported that individuals with higher levels of the long-chain omega-3 fatty acids found mainly in seafood are less likely to develop atrial fibrillation. Patients undergoing coronary artery bypass surgery who consumed seafood omega-3s for at least 5 days prior to surgery had half the chance of developing atrial fibrillation after their operations as patients who consumed a placebo.

Three new studies on the effect of seafood omega-3s on atrial fibrillation in heart surgery patients reported inconsistent results. Findings varied from no effect to a significantly lower risk of the condition. There are still no clear answers.

Three recent studies evaluated the effect of seafood omega-3s on the occurrence of atrial fibrillation in coronary bypass patients. In one study, atrial fibrillation was more frequent in the patients given omega-3s before surgery, but the differences could not be distinguished from chance occurrences. In the second study, patients who were given omega-3s were significantly less likely to develop atrial fibrillation and in the third study, there was no difference in the condition between omega-3-treated patients and those given a placebo. What does one make of such results?

True, the doses of omega-3s, the definition of atrial fibrillation and its duration varied among the studies. In addition, the types of surgeries were not the same. The patients also had different clinical histories, so comparisons among these reports are not straightforward. Thus, these findings indicate that the question of whether seafood omega-3s lower the chance of developing atrial fibrillation remains unsettled. The search for clarity and the beat go on.

Something Fishy in Your Heart

Scientists have a good idea where long-chain omega-3 fatty acids go after we consume them from seafood or fish oil supplements. These fatty acids are avidly retained in the cell membranes of the brain, eye, heart, red blood cells and essentially all the cells in the body. Researchers want to know whether they can look at the omega-3s in readily available tissues, such as red blood cells (Illustration), and use the concentrations in these cells to estimate how much is

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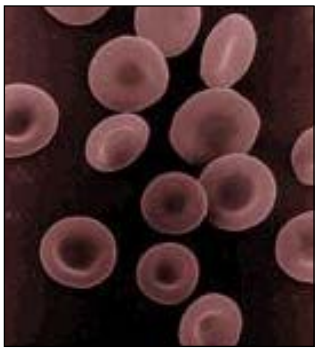
in other tissues.



Research has shown that the seafood omega-3s are readily taken up into the heart muscle, with DHA (docosahexaenoic acid) being more concentrated than EPA (eicosapentaenoic acid). That finding suggests that patients who have low levels of omega-3s in their blood may take up omega-3s from supplements or foods more avidly. In order to test that assumption, researchers in Australia examined the relationships between omega-3s and other fatty acids in red blood cells and muscle from the upper chamber of the heart. They obtained heart tissue from patients who had coronary artery bypass or valve surgery. None of the patients consumed fish oil supplements regularly or ate more than 2 fish meals a week, so they were typical of the general population.

This study indicates that doctors should be able to estimate the level of omega-3s in heart muscle from how much is in a patient's red blood cells.

The investigators found that all omega-3 fatty acids in the heart were strongly related to the omega-3 concentration in red blood cells. The same was true for omega-6 fatty acids found in plant and seed oils, but the relationships were not as strong as for the omega-3s. The importance of these observations is that clinicians should be able to estimate the omega-3 content of heart muscle based on the levels found in red blood cells. These fatty acid relationships also imply that one could monitor the effect of increased consumption of omega-3s in the heart by following the changes in red blood cell fatty acids. That would be easy for the patient and doctor.

MOTHERS AND INFANTS

Is More DHA in Infant Formula Better for Infant Visual Development?

Some research suggests that certain tissues, including parts of the brain, would accumulate higher levels of DHA (docosahexaenoic acid) during development if more of this omega-3 fatty acid were provided in infant formula. In the U.S., manufacturers of infant formula may not add more than 0.3% DHA to their formulas. This is the average DHA level found in human breast milk worldwide, but DHA levels vary widely. Mothers who consume plenty of fish or take fish oil supplements often have higher levels of DHA in their milk than the amount provided in DHA-supplemented infant formula. There is some evidence that visual acuity scores in healthy infants whose mothers consumed twice as much DHA as recommended (that is, 400 mg/day) during pregnancy were higher compared with infants whose mothers consumed a placebo. This finding suggests that there might be additional benefits to infants' vision from consuming more DHA than is present in infant formula. On the other hand, other studies have failed to observe developmental benefits from feeding infants as much as 1% DHA. Whatever the case, additional clarification from confirming studies is needed.

Infant formula contains 0.32% DHA, but no more. Would higher amounts improve visual acuity in healthy term infants? This study aimed to find out.

Toward that end, researchers at several institutions in the U.S. and Canada conducted a study in two American cities to examine the maturation of visual acuity in healthy term infants who consumed 4 different levels of DHA for the first year of life. The amounts of supplemental DHA covered the range of DHA observed in human milk varying from none to 1%. All infants have some DHA carried over from fetal life.

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Quarterly News for Consumers About Healthy Fats

Over the course of one year, the visual acuity scores among the groups of DHA-fed infants showed no differences. However, compared with the infants fed unsupplemented formula, all DHA-supplemented groups had better acuity scores. At one of the two cities, visual acuity scores improved with DHA supplementation twice that usually added to infant formula (compared with the unsupplemented infants), but why this difference occurred in only one of the test cities is not known.

By age one, all infants fed DHA-supplemented formula had better visual acuity scores compared with infants fed unsupplemented formula. There were no differences in scores among the different DHA groups.

Although this study did not provide a clear answer to whether DHA supplementation above 0.3% percent is better for visual acuity, it showed that additional DHA up to 1% was not harmful, could have potential benefits in some infants and was superior to using formula without added DHA. Relying on maternal transfer of DHA during the last trimester is insufficient to achieve optimal visual acuity maturation at one year of age. In the first year of life, infants can obtain the DHA they need from breast-feeding or DHA-supplemented infant formula.

Do Diets High in Omega-6 Fatty Acid Limit DHA in Maternal Red Blood Cells?

Women in North America and many other western countries consume plenty of omega-6 fatty acids because these predominate in most vegetable oils used in processed and restaurant foods. The main omega-6 is linoleic acid. Because fish consumption tends to be quite low, the usual western diet falls short in omega-3 fatty acids, especially the long-chain omega-3s found mainly in fish and shellfish. Our bodies need both types of fatty acids, but there are fewer food choices for obtaining the long-chain omega-3s. Fish oil supplements, eggs and a few supplemented foods are the main options. This "imbalance" in fatty acid intake means that various tissues can be very low in long-chain omega-3s.

Women in western countries consume plenty of omega-6 fatty acids, but little of the long-chain omega-3s found in fish. This study explored whether high intakes of linoleic acid, the main omega-6 in foods, affected the level of DHA in the red blood cells of pregnant women.

This situation is important for women's nutrition during pregnancy and lactation. In the last trimester, large amounts of long-chain omega-3 and omega-6 fatty acids are transferred to the fetus. Studies have shown that if the mother's diet and body stores of long-chain omega-3s, especially DHA (docosahexaenoic acid), are low, the infant will also have less DHA in the brain and elsewhere. Because low brain DHA is linked to poorer brain development and function, pregnant and nursing women are urged to consume at least 200 mg of DHA per day. To reach that intake, eating fatty fish twice a week or taking fish oil supplements may be the most feasible choices.

Because the availability of DHA during pregnancy is so important, researchers at the University of British Columbia, Canada, wondered whether the usual western diet high in linoleic acid affected the amount of long-chain omega-3s in red blood cells. These cells shuttle both types of long-chain fatty acids to the brain. To answer this question, the research team examined the content of the major long-chain fatty acids in in relation to linoleic acid in red blood cells.

They discovered that as the amount of linoleic acid in the red blood cell increased, there was less DHA or arachidonic acid, the chief long-chain omega-6 fatty acid. Interestingly, the levels of these 2 fatty acids in the red cells were not linked to how much arachidonic acid the mothers consumed. This observation confirms

other reports that dietary intake of arachidonic acid has little influence on its level in red cells. In contrast, how much DHA the mothers consumed had a direct effect on the amount of DHA in their red blood cells. Further, it appeared that the more linoleic acid the mother consumed, the less DHA was appeared in their red blood cells.

Pregnant women consuming a typical western diet high in linoleic acid had less DHA in their red blood cells the more linoleic acid they consumed. Women with higher intakes of DHA had higher levels of this fatty acid in their red blood cells.

The implication of these observations is worth pondering. Typical high intakes of linoleic acid in western diets may limit DHA uptake into maternal red blood cells when dietary DHA consumption is low. In other words, high linoleic acid diets may contribute to the low levels of DHA seen in pregnant women. A related study by these investigators showed that consuming 1 to 2 fish meals a week increased the amount of DHA in the mothers' red blood cells. Many scientists have recommended a more balanced intake of omega-6 and omega-3 fatty acids. The findings in this study would support those recommendations and suggest that consuming more long-chain omega-3s is an important part of rebalancing our unsaturated fatty acid intake.

Gestation Time Not Prolonged with Omega-3s in Women at Risk of Preterm Delivery

Women at high risk of preterm delivery might welcome non-medical strategies, such as nutritional interventions, that would prolong gestation. Several studies have reported that mothers with a history of pregnancy complications or preterm delivery who consume fish oil supplements experience longer gestation times. However, the increase is usually just a few days. Some investigators have reported that fish oil supplements prolong gestation only in women who eat very little fish. This would suggest that perhaps there is a threshold for fish or long-chain omega-3 fatty acid consumption above which no further change in gestation time occurs. Because not all studies of this question have observed longer gestation with greater omega-3 consumption, this nutritional approach has not been recommended.

One treatment to prolong gestation is the hormone progesterone. What a team of researchers from several US universities wanted to learn was whether adding long-chain omega-3s to the progesterone treatment would increase gestation time in women at high risk of preterm delivery. To find out, they recruited over 800 women who had had at least one previous preterm delivery and invited them to consume capsules containing either long-chain omega-3s or a placebo from the 20th week of gestation until delivery. All women received progesterone. The investigators were particularly interested in the proportion of women who gave birth prior to 37 weeks' gestation, considered borderline term pregnancy.

Women at high risk of preterm delivery who were treated with progesterone and long-chain omega-3s during pregnancy did not experience a lower rate of preterm delivery compared with women given a placebo.

The results indicated that women who consumed long-chain omega-3s were slightly less likely to deliver before 37 weeks' gestation, but the difference compared with the placebo mothers did not reach statistical significance. The small difference could be due to chance. Several other outcomes, such as having an infant weighing more than 2,500 grams, were somewhat better in the omega-3 mothers, but these, too, were not statistically significant. Unexpectedly, infants in the omega-3 group were more likely to develop respiratory distress, a condition that occurs more frequently in preterm than term infants. This observation had no obvious explanation, as long-chain omega-3s have

been linked to greater production of lung surfactant, a substance needed for proper lung function. This is a question that needs more detailed examination and confirmation.

BRAIN FUNCTION

DHA Protects Neurons and Encourages Their Growth—Part I

One of the places the long-chain omega-3 fatty acid DHA (docosahexaenoic acid) accumulates is the outside membrane of brain cells called neurons (Figure). As part of the neuronal membrane, DHA affects the communication between brain cells and the synthesis and release of chemicals from neurons. The DHA in neurons also affects the interior workings of the cell, helping to determine which substances neurons make and which ones are put on hold. DHA is also the starting material for making substances that stop inflammation or interfere with abnormal proteins, such as those formed in Alzheimer's disease. Neuronal DHA has many functions!

Figure. Healthy neuron. Image, National Institutes of Health, USA.

Brains that develop without sufficient DHA have less DHA in their neurons and their owners are more likely to develop impaired learning and memory. Some of these learning deficits have been linked to the production of neurons with fewer branches and sites of active growth. These growth sites are called neurites and like neuronal membranes are highly enriched in DHA.

In aging, brain injury, inflammation and conditions of oxygen deprivation, such as a stroke, neurons in the affected area have fewer protrusions on their "arms" and fewer neurites and synapses, the endings that release substances necessary for transmitting nerve signals. When these structures are impaired the neuron cannot function normally.

These experimental studies demonstrated that brain cells grown without DHA do not develop normally, are less able to communicate with other neurons and do not function as well as neurons grown with DHA.

In a new study focused on the hippocampus, where long-term memory and spatial navigation functions reside, researchers compared the development of neurons in the offspring of animals fed adequate or deficient DHA during pregnancy. The investigators saw that neurons grown with DHA developed normal branching, neurites and developing synapses. Those grown without DHA had less DHA in their membranes, fewer neurons, cells with shorter branches and fewer neurites. The DHA-deprived neurons had less activity in their synapses compared with neurons grown with DHA. Thus, the cells with more abnormalities were less functional as well.

These studies provide evidence that DHA is required for the optimum development and function of brain neurons. No closely related fatty acid was able to compensate for the lack of DHA. What these findings suggest is that DHA is essential for brain function and cell communication in the region where learning and long-term memory occur. Without sufficient DHA, injured or diseased neurons are unlikely to regenerate or fully recover their function.

DHA Protects Neurons and Encourages Their Growth—Part II

As the preceding article described, DHA (docosahexaenoic acid), a long-chain omega-3 fatty acid found mainly in fish and shellfish, is necessary for brain cells (neurons) to develop properly and function as they should. If the amount of DHA in the cell is inadequate, neurons will develop fewer synapses—the ends of their "arms" that release substances transmitting signals from one cell to the next—and the synapses will be less active. There will also be fewer growth sites in the neuron (neurites),

which limits the connections the neuron can make to other neurons. These handicaps can be overcome by providing sufficient DHA.

In this report, a different group of investigators from those involved in the previous studies wanted to find out whether the growth and function of neurons remained the same throughout the lifespan. From a practical point of view, the researchers conducted their studies in cells isolated from laboratory animals. They grew neurons from animals at young, adult and old ages and evaluated the effect of different long-chain fatty acids from the omega-3 and omega-6 families on neuron characteristics.

Figure. Image of a neurite.

With EPA (eicosapentaenoic acid), a long-chain omega-3 fatty acid, and arachidonic acid, a long-chain omega-6 important in membranes, the number of abnormalities in the neurons at all ages was reduced compared with the control neurons. In these conditions, the number of growth sites or neurites (Figure) in the neurons was markedly reduced. However, when the cells were grown with DHA, the number of abnormalities or underdeveloped cells was sharply reduced. The investigators noted that the complexity of the cell structure increased and the number of neurites was about 3-fold greater than seen in the unsupplemented controls. Interestingly, these results were observed in cells of all ages.

Neurons exposed to DHA had superior development and complexity compared with neurons grown with other long-chain fatty acids, but not DHA. These differences were seen at all ages.

Even more striking results were obtained when the cells were grown with DHA. There were far fewer neurons with abnormal growth patterns, the "arms" of the neurites were longer and there were more neurites compared with cells grown with either EPA or arachidonic acid. Moreover, these findings were seen in the neurons taken at all ages. Unlike the preceding report, arachidonic had some growth-promoting effects, but they were not nearly as pronounced as with DHA.

This work confirms the importance of DHA in the growth and complexity of neurons throughout the lifespan. These observations suggest that DHA might be important in repairing neurons damaged from diseases like Alzheimer's disease, injury such as happens in stroke, and in normal cell wear and tear.

Supplemental DHA Linked to More and Faster Brain Cell Activity

It is hard to determine how the brain responds to changes in its environment, so researchers have turned to imaging technology to help them "see" what is happening. Magnetic resonance imaging (MRI) has been linked to neural activity where signals change as conditions vary. At present, changes in neural activity cannot be directly linked to alterations in nutrients, such as the availability of DHA (docosahexaenoic acid), a long-chain omega-3 fatty acid concentrated in neural membranes. However, neural activity can be related to changes in the composition of red blood cells that reach the brain, even though such relationships are indirect.

Magnetic resonance imaging allowed researchers to "watch" neural activity in the brain during an attention task. The investigators wanted to know whether providing extra dietary DHA would affect healthy brain activity.

Researchers interested in mental function, memory and learning often focus their attention on the frontal cortex (Figure), a region of the brain involved in complex "executive" functions. They can visualize what is happening in the frontal cortex by monitoring neural activity in that area using functional MRI. They know, too, that DHA is highly concentrated in this

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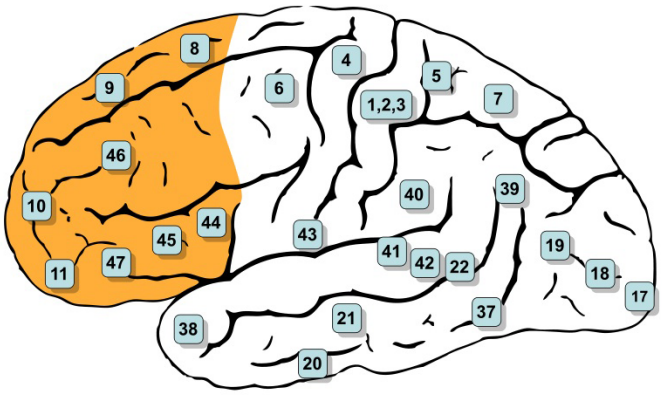

Figure. Illustration of the human brain showing the frontal cortex in yellow.

region, but whether dietary consumption of DHA affects cortical DHA in humans after the age of 2 years is not known.

To explore whether the consumption of supplemental DHA affects performance on an attention-demanding task, researchers at the University of Cincinnati, USA, gave healthy 8 to 10-year-old boys a moderate or high dose of DHA for 8 weeks. They engaged the boys in an attention-measuring task before and after the supplementation. Using imaging technology, the investigators measured the activity of neurons in the frontal cortex during the attention task. They also measured the DHA in the boys' red blood cells.

DHA supplementation in boys did not affect their performance on an attention-demanding task, but was linked to greater neuronal activity in certain areas of the frontal cortex. How this activity might relate to brain function remains to be learned.

At the end of the supplementation period, there were no differences in the attention scores between the boys taking DHA and those taking a placebo. This observation suggests that the DHA supplementation did not affect the boys' attention skills. However, in the high-dose DHA boys, neural activity was significantly higher in one region of the frontal cortex during the attention task compared with the activities in the low-dose DHA and the placebo groups. Could this altered activity be related to the consumption of DHA?

The investigators compared the DHA content of the boys' red blood cells and found that greater neuronal activity occurred in boys with higher red blood cell DHA. This relationship does not establish whether the higher DHA content was directly related to the neuronal activity in the frontal cortex, but it is consistent with that possibility. Other evidence in animal studies suggests a direct link between brain DHA, memory and learning, so the idea is not far-fetched. This imaging approach might be useful in identifying precise areas of the brain affected in different conditions related to DHA status, such as attention-deficit hyperactivity disorder, mood disorders and others. Brain imaging studies have considerable potential to show specifically which parts of the brain are influenced by changing conditions.

MENTAL HEALTH

Might Seafood Omega-3s Slow or Prevent Psychotic Illness?

The title of this article suggests the daring possibility that the course of serious mental illness might be altered by nutritional therapy. Is this just a fantasy? Fortunately, many researchers are pursuing this prospect and are hopeful of progress. This report of a study in young people at high risk of developing a major psychotic disorder is a promising example of the possibilities.

"Experience of Psychosis", original painting by Maureen Oliver, © 2009 by the artist. Reproduced from http://www.MaureenOliver.com with the artist's permission.

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Quarterly News for Consumers About Healthy Fats

Psychosis refers to a state in which a person has lost contact with reality. Symptoms may include hallucinations in which an individual hears things that are not there or experience delusions with bizarre thoughts. These characteristics are marked by a loss of social skills and the ability to interact fully with the world. An example of psychotic illness is schizophrenia. Some experts think of psychotic illness as part of a continuum along which individuals at very high risk with subclinical symptoms may progress to actual psychosis. This view suggests that there is a pre-illness state in which preventive strategies might make an important difference in the course of the affected individual's life. Those at high risk of psychotic illness are sometimes treated with medications and social support. This approach has achieved modest success, with medications carrying the burden of side effects.

A recent addition to the treatment repertoire is long-chain omega-3 fatty acids, the kind found mainly in seafood. To date, controlled trials have produced mixed results, but small short trials have reported that these fatty acids may improve a person's mental state and reduce the amount of drugs needed. A particular appeal of omega-3s is their lack of harmful side effects and high rate of patient acceptance.

Young individuals at high risk of developing a psychotic illness who consumed a modest amount of long-chain omega-3s for 12 weeks were much less likely to develop psychosis compared with those who took a placebo.

In this study, researchers aimed to prevent a first episode of a psychotic illness or reduce the psychiatric symptoms in young individuals at high risk of developing a psychotic disorder. They randomly assigned the participants to consume a modest dose (1.2 grams per day) of long-chain omega-3s or placebo capsules for 12 weeks. The physicians monitored the participants' clinical symptoms throughout the study and used a variety of assessments to evaluate their mental state.

At the end of the study, only 2 of the 41 participants (5%) who consumed the long-chain omega-3s progressed to psychosis, whereas 11 of the 40 taking the placebo (28%) did so. The participants who took the omega-3s also had significant improvements in their symptoms and these persisted up to one year after the study began.

These striking results suggest that the consumption of long-chain omega-3s by individuals at high risk of developing psychotic illness, who have not had a previous psychotic disorder, might be effective in delaying or preventing the onset of a psychotic illness. To confirm these outcomes, other research groups will have to conduct larger and longer studies. Whether similar results would be obtained in individuals who have already experienced a psychotic illness is another urgent question. However, this study should spur others to explore the use of long-chain omega-3s in patients at risk of psychotic illness.

Higher Blood DHA Linked to Better Mental Processing Ability in Adults

Scientific progress in the past 20 to 30 years has shown how important long-chain fatty acids are in brain structure and function. Among them, DHA appears to be the most sensitive to dietary intake. Children of mothers who had insufficient DHA during pregnancy have less DHA in their brains than those whose mothers had plenty of DHA in their diets. The main food source of DHA is seafood, although eggs and DHA-fortified foods may provide useful amounts.

Middle-aged and older adults begin to think about preserving their mental abilities and avoiding cognitive decline. There are limited options for doing so, but this report suggests that healthy adults with higher levels of DHA in their blood have higher mental function.

Brain DHA accumulates rapidly in the last trimester of pregnancy and continues at a slower rate through the first 2 years of life

and more slowly after that until early adulthood. This means there are some opportunities to increase brain DHA in the growing years. DHA status has been linked to learning, reduced chance of developing several behavioral disorders, such as attention-deficit hyperactivity disorder, memory, attention, less aggressive behavior and several other conditions reflecting brain function. Many of these observations have been reported in youngsters and young adults.

In middle-aged and older adults, the function of DHA in mental processing has focused on maintaining cognitive function and delaying its decline. This includes preventing or lessening the severity of Alzheimer's disease and other neurodegenerative diseases and protecting brain cells from damaging metabolic products, injury, inflammation and disease. In some studies, the results of increasing the consumption of DHA have been promising, but not resounding. Others have disappointed. Having higher levels of DHA in blood and lifelong intakes of seafood appear to lower the chance of developing dementia or delay its onset. In its early stages, long-chain omega-3 fatty acids, which include DHA, may slow the loss of memory and learning. However, as dementia advances, long-chain omega-3s may be unable to slow its progress.

Healthy middle-aged adults with higher levels of DHA in their blood scored higher than those with lower DHA levels in tests of nonverbal reasoning, logical memory, working memory and vocabulary.

To obtain a more detailed picture of how seafood omega-3s might affect cognition or the processing of information, a team of investigators at the University of Pittsburgh, USA, examined several aspects of information processing in healthy middle-aged adults. They wondered if the participants' scores might relate to the level of omega-3s in their blood. The investigators looked at 5 dimensions of cognition: nonverbal reasoning, attention, general memory, working memory, and verbal knowledge and processing.

One of the most conspicuous findings was the lack of significant relationships between cognitive scores and blood EPA (eicosapentaenoic acid, a long-chain omega-3) or alpha-linolenic acid levels. The latter omega-3 fatty acid from plants is shorter and less complex than its long-chain cousins and is not abundant in the brain. However, there were many significant correlations between blood DHA levels and mental processing scores, with the exception of attention and concentration measures. In the remaining 4 categories of cognition, higher blood DHA was significantly related to nonverbal reasoning, logical memory, 4 aspects of working memory and vocabulary. When the researchers accounted for the participants' level of education, vocabulary test score and blood pressure, these relationships remained significant. In general, those with higher blood DHA levels had higher scores.

As often noted, a correlation does not reveal whether one factor causes the other. In this example, it is highly plausible that higher DHA levels improve brain function and information processing, but this type of observational report cannot show that. Keeping this limitation in mind, this study points to the likelihood that DHA from seafood really is brain food.

VISION

DHA and Growth Factor Enhance Nerve Regeneration After Corneal Surgery

One of the most popular corrective surgeries to improve a person's visual clarity is a laser-assisted procedure known as LASIK surgery. The operation on the cornea, the outermost layer of the eye (Figure), aims to reshape the cornea so that light is better focused. LASIK surgery is used to correct near- and far-sightedness, for example.

One of the unintended consequences of this and other corneal corrective surgeries is damage to the corneal sensory nerves. When this occurs, tear production may be reduced and a condition known as dry eye syndrome (dry eye) can develop. Eye drops and artificial tear fluids help alleviate the soreness of dry eye, but do not address the underlying problem of corneal nerve damage. The challenge to eye researchers is to develop

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techniques that can repair corneal nerve damage or generate new nerves. That was the goal of a team of researchers at the Louisiana Health Sciences Center, USA.

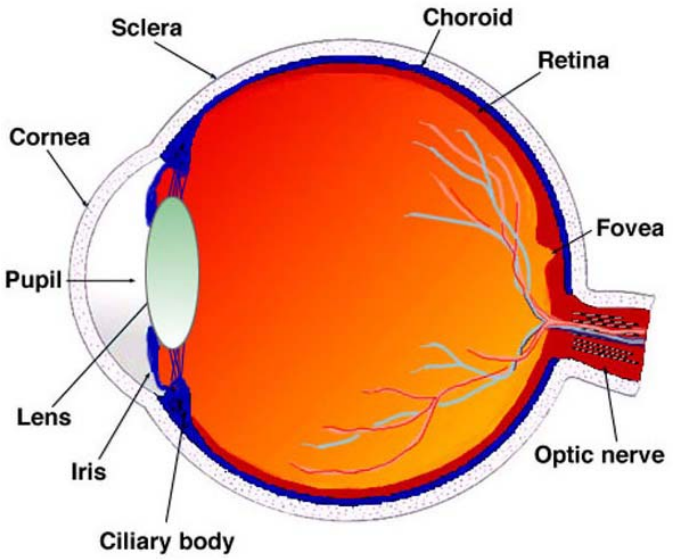

Figure. Structure of the eye showing the cornea and other parts of the eye.

After corneal surgery, treatment of the eye with a growth factor plus DHA enhanced corneal nerve regeneration. This outcome has the potential to reduce the occurrence of dry eye that often follows such surgery.

The investigators examined the effects on corneal nerve regeneration in experimental animals that underwent corneal surgery similar to that performed in humans. After surgery, they treated the eyes with a potent nerve growth factor with or without DHA, a long-chain omega-3 fatty acid important for visual function. The researchers were able to see the extent of nerve growth using specialized imaging techniques. With growth factor or DHA alone, there was no nerve regeneration in the corneas even after 6 weeks of recovery. However, in the corneas treated with both the nerve growth factor and DHA, nerve regeneration was 3 times as great as in the corneas without these factors. Further, nerve generation occurred in 3 major cell types in the cornea, likely strengthening the effectiveness of the nerve growth.

These important experiments suggest that nerve regeneration following corrective corneal surgery can be enhanced using relatively straightforward treatments. Whether enhanced nerve regeneration will abolish dry eye remains to be determined, but this work passes the first hurdle toward that achievement.

CLINICAL CONDITIONS

Type 2 Diabetes

Omega-3s Lead to Improved Circulation in Small Blood Vessels of Type 2 Diabetic Patients

Individuals who develop type 2 diabetes frequently develop circulatory complications involving both large and small blood vessels. Impaired circulation can reduce the function of the heart, kidney, eye, feet and nerves. To lower the chance of these problems, researchers are exploring ways of preventing vascular disease and slowing its progress. Measuring blood flow in the forearm is one way of evaluating the function of large blood vessels. Looking at the circulation in a hand reflects what is happening in the small blood vessels. This report describes the findings on blood circulation in patients with type 2 diabetes who consumed about 2 grams of long-chain omega-3 fatty acids for 6 weeks.

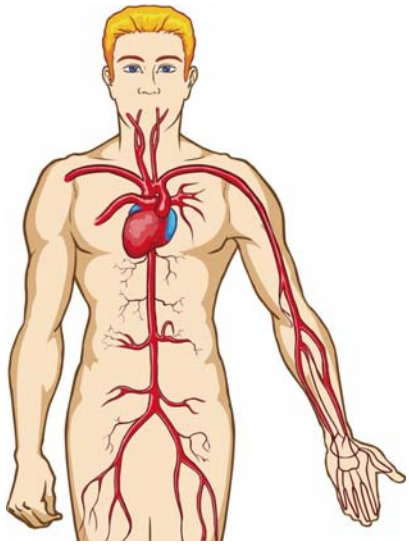

Figure. Simplified drawing of blood circulation in the body showing large and small arteries.

Long-chain omega-3s, the kind found mainly in seafood, have been linked to improved blood flow in the large arteries of the forearm in individuals with

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Patients with type 2 diabetes who consumed about 2 grams of long-chain omega-3s per day for 6 weeks experienced improved circulation in the small blood vessels of the hand and no change in forearm blood flow.

type 2 diabetes. They have also been associated with better function in the cells lining the arteries, effects that reduce low-grade inflammation and improve the flexibility of the arteries. In this study, the investigators compared the effects of omega-3s or a placebo on changes in the patients' blood vessel function in the period immediately following a high-fat meal. This time frame puts the greatest stress on the blood vessels.

During the 6-hour monitoring period, blood flow through the forearm of the placebo participants was reduced, but that of the omega-3 group was unaltered. This comparison suggests that the omega-3 group did not experience further impaired circulation in the large vessels of the forearm, while circulation in those consuming the placebo deteriorated. Upon examining blood flow in the small vessels in one hand in the two groups, the investigators observed significantly greater circulation in the omega-3 group, but no change in the placebo group.

These results suggest that consuming moderate amounts of long-chain omega-3s might improve blood flow in the small vessels of patients with type 2 diabetes. The observations also suggest that omega-3 fatty acid consumption for 6 weeks prevented further decline in blood flow in the larger arteries. If confirmed in larger studies, these findings would support the consumption of long-chain omega-3s as an effective way to enhance blood circulation in type 2 diabetic patients. Considered along with the other established heart-protective effects of long-chain omega-3s, these results add further support for patients with type 2 diabetes to consume up to 2 grams per day of these fatty acids. An added benefit was the reduction in blood triglycerides (fats) in the patients who took the omega-3 supplement.

FRONTIERS

Might Long-Chain Omega-3s Slow Cellular Aging?

As part of healthy cell and tissue maintenance, cells divide to produce new ones, while the worn-out ones are discarded. This regeneration requires copying the genes in each cell. Nearly always this process occurs faithfully and any faulty cells are destroyed. Such cell regeneration comes at a cost, not surprisingly, which is the gradual shortening of the chromosomes that carry the genetic information for each cell. When the ends of the chromosomes (telomeres) become too short, the cell no longer reproduces itself and graduates to retirement (Figure). The telomeres protect the chromosomes from incomplete copying.

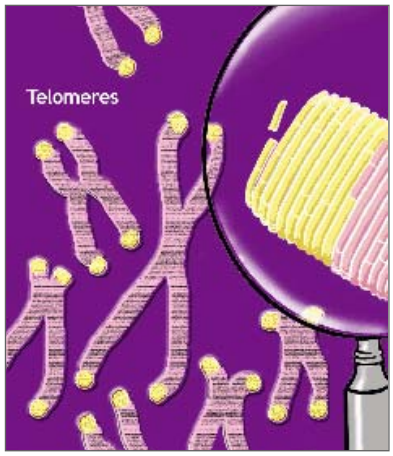

Figure. Drawing of human chromosomes showing the telomeres (yellow) at the ends of each.

Scientists studying chronic diseases and how they are affected by aging are paying attention to telomeres. They have produced evidence suggesting that shorter telomeres are associated with poorer survival, higher mortality from heart and infectious diseases, and greater decline in cognitive function. Because the consumption of long-chain omega-3 fatty acids found mainly in seafood have been linked to lower mortality from heart disease and slower cognitive loss, it seemed reasonable to ask whether long-chain omega-3 status was related to telomere length in older adults with stable coronary artery disease.

To find the answer, investigators in San Francisco, USA, monitored patients with stable heart disease for 5 years. At the beginning and end of the study, the researchers measured the participants' blood level of omega-3s and the length of their telomeres

A team of US researchers reported a link between having a higher DHA content in the blood and a slower loss of the tips of chromosomes (telomeres) that happens from cell division. Telomere loss may be linked to faster aging and higher mortality.

in white blood cells. In their analysis, the investigators divided the participants into 4 groups according to their blood omega-3 levels. Then they compared the changes in telomere length over 5 years in each of the 4 groups.

Over the 5-year period, participants with the lowest levels of omega-3s experienced nearly 3 times the loss in telomere length as those having the highest omega-3 content in their blood. At the start of the study, however, the participants' omega-3 status was unrelated to the length of their telomeres. These observations suggest a connection between long-chain omega-3s and the shortening of telomeres as cells divide and age, but they do not demonstrate that omega-3s are directly involved in this process. To show that will take direct experiments in isolated cells.

Many factors affect cell division and telomere length in aging and several of these were considered in the analysis. Undoubtedly, the picture is more complex than this study depicts, but these findings may open a new window on the conditions that promote or restrain cellular aging.