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Memory and Cognition: _The Omega Boost

,_Over the past decade, researchers have documented the broad-based role of omega-3 deficit in heart disease, immune problems, and psychiatric disorders, among other illnesses. But what about those without a clinical deficit—with omega-3 fatty acid levels that are adequate, even ideal? Will providing still more—supplemental omega-3 oils, above and beyond the nutritional guidelines—cause problems? Or will such boosters push us still further along the curve of mental sharpness and health?

In most medical specialties and scientific disciplines, the issue of health enhancement is unstudied. The use of "megadose" nutrients, vitamins, and supplements remains largely unexplored scientifically and can be dangerous with certain vitamins, such as A, D, or E. Anecdotal or even fictional reports of enhanced bodily or mental functioning from such high-dose supplements are widespread. Literature and Web sites from disreputable firms often make wild and unsubstantiated claims. The dramatic promise of enhanced health sells products. If we are free from heart disease and cancer, after all, why not be content? However, the quest for an edge can be keen, particularly in areas like mood, memory, and learning. Natural food pundits have advocated ginkgo biloba, ginseng, and other herbs to stoke the engines of cognition. However, two of the leading natural candidates for cognitive sharpening may be the long-chain omega-3 fatty acids, EPA and DHA.

Numerous studies document the role of omega-3 fatty acids in the development of the human brain. Animals and humans lacking these fatty acids during gestation and the first years of life score lower on IQ tests and a range of cognitive benchmarks. Convincing studies have traced omega-3 fatty acid deficits to reduced scores on measures of attention across different species, from humans to mice. Now, it turns out, the latest work may extend these findings; a surplus of omega-3 oils may possibly sharpen attention and enhance learning, even in those who had appropriate omega-3 levels before the studies began.

Smart Mice

The first evidence comes from studies in Japan of mice. In an initial experiment, the researchers studied a group of prematurely aging mice they called SAM-P because they were genetically "senescence prone," (wired to age prematurely). The SAM-P mice showed age-related impairments in memory and learning far earlier than normal mice. Yet when fed perilla oil (from the perilla plant, which contains high levels of the omega-3 fatty acid alpha-linolenic acid), the SAM-P animals were able to learn significantly more effectively than their genetically similar SAM-P siblings fed safflower oil (a source of omega-6 fatty acids). The improved profile for learning with the omega-3 supplement led the researchers to wonder just what kind of mechanism was operating. Had the ability to learn and remember really improved or were the mice merely performing on target thanks to a positive emotional state, including reduced anxiety?

To find out, they decided to test SAM-R (for "senescence-resistant") strains of mice, which do not show age-related deterioration of learning and memory. The team again fed the mice either perilla oil or safflower oil over the course of two generations, and then tested them for hyperactivity, exploratory behavior, and learning, among other traits. The researchers found that the SAM-R mice fed safflower oil (omega-6) were more hyperactive than those on perilla oil (omega-3) but scored lower when it came to actual exploration of the environment. The more hyperactive the mice were, the less likely they were to display normal, adaptive exploratory behavior.

Mice supplemented with omega-3 oils were also better learners. In one experimental setup, mice were trained to push a lever in response to cues of light or dark; correct responses were rewarded with pellets of food. As the test went on, the mice given omega-3 supplements made significantly fewer mistakes. They were also better at responding when the conditions of the experiment changed. When scientists stopped delivering the pellet reward after numerous trials, the omega-3-supplemented mice noticed the change and adjusted their behavior accordingly, while the safflower-oil-fed, unsupplemented mice did not.

Fat for Thought

Human studies parallel the findings in mice and rats. The most compelling evidence comes from psychologist David Benton, a professor at the University of Wales in the United Kingdom. Benton has found that low-fat diets in general often impede reaction times, memory, and cognitive skills. In a study of 9,003 British participants, for instance, he found that people who consumed more fat, including saturated fat, could react more rapidly to stimulation. In a related study of 153 women, he found lower cholesterol levels—known to lower risk of heart disease—were nonetheless also associated with slower reaction time. Finally, in a recent controlled study of 285 healthy young women, he found that vigilance—attention to task—was significantly enhanced for those on 400 milligrams of DHA a day versus those taking a placebo sugar pill.

Most researchers have traditionally focused on DHA, not EPA, in studies of brain function since DHA is heavily incorporated into the cell membranes of neurons. But fish oil often contains more EPA than DHA. EPA is both incorporated into cell membranes and circulated in the bloodstream, bathing all parts of the body, including brain tissue. Also, the body of someone who is deficient in omega-3 fatty acids will hold on tightly to DHA while EPA levels continue to drop. It is important to remember that even though less EPA is incorporated into membranes than DHA, the EPA that is in the membrane is highly active and has a rapid turnover rate.

For those taking omega-3 supplements, it is the rise in EPA that often correlates with response. There is a growing amount of scientific data suggesting that EPA may be the crucial omega-3 fatty acid in sustaining mood, cardiovascular health, and more. At this point in our knowledge of the omega-3 fatty acids, we have not determined if EPA, DHA, or both are the crucial components of fish oil for mental health. Are they redundant or do they have independent, distinct actions?

Rejuvenating the Brain

The most exciting finding, it turns out, may be new hope for revving the engine of the aging brain. As the senescent-prone mice illustrate, aging impairs not just memory but also the rapidity and accuracy of thought. Gerontologists on the trail of cognitive decline in humans have focused on a few biochemical factors, including polyunsaturated fats (omega-6 and omega-3 fatty acids).

To test the theory that omega-3 fatty acids keep the brain active longer, a team of Dutch scientists studied cognition in a group of men aged sixty-nine to eighty-nine. The men were part of what is known as the Zutphen Elderly Study, which looked at risk factors for chronic diseases in men who live in Zutphen, a town in the eastern part of the Netherlands. Interestingly, the Zutphen Elderly Study is a continuation of the original Zutphen Study, initiated in 1960 as the Dutch contribution to the famed Seven Countries Study that examined nutrients and disease across a range of cultures. This aging group of men with a wealth of health data and well--documented nutritional profiles was ideal for investigating the impact of omega-3 fatty acids on lifelong maintenance of brain function.

With that in mind, the researchers set out to interview the Zutphen men, documenting their dietary habits in the spring of 1985 and then assessing their cognitive skills in 1990 and again in 1993. The original group consisted of 1,266 men; 555 subjects (44 percent) were still alive in 1985. However, only 342 men (27 percent) were available for the final cognitive assessment in 1993.

The results painted a sobering picture of the aging brain. Thirty-two percent of the surviving subjects were cognitively impaired in 1990, with the oldest and least educated the most impaired of all. The scientists found that the cognitive decline did not alter diet in these men; they ate the same general diet after impairment as before. When the data were analyzed, it became apparent that certain foods—including margarine, butter, baking fat, sauces, and cheese—placed subjects at especially high risk for later cognitive impairment.

The connection between cognitive impairment and fatty acid intake was especially striking: the average intake of total fat and certain polyunsaturated fatty acids (especially linoleic acid, an omega-6 oil) was higher in subjects with cognitive impairment while the intake of fish, EPA, DHA, and total energy was low. Stated another way, high consumption of fish was associated with less cognitive impairment. This makes sense because high levels of the omega-6 arachidonic acid can be neurotoxic. Surprisingly, there was no detectable relationship between lower cognitive impairment and consumption of any of the antioxidants (such as vitamins C and E) thought to protect the brain.