# OMEGA-3 FATTY ACIDS AND BRAIN HEALTH

The human brain is the fattiest organ in the body, with DHA being the most abundant fatty acid present. Omega-3s may impact everything from mood to learning.[1,2] One of the primary reasons that omega-3s have such a significant impact on your mood and ability to focus is that the human brain is largely made up of fat. In fact, 50-60% of the solid matter found in the brain is fat, and the quality of the fat is what is most important.[3] Unlike the fat that is deposited and packed in our thighs and abdomen, brain fat is a major structural component that plays a vital role in how our brain functions.[4]

Neurons within the brain process and transmit electrical and chemical "messages" that enable our bodies to function normally. Neurons are the core component of the central nervous system and connect to each other to form neural networks. Neurons are unusually rich in the omega-3 fatty acid DHA[5], and as such, a diet deficient in DHA will deprive the nervous system of a critical nutritional component that could impair your body's ability to learn, think, remember, and be happy.[6,7]

DHA intake is most important during pregnancy and lactation for both mom and baby alike. During the prenatal time, there is a huge demand and rapid accumulation of specific fatty acids including AA (arachidonic acid) and DHA in the infant brain, DHA in the retina (eye) and AA in the cells throughout the whole body. The human brain relies on DHA for proper growth and development and it continues to accumulate DHA up to age 18, but it does so most aggressively from about halfway through gestation to two years of age.[8] Because the mother is the sole source of DHA for the developing baby, it is critical that a pregnant, and nursing, mother consume enough omega-3s to ensure proper brain development for her baby.[9,10]

## Depression

A growing body of clinical and epidemiological evidence suggests that low dietary intake and/or tissue levels of the long-chain omega-3s are associated with depression. Early research explored the connection between omega-3s and brain health by looking at the connection between people who eat a lot of fish and the rates of depression.[11,12] In countries where fish consumption is high, such as Japan, Taiwan, and Hong Kong, rates of depression are extremely low. The traditional Japanese diet contains about 15 times more omega-3s than the American diet, and the rate of depression in Japan is about 1/10 the rate of depression in the United States.[13]

While evidence from clinical trials on the effects of omega-3s on depression has increased, it remains somewhat difficult to summarize and draw definitive conclusions, because subject pools among studies have not been homogeneous.

None the less, a recent analysis of 19 studies conducted in patients with a defined diagnosis of major depressive disorder (MDD) and patients with depressive symptomatology (but no diagnosis of MDD) demonstrated significant clinical benefits of omega-3s compared to placebo.[14] To date, the majority of studies showing benefits, used omega-3 formulas with a higher ratio of EPA rather than DHA, and there appeared to be more significant clinical efficacy with the use of omega-3s as adjuvant rather than mono-therapy. Findings from the above described meta-analysis should be replicated in randomized clinical trials before drawing a more definitive conclusion.

**Memory and Cognition**

Quite simply, cognition refers to thinking; however, more broadly defined, cognition is mental processing that includes working memory, comprehending and producing language, calculating, reasoning, problem solving and decision making. As we age, our brains naturally do not perform the same way as they did in our younger years, and nutrient deficiencies, such as omegag-3s, certainly do not help.[15] In a healthy brain, mass and speed may decline in adulthood, despite the brain continuing to form vital connections throughout life. However, when connections are lost through inflammation, disease, or injury, neurons eventually die and dementia may result.

Dementia is a general term for a decline in mental ability severe enough to interfere with daily life, and memory loss is one example. Dementia is not a specific disease; rather it is an overall term that describes a wide range of symptoms associated with a decline in memory or other thinking skills severe enough to reduce a person's ability to perform everyday activities. Alzheimer's disease, accounting for 60-80% of cases, is the most common type of dementia.[16]

In a study out of UCLA, 1575 dementia-free study participants underwent MRI brain scans and were given tests to measure mental function, and omega-3 red blood cell status.[17] Researchers found that those participants with DHA levels in the bottom 25% scored lower on tests of visual memory and executive function, including problem solving, multi-tasking and abstract thinking.

In early 2014, researchers published data from the Women's Health Initiative Memory Study.[18] At the beginning of the study, 1,111 post-menopausal women had their red blood cell levels tested for EPA and DHA. Eight years later, when the women were an average of 78 years old, MRI scans were taken to measure their brain volume. The women whose omega-3 fatty acid levels were twice as high, 7.5%, had 0.7% larger brain volume. Those with higher levels also had a 2.7% larger volume in the hippocampus of the brain, which plays an important role in memory and can begin to atrophy as a result of Alzheimer's disease before symptoms even appear. This study demonstrated that a higher omega-3 index (RBC test) was correlated with larger total normal brain volume and hippocampal volume.

While results from recent research demonstrate a positive association between circulating omega-3 levels and brain volume, clinical trials of omega-3 supplementation on cognitive outcomes at different times of the lifecycle have yielded mixed results. A review of the literature suggests that many of the neutral studies may have been due to experimental design issues. While further research is needed to draw more definitive conclusions, there is good reason to believe that results from well-designed future trials will be positive.

## Traumatic Brain Injury

Traumatic brain injury (TBI) is an acquired brain trauma that occurs when a sudden trauma or injury causes damage to the brain. It can be as simple as a concussion or as complex as a major car accident. TBI is characterized by tissue damage and an imbalance in the blood flow in the brain. While data from human studies is extremely limited, animal and laboratory experiments have established that omega-3 supplementation can reduce oxidative stress and neuroinflammation, while activating cell survival pathways.[19] Studies have shown that inclusion of omega-3s in the diet can normalize the levels of brain-derived neurotrophic factor (BDNF), and thus restore the survival of neuronal cells in the brain.[20,21]

The brain tissue analysis of TBI models supplemented with omega-3s shows significantly reduced lipid peroxidation, nucleic acid and protein oxidation, thereby promoting neuronal and glial cell survival.[22] Other studies show that acute administration of omega-3s after injury, and dietary exposure before or after injury improves neurological outcomes in experimental spinal cord injury and TBI.[23,24,25] As research continues to emerge for this complicated condition, with few other treatment options available, omega-3s could be considered as a therapeutic option to reduce the secondary tissue damages initiated by TBI.

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