Omega-3 for Brain Health, Sleep, and Critically Ill Patients

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Exploring omega-3 benefits beyond heart health

Omega-3 fatty acids derived from oily fish and other sources are essential structural components of human cell membranes and play significant roles in moderating inflammation. Among the family of omega-3 fatty acids, docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) have been well-researched for their ability to support heart health, including helping to prevent heart disease, helping to normalize blood fats such as triglycerides, and maintaining healthy blood pressure levels, as a recent meta-analysis attests.¹

But, the potential benefits of omega-3 fatty acids extend beyond heart health. Recent strong evidence points to their beneficial impact on patients with critical illnesses, an area of omega-3 research that hasn’t garnered much mainstream attention but is significant nonetheless. Furthermore, evidence from recently published investigations highlights emerging indications, including unique, cognitive benefits of omega-3s, especially on memory function, as well as potential in addressing sleep-related issues.

Fish Oils for Critical Illness

A fair amount of evidence points to the benefit of omega-3 fats from fish oil in patients with critical illness. Among other actions, omega-3 fatty acids have potent anti-inflammatory effects that are believed to be of primary usefulness in these cases. Researchers have found that the administration of fish oil as continuous infusions as a component of a post-surgical enteral nutrition protocol has the potential to improve patient outcomes and reduce morbidity and mortality. Jacquelyn Glenn and Paul Wischmeyer conducted a review of clinical trials encompassing the use of fish oils in critically ill patients with lung injury, including those with acute respiratory distress syndrome (ARDS).² Their examination of trials published between 1999 and 2012 found that the continuous administration of an enteral nutrition formula containing fish oil was associated with significant reductions in 28-day mortality, intensive care unit (ICU) length of stay, and time on a ventilator, compared to standard formula administration.

In infants, intestinal failure is a condition that sometimes occurs as a result of certain gastrointestinal infections, which then leads to a significant portion of the small intestine being surgically removed. It is a condition associated with severe nutrient malabsorption. During the interim period after surgery, patients generally receive most of their nutrition through a combination of enteral feeding and parenteral intravenous nutrition. Current standard protocols often involve the intravenous infusion of soy-based lipid formulas; however, this often leads to complications, including cholestasis (disrupted or blocked flow of bile from the liver to the intestines), which is associated with high morbidity and mortality in infants. Recent trials have investigated the use of fish oil–containing formulas as alternatives to traditional soy-based lipids in these cases. Qing Yang and colleagues from Wake Forest University in Winston-Salem, NC, assessed the benefits of early enteral feeding of fat and fish oil in premature infants who had undergone surgical bowel resection and found that this led to a decreased need for intravenous lipid therapy, increased uptake of nutrients through enteral nutrition, lower risk of cholestasis, and greater gains in weight and length compared to the control group receiving standard care.³ Taken together with previous studies in patients with intestinal failure showing benefits using lipids from fish oil, this research indicates favorable outcomes from this simple and cost-effective intervention and significant reductions in both morbidity and mortality.

Memory and Prevention of Dementia

The relationship between dietary fat intake and cognitive development has been examined previously in several research studies. While the essential omega-3 fatty acids have been linked to various cognitive benefits, the research remains somewhat ambiguous regarding clinical results. Carol Baym and colleagues from the University of Illinois in Urbana, IL, suggest that a potential
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reason for these mixed research findings is that studies have tended to use assessment techniques that are often not well suited to delineating the specific interactions of essential fatty acids with brain structures. Looking at the interactions of nutrients and specific brain areas, and assessing the cognitive processes influenced by those areas, should yield better outcomes in reaching conclusions about the effects of different dietary fats on cognitive development. In this light, the research team conducted a study to assess the impact of dietary fat intake on hippocampus function in 52 healthy children aged 7–9 residing in the East-Central Illinois area.

Specifically, the researchers assessed the impact of dietary fat intake on relational memory function, which is significantly influenced by the hippocampus, and contrasted this with item memory retention ability, known to be largely hippocampus-independent. Item memory encompasses functions like remembering simple facts. Relational memory, on the other hand, plays a role in scholastic achievement and learning and involves the formation of memories surrounding complex situations that require interpretation and organization.

In the study, children completed a memory task that was designed to assess both hippocampal-dependent as well as hippocampal-independent memory function. A standardized food-frequency questionnaire was used to assess dietary intake. The results of the study indicated significant positive associations between the intake of omega-3 fatty acids and accuracy regarding the relational memory indicators. In contrast, saturated fatty acid intake was negatively correlated with both relational and item memory task performance. No clear correlation was observed (positive or negative) for omega-3 fat intake on item memory abilities, indicating the preferential influence of omega-3 fatty acids on hippocampus function.

Ultimately, the results of the study indicated that children who consumed more omega-3 fats as a part of their diet had superior relational memory compared to those children consuming lower amounts.

While the study mentioned above showed that omega-3 fatty acids support hippocampus function and development in children, at the other end of the age spectrum the loss of total brain volume and atrophy of the hippocampus are indicators of dementia, including Alzheimer’s disease. Studies indicate the importance of DHA and EPA in maintaining brain structure and function. DHA makes up approximately 40% of the fatty acid profile in grey matter of the human cortex, and Alzheimer’s patients have been reported to have decreased serum, brain, and neuronal levels of DHA and EPA compared to individuals without dementia.

James Pottala and colleagues set out to assess the relationship between red blood cell concentrations of DHA and EPA and brain volumes. The researchers analyzed MRI scan data from 1,111 postmenopausal women that were included in the Women’s Health Initiative Memory Study. The Women’s Health Initiative was a randomized placebo-controlled trial designed to test the effects of hormone replacement therapy in women. The Memory Study included a subset of these women who were free of dementia at the time of enrollment and between the ages of 65 and 80. Red blood cell fatty acid levels and MRI scans were taken as a part of the Memory Study. There was a mean time differential of eight years between the fatty acid analysis and the MRI scans.

James Pottala’s group analyzed this data and concluded that higher omega-3 concentrations (omega-3 index; a measure of total red blood cell EPA + DHA) were associated with larger total brain and hippocampus volumes, as assessed by MRI. While additional research is needed, these results suggest that higher omega-3 fatty acid tissue levels that are achievable through diet and supplements may be a promising approach for delaying brain aging and the onset of dementia.

Nutrition, Fatty Acids, and Sleep

An additional area of emerging research is the potential role that fatty acids play in sleep problems in children. Adequate sleep is essential for cognitive function and emotional wellness, while contributing broadly to health overall. Poor sleep is linked to aspects of Attention Deficit Hyperactivity Disorder (ADHD) and other behavioral and learning difficulties. Along the same lines, adequate essential fatty acid intake is associated with healthy cognitive function and overall health. Essential fatty acids are critical for the optimal performance of cells throughout the body because of the crucial structural and functional role they play. Deficits especially in the intake of omega-3 fatty acids DHA and EPA have been implicated in ADHD and other learning and behavioral issues.

Given the similar associations and outcomes common to poor sleep and fatty acid deficiencies, Paul Montgomery and colleagues at the University of Oxford in the UK investigated the association between blood concentration of fatty acids and subjective measures of sleep in 395 healthy children aged 7–9. In a 16-week randomized trial, they further explored supplementation with DHA (600 mg/day) versus placebo in 362 of these children who were underperforming in reading. Analysis of
blood fatty acid levels and subjective sleep measures found that higher blood DHA status was significantly associated with better sleep. In the 16-week study including DHA supplementation, no significant effects were evident across the whole sample; however, in a subgroup analysis in individuals with clinically significant sleep issues, DHA supplementation was found to improve total sleep disturbance scores.

Furthermore, a subsample of 43 individuals underwent a pilot study in which actigraphy was used to measure sleep patterns. After 16 weeks of DHA supplementation (600 mg/day), significant improvements were noted in sleep duration (average increase of 58 minutes in the DHA group versus placebo), with improvements seen in sleep efficiency as well as less night waking. Although more studies are needed, the evidence from these investigations indicate that DHA supplementation plays a positive role in enhancing sleep parameters in children with sleep issues.

The Future of Omega-3s
Emerging research clearly suggests that science is just scratching the surface with regard to the benefits of omega-3s for human health. With well-established indications for supporting the heart and brain, and reducing inflammation, these essential fats occupy a crucial place in any diet and supplement regimen. However, as newer studies continue to explore the unique mechanisms of these critically essential molecules, it is inevitable that their useful potential will extend to even more broad and diverse areas.

*Nutritional Outlook thanks editorial advisory board member Harry Rice, PhD, for his help in culling research studies for this article. Rice is the vice president of regulatory and scientific affairs for the Global Organization for EPA and DHA Omega-3s (GOED).*

References


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