Omega-3 and dyslexia

Uncertain connection

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Abstract

Question In light of the increase in the number of school-aged children diagnosed with dyslexia, what is the role of omega-3 supplements in the management of this condition?

Answer Dyslexia is the most common learning disability and is known to have multifactorial causes. Recent evidence suggests that there is a connection between defects in highly unsaturated fatty acid metabolism and neurodevelopmental disorders such as dyslexia. While the benefit of omega-3 supplementation for children with dyslexia has been studied, evidence remains limited. Unified diagnostic criteria for dyslexia, objective measures of fatty acid deficiency, and close monitoring of dietary intake are some of the factors that would improve the quality of research in the field.

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Dyslexia, dyspraxia, and attention deficit hyperactivity disorder (ADHD) are separate complex developmental syndromes with substantial clinical overlap. About half of individuals with dyslexia will have dyspraxia, and dyslexia and ADHD co-occur in 30% to 50% of cases.[1]

Dyslexia is a persistent difficulty in learning to read and write, despite having adequate general ability, motivation, and opportunity. The condition typically involves problems in short-term memory and in sequencing of words or numbers, abnormalities of visual perception, deficits in auditory working memory, and difficulties with spatial orientation and following directions.[2] Dyslexia represents most (80% to 90%) of all learning disabilities and its prevalence throughout Canada is estimated at 23%.[3] The causes of dyslexia and its pathologic mechanisms are multifactorial and might differ considerably between individuals. Genetic studies suggest heritability in half of those with dyslexia, with higher expression among boys.[4]

Highly unsaturated fatty acids (HUFAs) of the omega-3 and omega-6 series, which constitute about a third of total brain fatty acids and are essential to the diet, are crucial for normal brain structure and function. Omega-3 can be obtained from seafood, and omega-6 can be obtained from dietary sources such as meat and dairy products.[5,6] Some chromosomal regions, containing genes that code for enzymes involved in fatty acid and phospholipid metabolism, were identified in association with dyslexia.[1]

Early studies using a mixture of a few omega-6 HUFAs showed only marginal benefits for those with learning and behaviour difficulties.[4] Omega-3 HUFAs, on the other hand, are more likely to be absent from the modern diet, and it is more likely that omega-3 supplementation would produce benefits among those with dyslexia.[1,7]

The biologic function of omega-3 HUFAs includes membrane fluidity, gene expression, and neuronal membrane structure and function, all critical for cell transduction and the process of learning.[5-8] More specifically, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) omega-3 HUFAs are essential for regulation of brain function (EPA) and the structure of neuronal membranes (DHA).[1]

Omega-3 deficiency

Levels of EPA and DHA in Western diets are often inadequate,[7] and lifestyle factors can impair in vivo HUFA synthesis from its essential precursors. High dietary intake of saturated fats, deficiency of vitamin and mineral cofactors (notably zinc deficiency), smoking, and excessive consumption of alcohol or coffee might result in EPA and DHA depletion. Impairment of HUFA synthesis might also be due to diabetes, eczema, asthma, or other allergic conditions.[4] In the case of dyslexia, contributory genetic factors might include mild abnormalities of fatty acid metabolism that act to increase the usual dietary requirements for these essential nutrients.[9]

Fatty acid deficiency presents with excessive thirst, frequent urination, rough and dry patches on the skin, dry hair, dandruff, and fraying fingernails.[4,10] In one study, these signs were considerably more common among 135 adults with dyslexia compared with 71

adults without dyslexia. The severity of fatty acid deficiency correlated with the individuals' scores on the dyslexia screening checklist. Moreover, fatty acid deficiency was found to be associated with other dyslexia-related features, including impaired visual perception and auditory and language confusion.[11] The results suggest that dietary supplementation with fatty acids might be of benefit for patients with dyslexia.

Supplementing with HUFAs for dyslexia

Long-term studies testing the efficacy of pharmacologic intervention in dyslexia are lacking, and side effects of pharmacologic intervention (such as methylphenidate or amphetamines) last even after treatment completion. As a result, use of nonpharmacologic management has become common.[12]

In 1997, Richardson et al found elevated levels of phosphomonoesters among 12 adults with dyslexia compared with a control group of 10 healthy adults. High levels of phosphomonoesters indicated a deficiency in the biosynthesis of phospholipids or their incorporation into membranes. Because the metabolism of membrane phospholipids is heavily influenced by their essential fatty acid composition,[2] there might be potential for HUFA dietary supplementation as therapy for children with dyslexia.

In a case study of a grade 6 boy with dyslexia, fatty acid supplementation with omega-3 (α-linolenic acid) and a reduction of saturated fat from the diet improved his reading skills and reduced physical findings of fatty acid deficiency.[10]

In 2002, Richardson and Puri conducted a 2-stage randomized, placebo-controlled study on the effects of supplementation with HUFAs on ADHD-related symptoms in children with learning disabilities. In the first stage, 41 children 8 to 12 years old were randomized to either taking daily dietary supplementation (186 mg of EPA, 480 mg of DHA, 96 mg of γ-linolenic acid, 42 mg of arachidonic acid, vitamin E, conjugated linoleic acid, and 8 mg of thyme oil) or receiving placebo for a period of 3 months. Results showed statistically significant reductions in ADHD symptoms, dyslexia-related symptoms (eg, inattention, learning and memory problems), and anxiety.[13] In the second stage of the study, the children who had initially received placebo were switched to the fatty acid supplement and were followed for a further 3 months. Among this group, the improvements in ADHD symptoms, dyslexia-related symptoms, and anxiety were statistically significant as they were in the initial treatment group.[14]

A larger randomized, placebo-controlled study of children with dyslexia revealed substantial improvements in reading skills among 102 children 8 to 12 years of age treated for 6 months with 186 mg of EPA, 480 mg of DHA, 96 mg of γ-linolenic acid, 42 mg of arachidonic acid, vitamin E, conjugated linoleic acid, and 8 mg of thyme oil. The difference was especially noticeable among children with symptomatic fatty acid deficiency at baseline.[15]

However, in another randomized, placebo-controlled study, investigators asked teachers to assess 61 children for dyslexia; 31 of the children with dyslexia were treated for 90 days with 500 mg of EPA and 400 mg of carnosine (ie, an amino acid presumed to interact positively with cognitive functions), while 30 of the children with dyslexia received placebo. There was no statistically significant improvement documented in any of the cognitive measures, including reading and spelling skills.[16]

Visual function in dyslexia

There is evidence of visual and central processing deficits in dyslexia.[17] The magnocellular layer of the thalamus, which is responsible for processing rapid visual stimuli, is dependent on a high content of unsaturated fatty acids.

Stordy[17] found that use of 480 mg/d of DHA supplementation for a month among young adults with dyslexia normalized dark adaptation compared with a control group; this finding contributes to the growing body of evidence for the benefits of omega-3 HUFA supplementation for those with dyslexia.

Conclusion

The benefit of omega-3 supplementation for children with dyslexia has been studied, but evidence is limited. Larger, systematic, and well controlled studies are needed in order to provide definitive evidence. Objective measures of fatty acid deficiency, closer monitoring of dietary intake throughout the study, and systematic diagnosis of dyslexia are some of the required measures to improve current evidence. Optimal dosing should also be determined.

Competing interests
None declared

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