Nutrition and Attention Deficit/Hyperactivity Disorder: The Role of Omega-3 Fatty Acids and Dietary Factors in the Expression of Typical Behaviors Associated with ADHD

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ABSTRACT

Attention Deficit/Hyperactivity Disorder (ADHD) affects millions of children in the United States, and while behavioral therapy and medication remain the primary treatments, growing research suggests that nutrition, specifically omega-3 fatty acids, may influence symptom expression. This paper explores how omega-3 fatty acid deficiencies contribute to common ADHD behaviors such as impulsivity, inattention, and hyperactivity. Drawing on historical dietary research, including the Feingold Diet, and modern studies on essential fatty acid (EFA) metabolism, the paper outlines biological mechanisms linking omega-3 levels to neurotransmitter function, inflammation, and executive functioning. Public health findings further indicate that children with ADHD show a higher prevalence of EFA deficiency, potentially due to reduced breastfeeding, allergies, or metabolic inefficiencies. While nutritional interventions show promise as a supplement to traditional therapy, ADHD remains a complex neurodevelopmental disorder requiring comprehensive, individualized treatment approaches. Additional research is needed to clarify the metabolic pathways involved and determine the therapeutic potential of targeted omega-3 supplementation.

KEYWORDS

ADHD; Omega-3 fatty acids; Essential fatty acids; DHA; EPA; Nutrition; Neurodevelopment; Executive function; Dietary intervention; Public health

INTRODUCTION

According to a national survey of parents, it is estimated that 6 million children ages 3-17 are diagnosed with attention deficit/hyperactivity disorder (ADHD) in the United States. Currently, about three in four children diagnosed in the US receive treatment. The typical treatment for children 6 years of age and older recommended by the American Academy of Pediatrics (AAP) is behavior therapy and medication. For children under 6 years of age, behavior therapy is recommended as the first line of treatment (CDC, 2022). The effectiveness of a treatment can be measured by its ability to make mental symptoms more manageable such as making a

person feel less anxious or allowing them to consciously control impulsive behavior (Johnson, 2018). Approximately 80% of children with ADHD have fewer symptoms after finding the proper treatment for them ("ADHD Medication", 2022).

Despite most children getting some form of treatment and the effectiveness of available treatments, the number of children diagnosed with ADHD is increasing. According to national population surveys, the prevalence of ADHD has increased from 6.1% to 10.2% as of 2016, and medical experts expect that number to only go up. They attribute this increase in part to the overdiagnosis of ADHD. ADHD diagnosis criteria have evolved since their origins in the early 1900s. Today, the changing criteria makes clinical diagnosis more difficult. Since there are no biomarkers for the condition, diagnosis is entirely based on signs and symptoms (Abdelnour et al., 2022).

While overdiagnosis is a viable explanation for the increase observed, some researchers and medical professionals have turned to other causes: food. Beth Roybal, who worked with Smitha Bhandari, a board-certified adult psychiatrist, stated that certain foods may play a role in affecting ADHD symptoms (Roybal, 2008).

DISCUSSION

Description Of Nutritional Factors And ADHD

Some experts attribute the modern diet, composed of processed foods containing colorings, preservatives, and additives, to causing modern diseases such as ADHD. These types of foods often lack the necessary nutrients and vitamins humans need to remain healthy. One such molecule is the omega-3 essential fatty acid (Greenblatt, 2017). These fatty acids optimize brain power. In fact, they can be found in some ADHD medications (Greenblatt, 2017). If the consumption of these fatty acids can increase cognitive brain function, then by that same principle, the deficiency of omega-3 fatty acids can cause people to be less attentive, hyperactive, and even hostile (Hawkins & Nigg, 2014). So, just as omega-3 fatty acids can be added to medication to treat ADHD, their absence in food could worsen ADHD symptoms. While there is no specific "ADHD diet," certain nutritional factors can influence brain function and potentially impact ADHD symptoms. For example, deficiencies in certain nutrients, such as omega-3 fatty acids, iron, zinc, magnesium, and vitamin D, have been associated with ADHD symptoms (Greenblatt, 2017). Ensuring an adequate intake of these nutrients through a balanced diet or supplements may support brain health and potentially alleviate some symptoms.

History Of Scientific Findings on Nutrition And ADHD

The effect food has on the symptoms of ADHD is not new. In 1973, Dr. Benjamin Feingold, Chief Emeritus of the Department of Allergy at the Kaiser Permanente Foundation Hospital and Permanente Medical Group in San Francisco, proposed a dietary approach to manage hyperactivity, which he titled the Kaiser-Permanente (K-P) Diet. He suggested that artificial food

additives, including colorings and flavorings, might contribute to hyperactivity symptoms. His diet was free of natural salicylates and seven artificial flavors that contained a salicylate radical. Feingold hypothesized that these additives might contribute to hyperactivity and other behavioral issues and thus, that their removal would improve children's symptoms and make their behavior more manageable. He began to recruit children diagnosed with minimal brain dysfunction and reported that they had much improved scores on behavior rating scales within 3 to 21 days. In his study, children diagnosed with ADHD or related disorders were assigned either the K–P diet or a placebo diet, and later their assignments were switched so that researchers could compare behavioral changes across both conditions. The study was double-blind, meaning neither the parents nor Feingold knew which diet each child was following. In 1977, in a presentation for the American Medical Association (AMA), Feingold stated that 60% to 70% of the children he treated improved (Stevens et al., 2011). There was, however, controversy over his findings as his conclusions were based on his own clinical observations rather than on rigorous experimental evidence. That controversy led other scientists to test and extend his hypothesis. In fact, by 1983, so many studies had been published evaluating the K-P diet a meta-analysis was possible and warranted (Stevens et al., 2011) Most other researchers evaluating Feingold's claims focused specifically on the effects of food dyes on behavior. One such study was performed by Swanson and Kinsbourne in 1980. Researchers admitted the children into the hospital so that the diet could be administered in a controlled manner, avoiding problems with dietary noncompliance. They also adjusted the amount of food coloring in the challenge to align with the average daily consumption of children. Their biggest change from Feingold's methods was using a laboratory test of cognitive functioning, called the paired-associate learning task, instead of Feingold's rating scales. This was a much more accurate measure to monitor the effect of diet on hyperactive behavior. Studies like Swanson and Kinsbourne's suggest that children demonstrate a dramatic reduction in hyperactive symptoms when following the diet (Schnoll et al., 2003). While early studies focused primarily on the potential impact of artificial food colorings and additives, research has expanded to explore various aspects of nutrition and their relationship with ADHD symptoms, such as fatty acids.

Today, the scientific consensus is that artificial food colorings may contribute to hyperactive behavior in a small subset of children, particularly those with underlying sensitivities; however, they are not considered a primary cause of ADHD. Large-scale reviews, including those conducted by the FDA and EFSA, note that while some children show behavioral changes after consuming artificial dyes, most children with ADHD do not experience clinically significant effects. Thus, food dyes are regarded as a possible but minor environmental trigger, not a core etiological factor in ADHD.

Public Health Findings on Essential Fatty Acids (EFA)

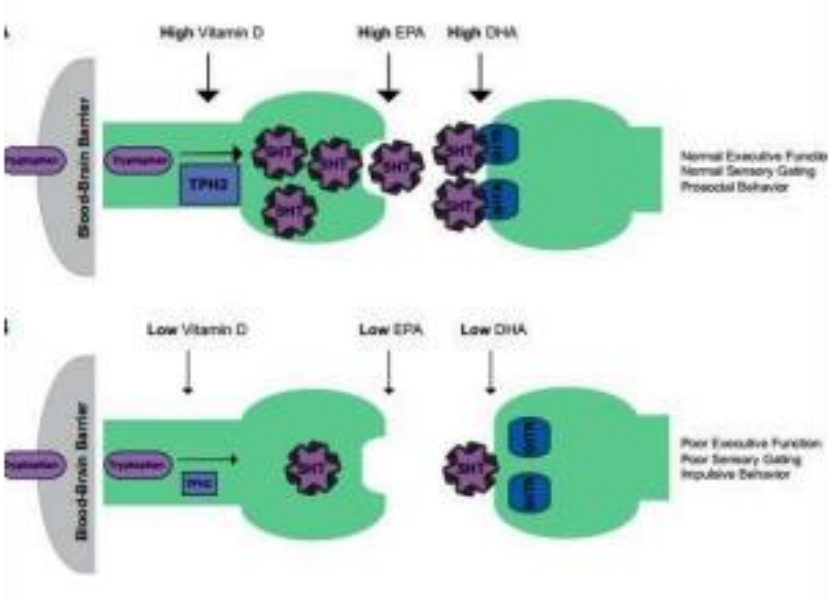
Two researchers with the Hyperactive Children's Support Group (HCSG) in the UK found that ADHD's connection with nutrition and molecules is a possible explanation for why ADHD is more prominent in men than in women. After conducting a survey on hyperactive children, the researchers noted various clinical signs of possible evidence for fatty acid deficiency in these children. Essential fatty acids (EFA) are polyunsaturated fats that the body cannot synthesize and must obtain through diet. These include omega-3 and omega-6 fatty acids. Further questioning this relationship between fatty acids and the development of ADHD, researchers from Purdue University in the United States found that children with ADHD were less likely to have been breastfed, more likely to suffer from allergies, and displayed signs of an essential fatty acid deficiency (EFA). Because men are more likely to develop EFA deficiencies than women, the sex ratio for people diagnosed with ADHD may be partly influenced by these underlying nutritional differences. (Richardson). According to the CDC, 12.9% of men and boys live with ADHD compared to 5.6% of women and girls (Mandriota, 2022). Breastmilk contains the preformed HUFA such as arachidonic acid (AA) and docosahexaenoic acid (DHA), while most formula does not, likely being the reason why the researchers found most children with ADHD to have been breastfed less as infants. Allergies are also known to be associated with an EFA deficiency, so it comes as no surprise that children with ADHD are more likely to have allergies than other children who do not have the disorder. People with malabsorptive disorders because of pancreatic insufficiency or massive bowel resection are at risk of developing a fatty acid deficiency and thus susceptible to expressing ADHD-like symptoms.

Biological Mechanisms Linking Omega-3 Fatty Acids To ADHD

Researchers with the HCSG proposed that the reason a fatty acid imbalance impacts ADHD symptoms is found in the conversion of essential fatty acids (EFA) to highly unsaturated fatty acids (HUFA). Many children with ADHD display an intolerance to certain foods such as salicylates because these substances block the formation of prostaglandins from HUFA (Richardson). Omega-3 fatty acids, specifically DHA and eicosapentaenoic acid (EPA), are important components of cell membranes in the brain (Hawkey & Nigg, 2014). They facilitate proper neurotransmitter signaling, including dopamine and serotonin pathways, which are essential for attention and mood regulation (Hawkey & Nigg, 2014). A deficiency in omega-3 fatty acids may disrupt neurotransmitter function, contributing to ADHD symptoms. These acids also possess anti-inflammatory and antioxidant properties and inflammation, and oxidative stress can affect brain function and have been seen in people with ADHD (Richardson). Executive functions, such as working memory, impulse control, and cognitive flexibility, are often inhibited in people with ADHD. As seen in Figure 1, when there are low amounts of EPA and DHA, specific fatty acids, the executive function of the neuron is poor in turn making the sensory gating poor and thus resulting in impulsive behavior (Hawkey &

Nigg, 2014). Omega-3 fatty acids play a role in these cognitive processes; therefore, deficiencies in omega-3 fatty acids can affect the efficiency and functioning of the prefrontal cortex, a brain region associated with executive functions, leading to difficulty in engaging these areas (Hawkey & Nigg, 2014).

Figure 1



Treatment Implications

To address the EFA imbalance, dietary supplementation or changes would be the most immediate way to increase the value of fatty acids present. As presented by two researchers for the Clinical Psychology Review, adding omega-3 fatty acids as a possible supplement to established therapies would be a good step towards this. On top of that, including foods rich in omega-3 fatty acids into one's diet can help boost omega-3 fatty acid intake. It is important to note that while increasing fatty acid intake can have potential benefits for the management of ADHD symptoms, it is not a standalone treatment for ADHD. ADHD is a complex condition that typically requires a comprehensive approach including behavioral interventions, medication (if recommended by a healthcare professional), and other therapeutic techniques. The dietary changes would merely be an added step that can help the ADHD population with their symptoms especially if they do not wish to partake in the traditional treatment options.

FUTURE DIRECTIONS FOR RESEARCH

While omega-3 fatty acid deficiencies have been associated with ADHD symptoms, not all individuals with ADHD have low levels of these fatty acids. Additionally, addressing fatty acid deficiencies through supplementation or dietary changes may not eliminate ADHD symptoms, as

ADHD is a complex neurodevelopmental disorder with various contributing factors. For this reason, there should be more research done on the relationship between fatty acids and the behavior of people with ADHD. By doing this, researchers would be able to focus solely on one part of nutrition and devote all their resources to investigating this nutrient in food. Rather than find a diet that could make ADHD symptoms more manageable or study food, scientists can experiment with fatty acids specifically and develop a more concrete answer on whether an effective treatment for ADHD would be rectifying the EFA deficiency. More discussion is required to investigate why children with ADHD exhibit lower blood levels of omega-3 fatty acids. Future observational studies of children with ADHD should obtain actual dietary intake levels of omega-3 fatty acids. As suggested earlier, these are long chain fatty acids, which are partially obtained through enzymatic elongation, and there may be a disruption in the conversion process from essential fatty acids to highly unsaturated fatty acids and alpha-lipoic acid (ALA) to EPA and DHA in the ADHD population. Further investigation of an inefficient or disrupted metabolic pathway would be beneficial in understanding the role of this disruption.

CONCLUSION

Nutritional factors, particularly omega-3 fatty acids, appear to play a meaningful role in the expression and management of ADHD symptoms, though they are not a standalone solution. Evidence suggests that deficiencies in omega-3 fatty acids may contribute to altered neurotransmitter function, increased inflammation, and impaired executive functioning, core challenges experienced by individuals with ADHD. Historical and contemporary research demonstrates that dietary changes or supplementation can reduce symptom severity for some individuals, highlighting the value of integrating nutrition into a broader treatment plan. However, ADHD is a multifactorial condition influenced by genetics, environment, and neurobiology, meaning that nutritional strategies should complement, not replace, established interventions like behavioral therapy and medication. Future research focused on metabolic pathways, dietary intake patterns, and individualized responses to fatty acid supplementation will be essential for strengthening our understanding of the nutrition-ADHD connection and informing evidence-based public health recommendations.

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