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Nutrition And ADHD; A Review of Studies Evaluating the Impact of Nutrition on Attention Deficit Disorder

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ABSTRACT

According to the Center for Disease Control, during 2020-2022 approximately 10.2 percent of children in the United States between the ages of 3-17 had been diagnosed with attention deficit hyperactivity disorder (ADHD) causing it to be one of the most common childhood neurodevelopmental disorders. [A1] It is believed that both genetic and environmental factors have contributed to the incidence of ADHD. While genetics are thought to play a large role in the cause of ADHD, researchers are studying environmental factors that might increase the risk of developing ADHD, including nutrition. Additionally, there is evidence to suggest a relationship between poor diet and mental health problems, including ADHD. The dietary interventions that have been subjected to clinical trials include various forms of diets and supplements. The purpose of this review is to explore whether environmental factors of diet and other nutrition may play a role in the risk of developing and the management of ADHD.

Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder. According to the Center for Disease Control, ADHD is classified into three typical presentations: (i) predominantly hyperactive-impulsive presentation, (ii) predominantly inattentive presentation, and (iii) combined presentation (a combination of inattentive and hyperactive-impulsive symptoms). Symptoms generally appear in early childhood and include hyperactivity, impulsivity, daydreaming, difficulty concentrating, trouble completing tasks, disorganization, forgetfulness, and losing things. Hyperactivity refers to a condition that causes constant movement, fidgeting, talking and/or restlessness. In many cases ADHD symptoms, especially attention problems, continue into adulthood. [A2]

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition [A3] (the standard classification of mental disorders used by mental health professionals in the U.S.) an ADHD diagnosis requires that symptoms be present before age 12, persist for at least six months, interfere with or impair social or school functioning and be present in two or more settings (such as school and home). Diagnosis is typically carried out by a mental health professional or a primary care provider and is based on the patient's mental health and medical history, school experiences, psychological tests that look at cognitive skills and standardized behavior rating scales or ADHD symptom checklists.

Current Treatments

Treatment of ADHD generally includes psychotherapy, behavior therapy and for children 6 years of age and older, stimulant medications (methylphenidate and amphetamine formulations) or non-stimulant medications (selective alpha-2 adrenergic agonists: guanfacine, clonidine; and selective norepinephrine reuptake inhibitor: atomoxetine), all of which have proven to effectively reduce ADHD symptoms. [A4] ADHD medications help ease the symptoms of ADHD by increasing the levels of neurotransmitters in the brain, but they have known side effects. ADHD medication

side effects may include decreased appetite, weight loss, insomnia, abdominal pain, headaches, anxiety, tics, minor growth delay, changes in blood pressure and heart rate. [A5]

Dietary Factors Influencing ADHD

Ultra-processed foods, including packaged foods, fast foods, hydrogenated fats and sugary drinks have become prevalent in the Western diet and are associated with multiple physical health issues. [A8] Physical health issues associated with a Western diet have been well documented, but until recently there has been less of a focus on the impacts on mental health consequences of a diet high in ultra processed foods.

More recently, overall nutrition, supplementation diet and elimination diets have been investigated as a risk factor for ADHD and potential treatment option for ADHD. Studies show that children with ADHD are less likely to have healthy diets than those without ADHD. [A5-A7 & A9-A11] "Western-like" diets have been associated with a higher risk of ADHD. [A6-A7] Conversely, healthy eating patterns high in vegetables, fruits, and micronutrients, have been associated with a lower risk of ADHD. [A9] Healthy diets with increased levels of vegetables, fruits, legumes, and fish have decreased the odds of ADHD up to 37%. [A6] As such, certain nutrition interventions explored below may be beneficial for adolescents with ADHD.

Some studies have identified adverse effects on ADHD from higher intake of sugar. In March 2020, an exhaustive systematic literature search was conducted to review the association between sugar and soft drink consumption and the risk of ADHD symptoms. This meta-analysis indicated a positive relationship between overall sugar and sugar-sweetened beverages consumption and symptoms of ADHD. [A12]

In addition to sugar, the Western diet includes foods high in artificial food coloring, preservatives and additives. Multiple studies have attempted to determine the impact of artificial food coloring and additives on ADHD. Studies suggest that some children with ADHD are negatively impacted by food additives. [A13-A15]

Dietary Factors Influencing ADHD

Recently, the role of nutrition in brain development and function has been studied. Nutrients and diet quality have been linked to behavioral, cognitive, and affective functions and the prevalence of mental disorders. As detailed below, specific nutrients, including vitamin D, magnesium, zinc, iron, and Omega 3 & 6 fatty acids may be deficient in children with ADHD, and therefore, diets including the missing nutrients and/or supplementation have been proposed as secondary treatments for ADHD.

Magnesium

Magnesium is a mineral that plays a crucial role in many bodily functions, including nerve function, muscle relaxation, and the regulation of neurotransmitters. By stabilizing these processes, magnesium may help improve many neurologic and psychiatric conditions. In 2018, a team conducted a thorough search of the literature and examined the connection between ADHD and magnesium levels. A total of twelve studies were included in the review. The results of the meta-analysis found that levels of magnesium in the blood of children diagnosed with ADHD were significantly lower than those in controls. [A16] In addition, a randomized, double-blind, placebo-controlled clinical trial involving 66 children with ADHD who were concurrently taking methylphenidate (common stimulate medicine used to treat ADHD) examined the effects of magnesium (6 mg/kg/day) and vitamin D (50,000 IU/week) supplementation over eight weeks. [A17] Children in the intervention group showed significant reductions in conduct, emotional, and peer problems compared to the control group. [A17]

Iron and Zinc

Iron and Zinc are essential minerals, with both being required for neurotransmitter metabolism. Iron and zinc deficiencies have been related with the aggravation and progression of ADHD. A 2021 review of nine clinical trials examined the impact of iron-zinc supplementation in the treatment of children and adolescents with ADHD. This meta review produced results demonstrating that low levels of zinc and iron were associated with higher ADHD severity levels and poorer treatment outcomes. Additionally, dietary supplements in children and adolescents with zinc and iron were associated with improvements in ADHD severity. [A18]

Fatty Acids

Omega-3 and Omega-6 fatty acids are critical to brain development and function. Evidence suggests that a relative lack of omega-3 may contribute to many psychiatric and neurodevelopmental disorders. Results from trials are mixed, but the few studies in this area have shown that dietary supplementation with Omega-3 and Omega-6 fatty acids in children with ADHD may help alleviate ADHD-related symptoms in at least some children. [A19]

Vitamin D

A 2019 systematic review and meta-analysis of trials was conducted to assess the benefits and harms of vitamin D supplementation for ADHD individuals. [A20] The paper concluded that Vitamin D supplementation as secondary treatment to ADHD stimulant medication appeared to reduce ADHD symptoms without serious adverse events and was associated with improved vitamin D status. However, the paper noted that additional studies are needed to determine the efficacy and safety of vitamin D supplementation for both children and adults with ADHD, especially when combining vitamin D and other ADHD treatments.

Heavy Metals

Heavy Metal exposure is another potential environmental factor associated with the development and severity of ADHD. [A21] Even in small amounts, toxic metals, such as arsenic, lead, mercury and cadmium are capable of harming neurological development. The developing human brain in babies and young children is particularly vulnerable to heavy metals. These metals can be transferred in utero from the mother to fetus. With more and more toxic chemicals being found in many foods, including baby food, studies are showing that children can develop neuro-development deficits that may be seen in disorders such as ADHD. [A22] Due to the recent studies and reports, the U.S. Food and Drug Administration (FDA) has focused on foods commonly eaten by babies and young children as their smaller body sizes and metabolism make them more vulnerable to the harmful effects of heavy metal exposure. Many studies have shown that zinc, calcium and iron deficiencies may lead to greater absorption of heavy metals. As such, it has been suggested that supplementation with these nutrients may provide protective effects against certain toxic metals. [A23]

The most commonly used therapeutic strategy for removing heavy metals from the body is chelation therapy (a medical procedure involving IV treatment with substances which bind to heavy metals and leave the body through urination). Additionally, consumption of fruits, vegetables and supplements, as well as shifting to a lower fat intake dietary pattern may be helpful in reducing heavy metals in the body. [A23]

Microbiome Composition

The gut hosts a number of bacteria and other microbial organisms, which collectively make up a gut microbiome. Recently, attention has been focused on the relationship between the gut microbiome and brain development/function.

This relationship is known as the brain-gut-microbiome axis and includes a network of connections that allow for communication between the brain and the gut. A link has been found between ADHD and gastrointestinal issues (including pain, diarrhea, constipation, nausea, abdominal pain, heartburn, abdominal distension, vomiting, and bloating). [A24, A25, A26] This link indicates a potential role of gut microbiome health and ADHD. A 2023 metadata review concluded that treatments directly targeting the gut microbiome have potential benefits for those who suffer with ADHD.

Elimination Diets

It has been suggested that food additives exclusion diets and oligoantigenic diets may be effective in reducing children's ADHD symptoms. Elimination diets are utilized to determine which foods are causing adverse reactions, including neurobehavioral symptoms. It is believed that behavioral reactions are seen as possible adverse reactions to food and elimination diets are used to identify foods that can contribute to mental disorders. At this time, the results are inconclusive as to if either the food additives exclusion diet or oligoantigenic diet are effective in alleviating symptoms in ADHD children and this would seem to warrant further examination of such approaches. [A28]

Other Diets

As noted above, studies have shown some correlation between diets that are high in processed, ultra-processed foods, including packaged foods, fast foods, hydrogenated fats and surgery drinks are linked to ADHD. A 2017 study found that a low adherence to a Mediterranean diet was associated with ADHD diagnosis. The Mediterranean diet focuses on plant-based foods and healthy fats, high in vegetables, fruits and whole grains. The study noted that lower frequency of consuming fruit, vegetables, pasta, and rice and a higher frequency of skipping breakfast and eating at fast-food restaurants were associated with ADHD diagnosis. Additionally, high consumption of sugar, candy, cola beverages, and non-cola soft drinks and low consumption of fatty fish were also associated with a higher prevalence of ADHD diagnosis. While the study size was relatively small (120 children), this study does provide preliminary evidence that following a Mediterranean diet should be considered for children with ADHD. [A7]

Additionally, a 2021 study looked at the impact of the dietary approaches to stop hypertension (DASH) diet on ADHD symptoms in children with ADHD between the age of 6 and 12. The DASH diet focuses on vegetables, fruits and whole grains. It includes fat-free or low-fat dairy products, fish, poultry, beans and nuts. The study concluded that adherence to a DASH-style diet might improve ADHD symptoms [A10].

Conclusion

Standard treatments for ADHD typically involve medication, behavioral therapy, psychological counseling, or a combination of these methods. Understanding a child's vitamins and mineral deficiencies together with dietary counseling is emerging as a promising tool for managing ADHD symptoms. Research suggests that dietary changes may improve symptoms for some individuals. Increasing the intake of certain nutrients which are often deficient, while eliminating potentially harmful foods may yield the most powerful effects for children with ADHD. While more studies are needed to determine the full impact of dietary interventions, they appear to be a promising pathway for improving the lives of those with ADHD.

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