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High Sugar Intake Increases ADHD Symptoms: a literature study

Ni Luh Ayu Putu Indah Yulantari[1,2], I Gusti Putu Martha Kusuma[2]
[1] Master of Sport Physiology, Faculty of Medicine, University of Udayana, Denpasar, Bali, Indonesia
[2] MAI Physiotherapy Clinic (MAI Physio), Tabanan, Bali, Indonesia

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Corresponding Author:

I Gusti Putu Martha Kusuma
MAI Physiotherapy Clinic,
Tabanan, Bali, Indonesia

Email:
rahmartha21@gmail.com

ABSTRACT

Attention-deficit and hyperactivity disorder (ADHD) is a neurodevelopmental disorder that occurs in 5–12% of children in the world. ADHD has the characteristics of difficulty concentrating (focusing), being easily distracted, not being easily tired, excessive activity, impulsiveness, decreased executive function, fidgeting, excessive talking, difficulty waiting for one's turn, and often disturbing others. External factors that play an important role in the treatment of ADHD are nutrition and diet. Various nutrition experts have stated that nutrition plays an important role in neurodevelopment. Increased consumption of sugar calories is associated with decreased activity in areas associated with dopamine (posterior midbrain, dorsolateral/orbitofrontal cortices) and taste processing areas (postcentral gyrus) during sugar consumption. The method used in this study uses study literature collected from various reference journal articles from 2007–2023 and international journal articles that are interconnected. All the articles obtained state that sugar can disrupt the balance of neurotransmitters in the body of people with ADHD, namely dopamine and norepinephrine, which will increase the symptoms of ADHD. The significance value obtained is below p 0.05, which means that there is an effect of sugar on the symptoms of ADHD. Based on several sources of journal articles, it can be concluded that consuming sugar in children with ADHD will increase the symptoms of ADHD, such as inattentiveness and impulsivity. However, sugar consumption in normal children does not cause ADHD, but it is possible to experience other diseases.

Keywords: *ADHD, Attention Deficit, Hyperactivity, Sugar*

1. INTRODUCTION

Attention-deficit and hyperactivity disorder (ADHD) is a neurodevelopmental disorder that occurs in 5–12% of children in the world. ADHD has the characteristics of difficulty concentrating (focusing), being easily distracted, restless, excessive activity, impulsiveness, decreased executive function, fidgeting, excessive talking, difficulty waiting for one's turn, and often disturbing others. ADHD has three subtypes: inattentive, hyperactive-impulsive, and a combination of both. [1,23] The prevalence of ADHD will decrease with age, whether it is persistent or symptomatic. [9] The causes of ADHD are genetic and neurotransmitter factors. The neurotransmitters that play a role are dopamine and norepinephrine, which are synthesized from dopamine. The etiology of ADHD is influenced by genetic, dietary, and environmental factors that are associated with strong genetics, with >70% heritability. [10] Gene variation also influences brain development, cell migration, and the gene encoding of catecholamine receptors and transporters. [15]

External factors that play an important role in the treatment of ADHD are nutrition and diet. Nutrition and diet are inseparable; one of the most common diets is the sugar diet, or sugar consumption. The sugar is not only pure sugar but also sugar produced from food conversion. An imbalance of sugar in the body will cause several disorders that can lead to diseases, such as caries, obesity, Type 2 Diabetes Mellitus, cardiometabolic disease, and kidney disease. [19] Excessive sugar consumption can lead to chronic inflammation, autoimmunity, and neuroinflammation. [22] Various nutrition experts have stated that nutrition plays an important role in neurodevelopment, including zinc and iron, which play a role in the production of neurotransmitters associated with ADHD. Several previous studies also stated that ADHD can occur due to factors during birth, including premature birth, low birth weight, consumption

of alcohol, tobacco, or cigarettes, and substances used by parents, especially during pregnancy. also found to decrease in ADHD, which plays an important role in neurotransmitters and signaling. [14]

The neurotransmitter dopamine has an important role in neuromodulation in areas such as motor control, motivation, reward, cognitive function, maternal function, and reproductive behavior. Dopamine is synthesized in the central and peripheral nerves and will work after binding to G protein-coupled receptors. Dopamine receptors are used throughout the body and function in both the central and peripheral nerves. Dopamine signaling pathways are important for maintaining physiological processes and unbalanced activities that will cause dysfunction and are also associated with neurogenerative diseases. [6] In ADHD, both neurotransmitters will decrease.

Increased consumption of sugar calories from SSB (Sugar Sweetened Beverages) is associated with decreased activity in areas related to dopamine (posterior midbrain, dorsolateral/orbitofrontal cortices) and taste processing areas (postcentral gyrus) during consumption of SSB. [7] According to the temporary hypothesis obtained from a literature review, there is a tendency for sugar consumption to be related to the condition of ADHD.

2. METHODS

The method used in this study was to collect literature from various reference journal articles from 2007–2023, namely international journal articles that are interconnected. All articles are online and can be accessed at PUBMED, MDPI, and Google Scholar. The keywords used are "ADHD", "sugar-sweetened beverages, "attention-deficit and hyperactivity disorder, and hyperactivity".

3. RESULTS AND DISCUSSION

Studies by several old researchers have concluded that consumption of sugar (sucrose, aspartame, and other sweeteners) can increase hyperactivity. [5,20] The 2022 Akin study found that consumption of snacks and processed meat products is associated with an increase in ADHD symptoms. Instant food has a high energy content but lacks nutrition; besides that, it also contains saturated fat and sugar, so it is called junk food. [1] A previous 2018 study by Guerrieri stated that high calorie consumption is associated with one of the symptoms of ADHD, namely high impulsivity towards foods of various colors, shapes, tastes, and textures. [4] Food coloring from artificial coloring or sodium benzoate can increase hyperactivity. [21] Not only food, but ADHD symptoms can increase when consuming energy drinks such as sports energy drinks and sweet coffee drinks. hyperactive, with a p value of 0.05. [11] A meta-analysis study stated that consumption of SSBs and all types of sugar correlated with an increase in ADHD symptoms, with a value of $P = 0.01$ ($p<0.05$).[13]

Several mechanisms link SSB consumption and ADHD, one of which is related to the reward system. Consumption of sugar results in a higher release of extracellular dopamine. Therefore, prolonged sugar intake can lead to the desensitization of dopaminergic receptors. Therefore, it is necessary to increase sugar intake to achieve the same level of satisfaction, resulting in a gradual decrease in dopamine response. This dysfunction of dopaminergic signaling triggers inhibition of control mechanisms in the frontal cortex, an area directly linked to the neurobiology of ADHD. The second mechanism is that high-sugar foods with low free choline content can cause IGF2 hypermethylation, which affects the development of ADHD symptoms in adolescents with EOP behavior problems. A high-sugar diet can also alter the human gut microbiome via the microbiome-gut-brain axis and then modify some central nervous system receptors that affect brain function and exert epigenetic control of gene expression, thereby causing behavioral problems. [11]

It should be noted that sugar does not cause ADHD but increases the symptoms of children with it. [5] As is well known, ADHD is also a genetic condition, so it requires control from the child's parents. Parents who have ADHD will easily imitate their children's behavior towards food consumption because they are in the same environment. [1] ADHD that doesn't get proper treatment will have a bad impact on the future. ADHD can cause anxiety, depression, addiction, and even suicide. [16,18] Studies suggest limiting caloric consumption based on age. Infants need 100 cal/kg/day, 1-3 years need 80 kcal/kg/day, 4–5 years need 70 kcal/kg/day, 6–8 years need 60–65 kcal/kg/day, and 9 and above need 35–45 kcal/kg/day. [24] Sugar consumption is suggested to be 10% of total daily calories and can be lowered to 5% of total calories. The need for calories will increase as we get older. [25]

4. CONCLUSION

Based on several sources of journal articles, it can be concluded that consuming sugar in children with ADHD will increase the symptoms of ADHD, such as being inattentive and impulsive. Be it food or drink. However, sugar consumption in normal children does not cause ADHD, but it is possible to experience other diseases. The weakness of this study is the limited study of literature that discusses this topic in more detail and specificity and uses the literature study method. It is hoped that further studies can be made with a higher level of evidence.

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