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Effect of sugar on ADHD symptoms in children up to 12 years old

Efeito do açúcar associado ao TDAH em crianças até 12 anos

Efecto del azúcar asociado al TDAH en niños hasta 12 años

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ABSTRACT

Objective: To identify scientific papers published in the last ten years relating to the effect of sugar on children with Attention Deficit Hyperactivity Disorder (ADHD). **Methods:** Integrative literature review in the Cochrane Library, EMBASE, LILACS, MEDLINE (PubMed), Science Direct, and SciELO databases from the last ten years, carried out between November 2023 and February 2024. The descriptors "Sugar," "Child," "Attention Deficit Hyperactivity Disorder," and "ADHD" were used. **Results:** The final sample consisted of 12 articles, which described various studies that evaluated the consumption of sugars through different diets, either by food or drink, by children with ADHD. **Final considerations:** Through the selected studies, it was possible to understand that there is still much to be studied to reach a causal conclusion about sugar and ADHD. Although there is no proven link between sugar consumption in the diet and symptoms, excessive sugar consumption may be one of several potentially relevant factors. More research is still needed to understand how diets and drinks with added sugars can influence symptoms. However, it has already been pointed out that they can present a dose-dependent response, mainly when drink consumption occurs.

Keywords: Sugar, Diet, Hyperactivity.

RESUMO

Objetivo: Identificar produções científicas publicadas nos últimos 10 anos relacionando o efeito do açúcar em crianças com Transtorno de Déficit de Atenção e Hiperatividade (TDAH). **Métodos:** Revisão integrativa da literatura nas bases de dados Cochrane Library, EMBASE, LILACS, MEDLINE (PubMed), ScienceDirect, e SciELO, dos últimos 10 anos, realizada entre novembro de 2023 até fevereiro de 2024. Foram usados os descritores “Sugar”, “Child”, “Attention Deficit Hyperactivity Disorder”, e “ADHD”. **Resultados:** A amostra final foi composta por 12 artigos, os quais descreveram diversos estudos que avaliaram o consumo de açúcares, através de diferentes dietas, seja por alimentos ou bebidas por crianças com TDAH. **Considerações finais:** Através dos estudos selecionados foi possível compreender que ainda existe muito a ser estudado para que se possa chegar em uma conclusão causal sobre o açúcar e o TDAH. Embora não exista uma relação comprovada entre o consumo de açúcar na alimentação e os sintomas, o consumo excessivo de açúcar pode ser um de vários fatores potencialmente relevantes. Ainda se faz necessário mais estudo para a compreensão de como dietas e bebidas com adição de açúcares são capazes de influenciar nos sintomas, mas já foram destacados que podem apresentar um resposta dose-dependente principalmente quando o consumo for através de bebidas.

Palavras-chave: Açúcar, Dieta, Hiperatividade.

RESUMEN

Objetivo: Identificar trabajos científicos publicados en los últimos 10 años que relacionen el efecto del azúcar en niños con Trastorno por Déficit de Atención e Hiperactividad (TDAH). **Métodos:** Revisión bibliográfica integradora en las bases de datos Cochrane Library, EMBASE, LILACS, MEDLINE (PubMed), ScienceDirect y SciELO, de los últimos 10 años, realizada entre noviembre de 2023 y febrero de 2024. Se utilizaron los descriptores "Sugar", "Child", "Attention Deficit Hyperactivity Disorder" y "TDAH". **Resultados:** La muestra final se compuso de 12 artículos, en los que se describen diversos estudios que evalúan el consumo de

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azúcares, a través de diferentes dietas, ya sea por alimentos o bebidas por parte de niños con TDAH. **Consideraciones finales:** Através de los estudios seleccionados, fue posible comprender que aún queda mucho por estudiar para llegar a una conclusión causal sobre el azúcar y el TDAH. Aunque no existe una relación demostrada entre el consumo de azúcar en la dieta y los síntomas, el consumo excesivo de azúcar puede ser uno de varios factores potencialmente relevantes. Aún es necesario investigar más para entender cómo las dietas y las bebidas con azúcares añadidos pueden influir en los síntomas, pero ya se ha señalado que pueden presentar una respuesta dosis-dependiente, especialmente cuando el consumo es a través de bebidas**.**

Palabras clave: Azúcar, Dieta, Hiperactividad.

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is characterized as a neurodevelopmental disorder related to behavior or symptoms associated with attention, impulsivity, and hyperactivity (COGHILL D, et al., 2023). It usually appears during childhood and adolescence and can remain throughout adulthood (GEISSLER J, et al., 2018). ADHD affects over 5% of children and teenagers, with an incidence of 7.6% in children aged 3 to 12 and 5.6% in teenagers aged 12 to 18 (SALARI N, et al., 2023). The exact cause of this condition is not fully understood, but it involves a combination of genetic, environmental, and social factors (DEL-PONTE B, et al. 2019).

Despite the vast amount of research in this area, the need for valid neurobiological markers or objective criteria for diagnosis remains a significant challenge for clinicians today (DRECHSLER R, et al., 2020). When diagnosing ADHD, a clinician must confirm it using established criteria for symptoms that can interfere with social, academic, or professional functioning (BANASCHEWSKI T, et al., 2023).

These criteria are specified by nosological systems, such as the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5), and the International Classification of Diseases, editions 10 and 11 (ICD-10/11) (DRECHSLER R, et al., 2020). There are three types of ADHD: one characterized by dominant attention deficit, another by dominant hyperactivity and impulsivity, and a third by both symptoms (RYU SA, et al., 2022).

In children, ADHD is the most common neurodevelopmental disorder (LI Y, et al., 2023). However, the initial signs of hyperactivity are frequently challenging to detect until a child reaches the age of four, and it is most evident in elementary school (SALARI N, et al., 2023). The prevalence of ADHD varies depending on the age group and diagnostic criteria used. Identifying whether a child has ADHD is a multi-step process, with a checklist for rating the symptoms providing a history of the child from parents and teachers (KIM JH, et al. 2020).

When using DSM-V criteria, the prevalence of ADHD in children and adolescents is higher than using alternative diagnostic criteria (SALARI N, et al., 2023). For the treatment of ADHD, all guidelines recommend a multimodal approach that addresses the psychological, behavioral, and occupational or educational needs of the child and their family (NATIONAL INSTITUTE FOR HEALTH AND CARE EXCELLENCE, 2018). Multimodal treatment approaches involve various treatment modules customized to meet the specific needs and situation of the individual. The treatment may be divided into different stages, starting with parental counseling in the first phase. In the second phase, the child undergoes individual behavioral therapy while the parents participate in a parental training program. Finally, in the third phase, stimulant medication is introduced (GEISSLER J, et al., 2018).

Stimulant drugs such as methylphenidate and dexamphetamine (or dextroamphetamine), together with the non-stimulants atomoxetine (a selective noradrenaline reuptake inhibitor) and guanfacine (an alpha 2A agonist), are considered the reference treatments (MECHLER K, et al., 2022). Worldwide, methylphenidate, popularly known as Ritalin, is the most frequently prescribed drug for ADHD. Evidence indicates that this treatment has a positive impact on reducing the significant ADHD symptoms in children and adolescents, in addition to being considered suitable for children aged six and above (STOREBO O, et al., 2018). Research has shown that certain treatment medications may come with unwanted side effects. As a result, dietary

therapy has been suggested as a possible alternative. Maintaining proper nutritional balance is essential to ensure a beneficial diet and avoid harmful food components (CURADO HTAM, et al., 2019). There has been growing interest in recent years in how proper nutrition can affect ADHD. Various studies have indicated that there is a link between diet quality and the overall health and well-being of children with ADHD. These children may be prone to nutritional deficiencies due to the attention required when eating a meal containing adequate nutrients and the appetite-suppressing properties of certain medications (SHA'ARI N, et al., 2017).

It is well known that eating behaviors during childhood are the basis of food consumption and the acquisition of nutrition. Poor eating behaviors can lead to an unbalanced intake of nutrients in the diet and even affect growth and development (HILBERT A, et al., 2018). However, food intake and eating behavior issues are generally overlooked in the treatment and follow-up of children with ADHD (YAN W, et al., 2023).

The available evidence indicates that children with ADHD tend to exhibit more unhealthy eating behaviors and that hyperactivity or impulsivity can trigger emotional or excessive eating (BRUNAULT P, et al. 2019). A cross-sectional study in the United States revealed a positive association between preschool children's inattention and hyperactivity/impulsivity with food reactivity, emotional overeating, and slow eating (FUEMMELER BF, et al., 2020). These findings underscore the link between children's ADHD symptoms and eating behavior, as well as physical development, highlighting the importance of healthy eating habits. However, the relationship between ADHD and the consumption of specific nutrients remains incompletely understood and necessitates further investigation (RYU SA, et al., 2022).

Known by several names, such as refined sugar or table sugar, sucrose is a type of carbohydrate that digestive enzymes process into glucose and fructose. Since the human body metabolizes sucrose quickly, its main effect is to provide quick energy (QI X and TESTER R, 2019). The consumption of sugar has been linked to ADHD as one of the environmental risk factors that may play a pivotal role (GOYAL MS, et al., 2015). The World Health Organization recommends limiting simple sugar consumption to no more than 10% of total calorie intake per day and a maximum of 25g total (RIPPE JM, et al., 2017).

It is essential to be mindful of the potential adverse effects of consuming too much simple sugar, such as hyperactivity and hyperglycemia. When we eat high-sugar foods, the pancreas releases insulin, which can lead to a drop in blood sugar levels, triggering epinephrine. This action can result in nervous reactions and hyperactive behaviors (RÖDER PV, et al., 2016). It is also suggested that the relationship between ADHD and sugar is due to its impact on the release of extracellular dopamine, a neurotransmitter part of the reward system. Over time, dopamine receptors become desensitized, which leads to an increased need for sugar to achieve the same level of satisfaction. This desensitization can reduce the dopaminergic response after consuming sugar, which, in turn, can inhibit control mechanisms in the frontal cortex. This area of the brain is directly related to the neurobiology of ADHD (DEL-PONTE B, et al., 2019).

A study carried out in Spain (2022) shows that, in general, children and adolescents with ADHD prefer superfluous foods that are more palatable and of lower nutritional quality. The ADHD group analyzed preferred the sweet dietary pattern, eating more unhealthy foods rich in sugar and fat and less fruit, vegetables, whole grains, and quality protein foods (ROJO-MARTICELLA M, et al., 2022). Current research suggests that surpassing the daily recommended limit of added sugar intake (25g/day) is associated with an increased risk of experiencing ADHD symptoms (FARSAD-NAEIMI A, et al., 2020; YINGCHANKUL N, et al., 2023). Nevertheless, Ricciuto L, et al. (2022) reported a decline in sugar consumption over the past twenty years, attributed to reduced added sugars in sweetened beverages. Hence, the purpose of this article is to conduct an integrative review of articles published in the last decade that have examined the effects of sugar on ADHD in children up to 12 years old.

METHODS

This integrative literature review, which combines a qualitative, exploratory nature with a theoretical approach, contributes to a better understanding of the concepts. It incorporates the applicability of the results to fill gaps within the subject. This study aims to gather research on the dietary consumption of sugar and its implications in children with ADHD. The following question guided the study: Does the consumption of sugar

by children diagnosed with attention deficit hyperactivity disorder have any impact on the worsening or improvement of symptoms? The search occurred in February 2024 in five databases: SciELO, PubMed, EMBASE, Cochrane Library and LILACS.

To select the studies, the following descriptors were used in Portuguese: “Transtorno do Déficit de Atenção com Hiperatividade”, “TDAH”, “açúcar”, “sacarose” “crianças”, “pediátrico” e “infância”, in English:“Attention Deficit Hyperactivity Disorder”, “ADHD”, “sugar”, “sucrose”, “children”, “pediatric”, “child” e “childhood” and in Spanish: “Transtorno por Déficit de Atencíon e Hiperactividad”, “TDAH”, “Azúcar”, “sacarose”, “niños”, “pediátricos” e “niñez”. The search was conducted using DeCS/MeSH descriptors in the titles and abstracts and combined with the Boolean operators AND and OR.

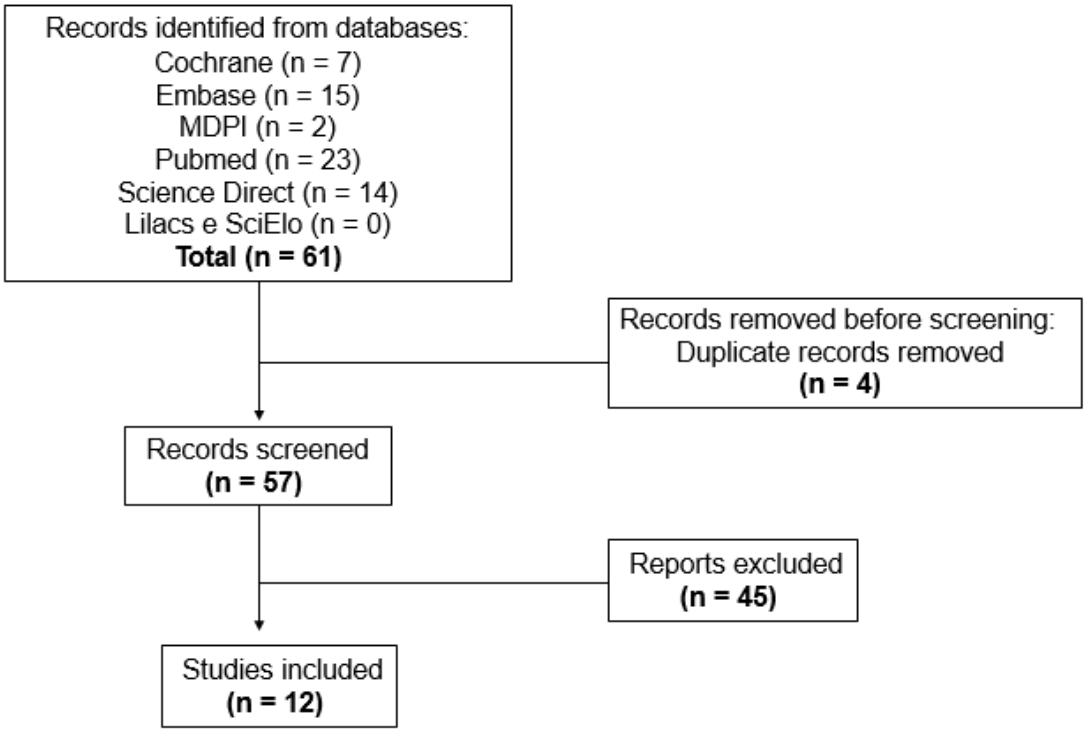
The inclusion criteria were articles published in the last ten years (2014 to 2024) in Portuguese, English, and Spanish, case-control field studies, and cross-sectional and cohort studies that emphasized the relationship between sugar consumption, children, and ADHD, meeting the study’s objective.

The exclusion criteria were studies that did not meet the study’s aim, studies that were outside the time frame, duplicates, and not available in full text. After critical reading, further exclusion of articles was carried out based on relevance to the research question.

RESULTS

After searching the databases, 61 articles were found. Of these, four articles were excluded due to duplication. Fifty-six articles were selected to be read in total, with a final sample of 12 articles, as shown in the flowchart in **Figure 1**.

Figure 1 - Flowchart of the article selection process for the integrative review.



Source: Rios RO e Klettenberg MRP, 2024.

Table 1 shows the articles selected by the three research strands. The first was attention deficit hyperactivity disorder, the second was dietary sugar consumption, and the third was the relevance of sugar consumption to the symptoms presented by children with ADHD. The articles are summarized, including their titles, authors, year of publication, the type of study, objectives, and conclusions included in the main results.

Table 1 - Selected articles, organized in columns of authors, years, titles, and considerations.

Number	Authors and year	Considerations
1	Esparham A, et al., 2014	Review article highlighting integrative medicine approaches, including dietary therapies, nutritional supplements, environmental hygiene, and neurofeedback for children with ADHD. In its analysis of sugar consumption, it found no evidence linking sugar to ADHD directly. However, it presented a few studies that evaluated the response to the acute effects of sugar consumption. It highlights the need for further research on sucrose consumption and chronic carbohydrate consumption and its impact on ADHD symptoms.
2	Woo HD, et al., 2014	A case-control study was conducted in a hospital with 192 elementary school students in Korea between the ages of 7 and 12 for six months. The aim was to analyze four diets (Traditional, Seaweed-egg, Traditional-healthy, and Snack) and their relationship with ADHD. They concluded that the Traditional-healthy diet, characterized by high intakes of kimchi, grains, and bonefish and low intakes of fast foods and beverages, was associated with lower odds of having ADHD.
3	Rytter MJH, et al., 2014	A systematic review article that analyzed evidence of dietary interventions for children with ADHD. Fifty-two articles were analyzed, including five on sugar or sweeteners. Most of the studies had short-term exposure and few participants. However, one found increased inattention with sugar relative to saccharin and aspartame. The conclusion from the selected studies was that the literature does not support the theory that sugar, or any other sweetener, causes ADHD symptoms in children.
4	Yu CJ, et al., 2016	A case-control study evaluated the Sugar-Sweetened Beverage (SSB) Consumption and ADHD in 332 children (one hundred and seventy-three ADHD subjects and one hundred and fifty-nine normal controls) among four and 15-year-olds. The study tried to associate SSB consumption with ADHD. The study showed a dose-response relationship between SSB consumption and ADHD. They suggest that the consumption of SSBs might be a consequence rather than a cause of ADHD.
5	Ríos-Hernández A, et al., 2017	A case-control study investigated the relationship between the Mediterranean diet and ADHD in 60 children between 6 and 16 years newly diagnosed with the disorder. The study tried to associate that adherence to a Mediterranean diet would be positively associated with an increase in ADHD diagnosis. The study suggested that dietary habits may have a significant impact on the development of ADHD, and a positive correlation has been observed between low adherence to the Mediterranean diet and ADHD diagnoses.This study demonstrated a reduced intake of vegetables and fruits and increased intake of sugar, candies, soft drinks, and fast food by children and adolescents with ADHD.
6	Yan W, et al., 2018	A cross-sectional study that evaluated 14912 children aged 3–6 years old in China. A questionnaire was used to assess usual dietary intake and ADHD. The study identified five nutritional patterns. Among them, two dietary patterns, "processed" and "snack," indicate a high fat and sugar intake. A greater adherence to the "processed" and "snack" dietary patterns was related to a higher prevalence of ADHD symptoms, and the "vegetarian" dietary pattern was related to a lower prevalence of ADHD symptoms among preschoolers.

Number	Authors and year	Considerations
7	Del-Ponte B, et al., 2019	A birth cohort study estimated sugar consumption, and the development and well-being assessment was conducted through a food frequency questionnaire (FFQ) in children 6 and 11 years old. The sucrose consumption was associated with the prevalence of ADHD only among boys at six years of age. That persistence of high consumption or an increase in sugar consumption between 6 and 11 years of age was not associated with a higher incidence of ADHD. This supports the hypothesis that the higher sugar consumption by children with ADHD is possibly a consequence rather than a determinant of the disorder.
8	Endreffy I, et al., 2020	A case-control study evaluated the urinary excretion of oligosaccharides and glycosaminoglycans (GAGs) in ADHD and control subjects. Forty ADHD subjects between 1 and 9 years old were enrolled in the study, with a standardized dietary regimen. The study concluded that carbohydrate metabolism differs among ADHD subjects compared with control subjects. However, they did not determine whether dietary control affects any of the metabolic dysfunctions observed in ADHD.
9	Lee KS, et al., 2020	A cross-sectional study aimed to determine the association between dietary patterns in 4-year-old children and ADHD symptoms in 6-year-old children. It evaluated four major dietary patterns from 535 children who had been followed up at 4 and 6 years from 2013 to 2017. This study found that a sweet nutritional pattern in children at age four years significantly increased the risk of attention deficit, hyperactivity, and ADHD symptoms at age six years. The study also suggests that vegetable intake may play a protective role against ADHD symptoms in children.
10	Johnson RJ, et al., 2021	A descriptive study about a common risk factor may involve consuming foods containing added sugars, salty foods, and refined high-glycemic carbohydrates. The study aimed to associate high intake of sugar with behavioral disorders. They suggested that fructose consumption may be associated with a foraging response that may assist in externalizing behavioral problems and that the mechanism involved in the generation of uric acid may act as a signal from the organism.
11	Salvat H, et al., 2022	A case-control study on 200 children aged 5–13 years old with and without ADHD. The study aimed to assess the nutrient intake, dietary patterns, and anthropometric variables in children with ADHD compared to typical peers. The main findings of this study were that children with ADHD consume more simple sugars, tea, and ready-made foods but have lower protein, vitamin B1, vitamin B2, vitamin C, zinc, and calcium levels compared with their typical control peers.
12	Zhang Y, et al., 2023	A cross-sectional study evaluated the consumption of sugar-sweetened beverages (SSB) and hyperactivity in 6541 children aged 6-12. The findings demonstrate that SSB consumption was significantly associated with hyperactive behavior in Chinese children. The association between SSB intake and hyperactivity was more substantial in girls and older children. The findings suggested a positive association between SSB consumption and the risk of hyperactivity in children and a dose-response relationship between the frequency of SSB consumption and the risk of hyperactivity behavior.

Source: Rios RO e Klettenberg MRP, 2024.

DISCUSSION

For several years, there has been research on the connection between sugar consumption and attention deficit disorder, particularly in children. Despite numerous studies, a conclusive verdict has yet to be reached. As seen in this integrative review, many experts believe further research is necessary to establish a definitive correlation. One aspect that should be considered in the different studies is the variation of the definitions of "excessive sugar consumption" used in the studies, which makes analysis challenging. Additionally, the various types of sugar analyzed further complicate the matter, as each type may have distinct effects on the body.

Diet has a significant impact on our health, particularly for children. When linking them to a specific food group, it is essential to approach any dietary restrictions carefully. Research often centers around elimination diets, especially with sugar, when such associations are made. Esparham's review highlights that most articles on food, children, and ADHD ultimately reference such restrictions (ESPARHAM A, et al., 2014).

Among the studies selected, few evaluated the cause and effect between excessive sugar consumption and ADHD; among them, Del-Ponte B, et al. (2019) suggested that higher sugar consumption by children with ADHD is possibly a consequence rather than a determinant of the disorder. This suggestion was made after the analysis indicated no association between high sucrose consumption between 6 and 11 years and the incidence of ADHD, compared with individuals who always presented low consumption, both among boys and girls (DEL-PONTE B, et al., 2019).

Thus, in agreement with the systematic review presented by Ritter MJH et al. (2014), which already showed that such an association had not yet been conclusive, emphasizing that sugar is not capable of causing ADHD in children (RYTTER MJH, et al., 2014). On the contrary, Lee KS et al., 2020 put forth a contrasting conclusion, asserting that a diet high in sugars, including items such as chocolate, chips, and fruit jams, was significantly associated with an increased risk of attention deficit, hyperactivity at age four years and ADHD symptoms at age six years (LEE KS, et al., 2020). In a case-control study, Woo HD et al. (2014) showed that the snack pattern score was positively associated with ADHD in school-aged Korean children (WOO HD, et al., 2014).

Regarding exposure, certain studies have concentrated on the consumption of sucrose or carbohydrates, while others have scrutinized the ingestion of sugar-laden foods or analyzed eating habits. However, constructing dietary patterns is complex and involves subjective judgments, such as identifying and deciphering food groups, from creating food groups to maintaining and interpreting patterns. Furthermore, the dietary patterns identified in the study are distinct to the particular population under examination, making comparing results from various investigations challenging.

When evaluating case-control studies comparing children with ADHD and those without the disease, it is possible to observe inadequate eating habits more frequently in children with ADHD, describing a different lifestyle and the need for an intervention. According to research conducted by Salvat H, et al. (2022), children diagnosed with ADHD often tend to consume excessive amounts of simple sugars, heavily processed meals, and a diet rich in carbohydrates. This scenario may necessitate implementing lifestyle interventions to address the impact of dietary habits on this disorder (SALVAT H, et al., 2022). Similarly, Yan S, et al. (2018) in a study involving more than 14,000 children carried out in China, found that children with ADHD symptoms showed a higher preference for "processed" and "snack" diets compared to other diets evaluated (YAN S, et al., 2018).

Another study by Rios-Hernandéz A, et al. (2017) also found that 60 newly diagnosed children had lower adherence to the Mediterranean diet, which promotes the consumption of whole grains, fruits, and vegetables, among other foods, demonstrating that ADHD children and adolescents prefer an increased intake of sugar, candies, soft drinks, and fast food (RIOS-HERNANDEZ A, et al., 2017).

Sugar-sweetened beverages have become a significant concern when assessing the diets of children. These drinks have become the leading source of sugar intake worldwide. Two studies have analyzed the consumption of these beverages by children with ADHD, and both have reached comparable findings. One study revealed that consuming these beverages contributes to cognitive and behavioral deficiencies. Children who frequently consume these drinks are up to 4 times more likely to develop these deficiencies than those

who consume them infrequently (YU CJ, et al., 2016). According to recent research, there is a correlation between hyperactive behavior and the consumption of certain substances. A study conducted in China found that girls were more susceptible to this effect than boys. This study also showed that the risk of hyperactivity in children and the frequency of SSB consumption and hyperactivity have a dose-response relationship (ZHANG Y, et al., 2023). Both studies agree that the severity of hyperactivity in children is directly related to the amount and frequency of consumption.

Throughout this integrative review, the selected studies shared a common focus on analyzing complete diets or food groups instead of solely examining individual nutrients. This way, it highlights the importance of carefully comparing sugar consumption in different forms. For instance, Lee KS et al.'s (2020) study demonstrates the contrast in sugar consumption between jam and juice, with jam accumulating more sucrose and juice more fructose. As a result, their analysis yielded opposite effects (LEE KS, et al., 2020).

This relationship with fructose was also evidenced by Johnson RJ, et al. (2021) in a descriptive analysis of fructose metabolism in the body, which results in the release of uric acid, which could be capable of acting as a signal for different behavioral disorders. This result suggests that high consumption of foods containing added sugars, salty foods, and refined high glycemic carbohydrates may be a risk factor for the development of disorders associated with impulsivity, such as ADHD (JOHNSON RJ, et al., 2021).

In line with the various studies analyzed, the only research in the selection that made a specific analysis of molecules sought to relate the presence of glycosaminoglycans in the urine of children with ADHD. This study, unlike the others, does not directly analyze the consumption of a particular food but instead seeks to understand how the intake of carbohydrates, which are rich in sugars, can influence children with ADHD. His analysis showed that children with ADHD reabsorb glucose much more effectively than other monosaccharides, even though impaired carbohydrate metabolism is a known characteristic of ADHD (ENDREFFY I, et al., 2020).

A diet high in sugars can have adverse effects on the neuropsychiatric health of children with ADHD, as indicated by a collection of studies presented here. These studies suggest that children with ADHD tend to prefer foods rich in sugar, preservatives, flavorings, and colorings. Frequently consuming such foods may negatively impact their behavior, leading to increased restlessness, inattention, and impulsiveness. However, it is essential to note that the studies presented have not yet confirmed a causal relationship.

All the articles in the review emphasize the pivotal role of a healthy diet in children, even though they may prefer foods high in added sugars and carbohydrates. In this respect, it is of utmost importance to monitor sugary drinks, as they appear to have a dose-response effect on hyperactivity symptoms in children with ADHD.

FINAL CONSIDERATIONS

This comprehensive review explored various studies related to children with ADHD, revealing that further investigation is necessary to establish a causal relationship between sugar and observed symptoms. Although there is no proven relationship between dietary sugar consumption and ADHD symptoms, excessive consumption of sugar may be one of several potential contributing factors. Additionally, research into the metabolism of different sugars and their effects on the body is increasingly important. It is worth noting that a common thread among all the articles is the importance of a healthy diet for children despite their preference for foods high in added sugars and carbohydrates. It is also essential to encourage a nutritious and well-balanced diet, as well as implementing measures to mitigate the use of added sugars in processed foods and sugary beverages, which can promote the cognitive and emotional well-being of children and adolescents as they appear to have a dose-response effect on hyperactivity symptoms in children with ADHD. Overall, this study emphasizes the need for continued research into the relationship between diet and ADHD symptoms, promoting healthier lifestyles for children to mitigate the impact of ADHD symptoms. Therefore, it is essential to encourage parents, caregivers, and healthcare providers to monitor children's diets closely, focusing on promoting healthier lifestyles for children.

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