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Proposal: How does the Total Sugar Intake Impact Cognitive Function in Children 10 Years of Age?

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Research question: "How Does the Total Sugar Intake Impact Cognitive Function in Children Aged 10?"

Abstract

The effects that high sugar intake has on cognitive function is an ongoing topic in research today. Although most studies point to a negative relationship between the variables, the evidence is not conclusive enough to be able to confirm its true effect. While evidence finds an association between high sugar intake and chronic diseases, its impact on cognitive function is yet to be determined. The purpose of this proposed research study is to examine how total sugar intake impacts the cognitive function in children. Fifty children, age 10, will be randomly chosen from schools in South Florida for a cross-sectional study. We will gather information by calculating dietary intake using 3-day dietary recall, cognitive screening tests, clinical measurements tests and by observing behaviors displayed. Results may show positive effects due to a greater energy supply to the brain, however, adverse effects, such as impaired memory, reduced cognitive function, brain fog, difficulty concentrating, and behavioral issues may also be seen. This may be the case as a high intake of sugar is known to be addictive and have detrimental effects on individuals. Potential confounding factors including age, environment, genetics, and pre-existing conditions will be controlled. More research is needed to understand the impact of sugar intake on cognitive function. Predicting the effects of sugar intake on cognition is complex and requires further research. This will help to create recommendations for guidelines related to intake quantity.

Introduction

Cognitive development in children is seen as a method of conveying a child's learning ability through reasoning, thinking, and using language. Traditionally, Jean Piaget stages of cognitive development are what has been used by most health professionals to base their interventions for children (Malik, 2023). These are essential for the overall development and growth of children. There are four stages: sensorimotor stage (0-2 years), preoperational stage (2-7 years), concrete operational stage (7-11 years), and formal stage (12+ years); the goal of each of these stages are object permanence, symbolic thought, operational thought, and abstract thought respectively (Malik,2023).

In the early childhood phase cognitive abilities of children include skills for building such as vocabulary, language, numeracy, memory and pre-reading. For each stage there are different criteria to look for as a measure. Sensorimotor toddlers utilize their sense and motor abilities to influence their surroundings; cause and effect, shaking a rattle may create a sound. Preoperational: children learn mental representation, language, or symbolic thought to pretend or imitate to play (Malik, 2023). This stage is characterized by egocentrism, unable to discern whether others think differently. Concrete operational: child uses logical thought, can reason, solve problems, and hold conversations. Formal operational stage: ability to use logical operations with abstractions, and ability to hypothesize, understand theories and abstract ideas (Malik, 2023).

In the fields of pediatric nutrition and developmental psychology, the effects of sugar consumption on children's cognitive development are among the most contentious topics. This interest is a result of the growing number of children who consume diets high in sugar and the possible long-term effects on their general health and cognitive function. There isn't much agreement among scientists about this complicated topic even though an increasing amount of research has started to address it.

Many elements of this relationship have been investigated in the past, with an emphasis on the effects of varying sugar types—such as fructose—and their consumption at different stages of growth. While some studies have examined the direct effects of sugar on cognitive processes like learning, memory, and attention, others have examined the indirect effects of sugar through conditions that are linked to it, such as ADHD. However, inconsistent sample sizes, focus areas, and methodology throughout these studies have produced inconsistent findings. This has made it difficult to come to firm conclusions and create thorough dietary guidelines and interventions for children.

This study aims to examine the effect of total sugars consumption and discuss how it impacts children's cognitive development and abilities. This study is important because it can help shape public health policies and educational initiatives that eventually aim to improve children's cognitive and general health outcomes. The intake of different types of sugar like fructose and differing consumption patterns during various phases of childhood development significantly affect cognitive functions, including learning, memory, and attention, in children. This research intends to investigate and demonstrate the consequences of sugar intake on

cognitive development, taking into account variables like ADHD that are associated with elevated sugar consumption.

Background

Whether it's natural or synthetic, children enjoy the sweetness of sugar and its ability to amplify the taste of foods or beverages. Along with its use in foods, sugar is used as a natural fuel source for the body and particularly for the brain. When sugar is consumed, the body utilizes enzymes to break sucrose, and other complex sugars down into smaller sugar like starch that the body can use such as glucose (Faria-Pereira et al., 2022). This is a readily available and quick source of energy glucose for the body's cells. The brain is one of the organs with the most neurons, or nerve cells, as such, it demands a lot of energy utilizing half of all the glucose in the body. (Faria-Pereira et al., 2022) Cognitive functions of the brain such as learning, memory and thinking are closely associated with glucose levels and how effectively the brain utilizes this fuel source. If the fuel source, glucose, is low, components of the brain such as the neurotransmitters which are the chemical messengers for the brain do not get produced (Edward, 2016). This would lead to a breakdown in communication between the neurons. In another example, individuals are sometimes found to have hypoglycemia, which is a result of low blood glucose levels. This eventually leads to a loss of energy, reduced brain function and is associated with poor cognitive function and attention (Edward, 2016).

Although sugar has a large appeal and widespread use, consuming large amounts of sugar puts individuals at risk for a lot of health issues, these include dental caries, obesity, and diabetes. Furthermore, there are even suggestions that consuming too much sugar may impair your

nervous system, which may affect your brain and how it functions (Edward, 2016). A study conducted by the University of California in Los Angeles suggested a positive relationship between fructose consumption and aging cells, thus affecting cognitive abilities, hindering learning and memory (Jiminez-Maldonado, 2018). Thus, this has led to an increase in effort to understand the role that sugar has on an individual's health, particularly children, which has led to efforts to promote health by reducing sugar intake or finding healthier alternatives.

The effects of sugar on the brain can be seen in groups with hyperglycemia. Hyperglycemia is when there is too much glucose sugar in the blood over a long period of time, and long term has some negative implications for the brain and neurons. Hyperglycemia can affect the functional connectivity of the brain, which links the connected regions of the brain that share brain matter and functional properties. It can lead to deterioration of the brain or shrinkage (Jiminez-Maldonado et al., 2018).

The current body of research paints a complicated picture of how children's cognitive function is affected by sugar consumption. Research typically can be divided into two categories: those that demonstrate detrimental effects and those that have no discernible effect or yield unclear findings.

Excessive consumption of sugar, particularly fructose, has been repeatedly linked to adverse effects on children's cognitive development (Clark ,2020). Changes in the hippocampus, a region of the brain essential to memory and learning, provide evidence for this and point to possible mechanisms such as neuroinflammation and hippocampus insulin resistance (Clark

,2020). According to the KIT-M3 cohort study, children's cognitive, linguistic, and motor development is impacted differently depending on when they are exposed to sugar (Tsai ,2023).

A meta-analysis revealed a positive association between children's risk of developing symptoms of ADHD and their consumption of sugar and sugar-sweetened beverages (Farsad,2020). According to a study conducted on students in 5th grade, there is no connection between the overall amount of simple sugar consumed from snacks and the development of ADHD (Chang ,2011). There was no significant relationship found between sugar intake and body weight or BMI Z-scores in another study involving preschool-aged children (Mahajan, 2021). There are a number of possible reasons for the contradictory findings in these studies, including variations in the methodologies used, the age groups considered, and the sugar types evaluated. Research demonstrating adverse effects frequently concentrates on sugar varieties, such as fructose. However, studies demonstrating no apparent effects might not distinguish between sugar varieties or might concentrate on total sugar consumption without taking other dietary factors into account.

It is becoming more widely accepted that consuming too much sugar, particularly when young, can harm a person's ability to develop cognitively. The literature does, however, also emphasize the necessity of more thorough investigations, particularly ones with bigger sample sizes and longer follow-up times. This study is important because it can help shape public health policies and educational initiatives that eventually aim to improve children's cognitive and general health outcomes.

Methodology

In order to evaluate the relationship between sugar consumption and cognitive function in South Florida fifth graders, the study uses a cross-sectional design. With the help of this design, data from a specific group of 10-year-olds can be assessed at one particular point in time, making it easier to analyze current trends and correlations.

Fifty children evenly divided by gender, will be included in the study. Schools in South Florida will be the source of these participants. Being ten years old and capable of following simple instructions, along with the necessary permissions from parents and kids, are inclusion requirements. Children with preexisting medical conditions, those on drugs that alter cognitive function, and those with neurological disabilities are not eligible to participate therefore would be excluded from the study.

Information will be gathered from various sources: A 3-day food journal kept with the assistance of a guardian will be used to measure dietary intake; clinical measurements, including blood glucose levels, vitals, physical exams, blood tests and anthropometric measurements will be used to assess overall health; questionnaires will be used to collect demographic data. Mini-Mental State Examination (MMSE), Wechsler Adult Intelligence Scale (WAIS), WISC Wechsler Memory Scale (WMS)and the Children's Memory Scale will be used to assess cognitive function. A variety of cognitive tests will be used in the study, including ones that measure academic achievement, executive function, language, attention, visual-spatial skills, processing speed, and intelligence.

The study's cofounding variables include physical activity levels, age, gender, and sugar intake. Standardized tests are used to measure cognitive function, which is the dependent variable. The study will obtain informed parental consent and child assent in accordance with IRB guidelines, thereby guaranteeing ethical compliance. Prioritizing confidentiality, the study must first receive IRB approval. Taking age, gender, and physical activity into account, the study will use hypothesis testing to assess whether observed differences or relationships in data are statistically significant via chi-squared test to investigate the connection between sugar consumption and cognitive function. Correlation Analysis will also be used to determines the strength and direction of the relationship between two or more variables.

Recognizing the limitations of cross-sectional design in proving causality, the purpose of this study is to provide guidance for future longitudinal investigations into the long-term impacts of sugar on neurological development. The study's conclusions may have an impact on public health policies, educational initiatives, and dietary recommendations.

Limitations could include inaccurate dietary recall, unmeasured factors like sleep quality or socioeconomic status, and the potential for cognitive tests to miss certain details in children's cognitive development.

Possible results/implications

The possible results of this study lie in three possible areas, positive, negative, and unforeseen results. In this study, it is expected to find a positive relationship between deficient cognitive function and sugar intake, particularly added sugars, in children. This would coincide with former studies proposing connections between high sugar intake and cognitive decline in children and adults. High blood glucose levels can affect the brain's functional connectivity, which links brain regions that share functional properties, and brain matter. It can cause the brain to atrophy or shrink (Edward, 2016). If a definite association is found, it would reinforce the case for dietary guidelines to curb or cap added sugar intake in children. This could lead to educational programs for parents and healthcare providers to help encourage healthy eating habits for children.

Alternatively, the study may indicate no noticeable connection or even a negative affiliation between sugar intake and cognitive function. This would end up contradicting current research and that would call attention to the need for new and further exploration into possible moderating components such as sugar type, total quality of diet, and individual distinctions in metabolism. If the study does not indicate a connection between cognition and sugar intake, the need for a more nuanced approach would be highlighted. Scientists could research certain types of sugars, dietary patterns, and particular differences that might influence cognitive function.

A possible unforeseen result could be a U-shaped relationship, where both very low and very high sugar intake are associated with poorer cognitive function. This would indicate an ideal range of sugar intake for the best cognitive performance. A U-shaped relationship could indicate

the significance of a balanced diet that avoids both sugar restriction and excessive intake. Public health proposals can then be able to focus on upgrading overall dietary quality instead of just targeting sugar intake.

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