

Research Article

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Nutrition and Academic Performance in School-Age Children The Relation to Obesity and Food Insufficiency

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Abstract

This paper analyzes multiple articles that demonstrate the effects of poor nutrition on school-age children. The research shows that having a healthy, balanced diet improves brain capacity, maximizes cognitive capabilities, and improves academic performance in school-age children. Alternatively, the research also shows that having too much junk food and an unhealthy diet decreases academic performance by limiting the amount of information to the brain. The brain is able to both retain and recall on demand. The literature also shows the danger of not having enough nutrition and the effects of food insufficiency, which can lead to malnutrition as well as poor academic performance. Overall, this research illustrates the need to aid children in maintaining a nutritious lifestyle. Whether at home or at school, there is a responsibility of the community; locally, regionally or governmentally, to afford each child an equal chance to succeed academically. Socioeconomic status has been shown to have an effect on a child academically, and this paper shows that coming from a poorer neighborhood should not decrease that child's chances of being a well-adjusted, healthy student.

Introduction

The purpose of this paper is to explore the relationship of cognitive functioning in school age children with the effects of dietary fat intake as well as food insufficiency. What the literature also showed was relevance between dietary intake and poor academic performance. With the easy access to foods that adversely affect a child's academic performance, it would seem that the literature should become better known among schools. The research reviewed shows that specific dietary components, such as a balanced nutrient intake that will be discussed further on, have a direct effect on the cognitive capabilities of the individual, highlighting the need to have proper nutrition provided to students in an effort to improve academic performance. The research presented also shows an improvement in academic performance once proper nutrition is achieved.

The literature suggests that it can be as dangerous to have too much "bad" food, as it is to have too little "good" food. "Good" and "Bad" are terms used to relate to the nutritional value of the food, and the chemical role in helping the brain best capitalize on cognitive capabilities. While not developed in detail in this paper, it is important to note that the research has shown a link between socioeconomic status and academic performance. Some researchers utilized students' test scores as well as Grade Point Average (GPA) to determine base levels of cognitive capabilities in some of the research presented, while others utilized governmental data such as NHANES III to aid in conducting a study.

Nutrition and Cognitive Capabilities

Neurotransmitters relay chemical messages to the brain to increase function, and each chemical plays a different role in maximizing neuron capabilities. Colby-Morley [1] found that the brain needs amino acids and choline from outside sources (dietary intake) in order to maintain the brain's necessary amount of neurons to release other necessary chemicals such as serotonin, acetylcholine, and norepinephrine. Byrd [2] explains that serotonin involves "control of appetite, sleep, memory and learning, temperature regulation, mood, behavior (including sexual and hallucinogenic behavior), cardiovascular function, muscle contraction, endocrine regulation, and depression" (p. 1). Likewise, acetylcholine and norepinephrine both play roles in controlling the central nervous system, heart contractions, and attention [1].

Wood breaks down the need for certain chemicals in brain transmissions by citing Wood [3], and through a series of tests, found that having a decreased amount of zinc in the diet affects memory by slowing down the brain's ability to recall information. A connection was also made between short attention spans and low iron levels in children, which also affect recall capabilities [3]. Erickson [4] reduces her research to reflect the five main components found in foods to maintain cognitive capabilities. Protein found in meat, fish, milk and cheese, among others, are used to create neurotransmitters, explained above as chemical messengers to the brain. A lack of this substance, known as protein energy malnutrition, led to poor student performance, and was also a cause of lethargy, and children becoming passive and withdrawn. The article goes on to cite carbohydrates, found in grains, fruits and vegetables, as key due to the breakdown of the compound into glucose (sugar), from which the brain gets energy. Carbohydrates also better enable the brain to absorb tryptophan, which is then turned into serotonin. As noted above, serotonin plays a critical role in helping children, as well as adults, utilize brain capabilities.

Erikson also noted that certain fats are necessary, such as Omega-3, in order to keep the brain well-nourished and stave off feelings of depression and inflammation, and increase memory and mood with an increase in serotonin, which is also known for creating the feeling of pleasure. The brain is comprised of 60% fat, and brain cells help regulate aspects of the immune system, as well as the factors mentioned above [4].

Furthermore, certain vitamins and minerals are vital to promote healthy brain growth and function. Vitamins such as A, B, and E are

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antioxidants and can be found in drinks such as green tea, and Vitamin B is essential in creating energy [4]. In an article expounding the necessity of proper nutrition, Wolpert and Wheeler [5] cite UCLA professor, Fernando Gomez-Pinilla, who analyzed over 160 studies regarding the effect of food on the brain. His research focused on the role of synapses and how food can benefit the plasticity, or flexibility, of said synapses. A synapse is essentially the connection or bridge between neurons and aide in vital functions, such as learning, retention and memory. Gomez-Pinilla supports Erickson's insistence on the importance of Omega-3 fatty acids, commonly found in certain types of fish, such as salmon, walnuts and kiwi, to name a few. He states, "Dietary deficiency of omega-3 fatty acids in humans has been associated with increased risk of several mental disorders, including attention-deficit disorder, dyslexia, dementia, depression, bipolar disorder and schizophrenia" [5].

The article cites the importance of proper nutrition and highlights the dangers of too much junk food; excess caloric intake can disrupt the plasticity of the synaptic relays to neurons, and increase the chance of damage to cells by the creation of free radicals. Free radicals are unstable molecules that play a part in aging, tissue damage, and possibly some diseases [5].

The Effects of Junk Food and Iron Deficiency

"Junk Food" is a term used here to denote the food that is considered unhealthy and inhibitive of children's cognitive processing, which in turn affects academic performance. Using a cross-sectional survey, Zhang et al. [6] looked at fats in the average American diet, including that of children and adults. The American diet is known to be high in fat, saturated fat, and cholesterol. The surveys looked to identify fat intake with cognitive and psychosocial functioning. Data was received from the 3rd National Health and Nutrition Examination Survey III (NHANES III), and mothers were asked a series of questions in relation to their children's behavioral patterns and social skills [6].

The results of the surveys found that the consumption of Polyunsaturated Fatty Acids (PUFAs) was associated with a decreased academic performance, while increasing cholesterol showed an increase in poor performance. The researchers also stated that their report had limitations; the cross-sectionalism of the report limited them from asserting causality, the possibility of inaccurate information supplied by the mothers in an effort to appease social desirability, as well as the limitation of having created anything but rough data in only a 24 hour diet recall period [6].

As Wood [3] found through a 21 week study that followed iron levels of volunteers with borderline anemia, low iron levels in children has a direct effect on the ability to pay attention to information. Halterman et al. [7] set out to investigate the relationship between low iron levels and test scores in a national sample of school-aged children. They based their study off the previous research that showed the effects that iron deficiency had on infants' developmental process. Halterman et al. [7] points out that while there has been research done to show the effects of anemia on cognitive capabilities and academic performance, they think that low level of iron levels preceding the diagnosis of anemia can also have an important cognitive effect.

To measure the cognitive effects in the study, they used NHANES III to provide data for children ages 6-16 in the United States. This information was used for both children with iron deficiency without anemia and children with iron deficiency with anemia. They differentiated between the two groups using a routine screening for hemoglobin levels, which indicates anemia when levels are below

the amount calculated for each age group. Within the 5,398 children involved in the study, 3% were found to be iron deficient. This equates to approximately 1.2 million school-age children and adolescents with iron deficiency in the United States, and was found to be more wide spread than iron deficiency with anemia [7].

The limitations of the study are similar to those of Zhang et al. [6] in that NHANES III being a cross-sectional survey, it was not possible to find a causal relationship between iron deficiency and cognitive scores could not be determined, instead showing only a hypothetical relationship. Secondly, smaller portions of available statistics for children with anemia may also have prevented the study from finding a larger association between anemia and cognitive scores. The results of the study found that 71% of children with iron deficiency scored below average in mathematics, whereas only 49% of children with regular iron levels did [7].

The effects of poor diet, as well as deficiencies in dietary intake, can be seen through the above studies. While low iron levels can be found in diets that have too much junk food, they can also be found in children coming from homes that are referring to as "food insecurity."

Food Insecurity and Insufficiency

Zhang et al. [6] created both a cross-sectional and longitudinal study to investigate the long-term effects of food insecurity on academic performance. Weight, height, and Body Mass Index (BMI) were assessed in both kindergarten and 3rd grade, when the two studies took place. Overall, there were 11,400 students for whom full data was available for both kindergarten and 3rd grade. Food insufficiency was measured by the quality and quantity of food supply within the previous 12 months. In order to measure academic performance, researchers administered direct assessments of math and reading skills individually and were calculated using Item Response Theory (IRT). The results of the longitudinal study showed that children from persistently food insufficient homes showed a smaller increase in both reading and mathematics performance than their more food secure counterparts, as well as a greater increase in BMI over the three years.

The researchers attempted to provide a hypothesis as to why there is an association between food insufficiency and academic performance; one being that a lower household income would affect the quality of the food purchased, and could lead to poorer health decisions, such as ingestion of fast food or foods filled with sugar and little nutritional value. Another interesting hypothesis was that the stress from food insecurity could lead to an increase of cortisol levels, which has been related to depression, decreased cognitive functioning and the atrophy in synapses involved in learning and memory.

Alaimo et al. [8] found an association between food insecurity, poor academic performance and poverty. Their research found that food insufficient children and teenagers were more likely to miss school and to repeat a grade than food sufficient children. The study also showed the food insufficiency had both biological as well psychological effects on a child, some of which included micronutrient deficiencies, reduced food intake, and feelings of deprivation, stress, and worry. Their research found a strong link between lower income families and food insufficient children. Coming from a lower income family, along with inhibiting the ability to eat healthfully, also affects the amount of health care a child can receive due to lack of affordable health care. This can lead to an inability to diagnose iron deficiency, as well as malnutrition, in children [8].

Consequences

Brown, Executive Director of the Center on Hunger and Poverty, reported evidence from research articles that support Alaimo et al. [8] findings that food insufficiency has a multitude of consequences for school-age children. These include, poorer health-which leads to an increase in illness, infection, and iron deficiency, poorer academic performance-which, as shown by Alaimo et al. [8] can lead to grade repetition and an increase in psychological issues, and can also lead to being overweight and a diagnosis of obesity. It is important to note however that research as to the correlation between family income and obesity in children is still considered inconclusive [9].

As the literature discussed has shown, there is a relationship between academic performance and food insufficiency. The effects that government programs have on lessening the academic gap created by improper nutrition is invaluable. Kleinman et al. [10] conducted a study with a pool of 97 students to determine whether food intake had an effect on academic performance. They utilized a Boston Public Schools Universal free School Breakfast Program (USBP) and measured the academic results of the students prior to the beginning of the USBP and for approximately six months following the implementation of the program. Kleinman et al. [10] also reviewed the students' academic and absence records to help determine whether dietary intake had an effect on academic performance. The results showed that the USBP increased nutrient intake for the students, which also increased cognitive functioning and decreased absenteeism [10].

This study is just one example of the benefits of school breakfast programs in increasing academic performance among school-age children. Kleinman et al. [10], as well as the Center on Hunger [9], strongly recommends that school breakfast programs be made free to all students regardless of socioeconomic status in an effort to increase nutrient intake and improve academic performance.

Background of School Food Programs

The National School Lunch Program was created in 1946 by President Truman in order to both promote the health of American children as well as to push for the consumption of American-grown agricultural commodities. The United States Department of Agriculture still controls the regulations of the NSLA, and the act has been amended

twenty-two times since 1946. In order for schools to qualify for federal subsidies for free or reduced lunch, they must follow the guidelines provided by the National Nutrition Standards. These guidelines, Dietary Guidelines for Americans (DGA), require that meals must provide one third of the RDA of protein, vitamin A, C, iron, calcium, and calories; of those calories, no more than 30% can be from fat, and less than 10% should be from saturated fat.

These regulations show that there is a strong understanding of the demonstrated correlation between nutrition and cognitive capabilities. The Food Research and Action Center (FRAC) cited the USDA's provision 2 of the NSLA which allows schools to begin the process of providing free breakfast/lunch to students without consideration of socioeconomic status. The provision also cites increased academic performance as an incentive to utilize the program and integrate it fully into school structures [11].

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