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The Relationship between Obesity and Academic

Achievement of School-Age Children

by

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Senior Honors Project

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### **Abstract**

With more of the adult population overweight or obese, the rates of childhood obesity have also risen to 33%. Just as research about obesity has indicated a negative effect on the body and vital organs, obesity seems to affect the ability to learn. Not only is it the responsibility of the family but also of the school to ensure that students have access to foods that promote good nutrition. A noteworthy link exists between nutrition programs in schools, such as lunch programs and snack options, and student achievement. This paper contains a review the research on connections between weight and academic achievement and attempts within schools to promote nutrition and, in turn, learning. The review will also highlight activities based on research evidence, which can be used by the teacher and the school in order to promote healthful lifestyle choices in and out of the classroom environment.

*Keywords:* childhood obesity, overweight children, school nutrition, fast food, academic achievement, academic performance, and school-based interventions

Childhood obesity has become an epidemic with more than one third of children aged 2 through 19 overweight or obese (Center for Disease Control and Prevention [CDC], 2013). As a result of the ever-increasing rate of childhood obesity, children are obviously eating more unhealthful foods and engaging in less physical exercise at home and at school than ever before. With a wider range of artificial flavorings, soft drinks, and fast food, obesity has risen to an all-time high.

Obesity is known to affect vital organs, such as the heart and lungs; and recent research has shown that obese adolescents have lower cognitive performance, indicating that the cognitive abilities may also be affected (Yau, Castro, Tagani, Tsui, & Convit, 2012). Researchers have investigated the link between children's health and nutrition and their academic achievement. They have examined a number of factors related to this relationship, including children's weight, amount and quality of food consumption, and amount of physical activity. Others have also studied aspects of family life, such as income level and parent level of education, in addition to how families as well as schools can promote healthful living and nutrition in children and—as a potential consequence—children's academic achievement. The current project involved a literature review in which the link between school-aged children's weight and nutrition and their achievement in school was examined.

### **Current Status of Children's Weight in the U.S.**

Throughout the past 30 years, the United States has seen a two-fold increase in obesity in children and a three-fold increase in adolescents (CDC, 2013). To assess whether or not a child is overweight or obese, the Body Mass Index (BMI) of the child is measured. BMI does not measure body fat, but it is calculated using a child's weight and height: however, for children and teens, this is generally an indicator of body fat. A child's classification of body weight is

established based on age and sex percentiles. The Center for Disease Control and Prevention (CDC) has defined *overweight* as “a BMI at or above the 85<sup>th</sup> percentile and lower than the 95<sup>th</sup> percentile for children of the same age and sex” (CDC, 2013). The CDC has defined *obesity* as having a BMI that is “at or above the 95<sup>th</sup> percentile for children of the same age and sex” (CDC). Obese children and adolescents are in the top fifth percentile of body weight, meaning that they generally have more body fat than 95% of same-sex peers.

Obesity is the result of consuming too many calories and not expending enough calories (Ebbeling, Pawlak, & Ludwig, 2002). Genetic factors can also have an effect on the likelihood of becoming overweight or obese; however, the increase in the prevalence of obesity in comparison with the stability of the general populations indicates that the change is mostly environmental (Ebbeling et al., 2002). Childhood obesity may be credited to several environmental changes. The increase in obesity has paralleled the increase in consumption of soft drinks, especially in adolescents. More than half of all adolescents consume soft drinks daily, which amounts to an additional 36 to 57 grams of sugar daily for each additional soft drink. Children and adolescents who consume more than one additional soft drink daily potentially increase their caloric intake by hundreds. Researchers have found a statistically significant link between becoming obese and consumption of sweetened drinks on a daily basis (Ludwig, Peterson, & Gortmaker, 2001).

Furthermore, as children grow older, they struggle to differentiate between portion size and actual hunger. In a study of 3- to 6-year olds, researchers found that younger children were more likely to stop eating when they felt full regardless of the amount of food remaining, whereas older children consumed more food when given a larger portion size (Rolls, Engell, & Birch, 2000). With an increase in consumption of fast food comes additional calories consumed.

For instance, research indicates that adolescent females who consumed fast food four times per week or more, consumed approximately two-hundred additional calories than those who did not (McNutt et al., 1997). A large fast food meal, consisting of a double cheeseburger, French fries, a soft drink, and dessert, is roughly 2,200 calories. In order to expend the energy consumed in this one meal, a person would need to run a full marathon (Ebbeling et al., 2002). If eaten on a regularly basis, children and adolescents are unlikely to maintain an acceptable weight.

### **Children's Weight, Learning and Well-Being**

Childhood obesity affects lives in various ways with serious consequences to a person's health, including immediate and long-term health effects. Some complications of childhood obesity include cardiovascular disease, such as high cholesterol or blood pressure; prediabetes, which indicates off-balanced blood glucose levels and can result in diabetes; and bone and joint problems, including flat feet, sleep apnea, asthma, gallstones, and polycystic ovarian syndrome (Ebbeling et al., 2002). In addition to those short-term health effects, obesity is associated with an increased risk for long-term health effects, including heart disease, type 2 diabetes, strokes, osteoarthritis, and many types of cancer (CDC).

Besides physical consequences, obesity can also lead to social and psychological problems. As early as five years of age, overweight or obese children display lower self-esteem (Davison & Birch, 2001). Obese adolescent females demonstrated significantly lower levels of self-esteem, which led to sadness, loneliness, and high-risk behaviors, such as smoking or alcohol consumption (Strauss, 2000). In addition to poor self-esteem and depression, childhood obesity is also linked with eating disorders (Austin, Nelson, Birkett, Calzo, & Everett, 2013). The effects of childhood obesity do not stop at physical and psychological outcomes: Recent

research indicates that childhood obesity may also affect cognition and therefore academic achievement (Yau et al., 2012).

### **Purpose Statement**

As the rates of childhood obesity continue to rise, whether cognitive abilities are affected by this epidemic has been questioned. This project involved a literature review of the work of researchers who examined the relationship between nutrition, particularly poor nutrition that can lead to obesity, and academic achievement. A link seems to exist between the types of foods that students eat, their weight, and their performance in the classroom, and the diminished rates of nutrition, by some, have been attributed to the growing epidemic of obesity. This review aimed to clarify that link with evidence from the research literature by addressing the question: What does the research show regarding the relationship between obesity and the academic achievement of school-age children?

### **Methods**

The current project involved a narrative review of nine studies in which the researchers examined the relationships among nutrition, weight status, and academic performance. Using library databases, I searched ERIC and Academic Search Complete for sources relating to obesity and academic achievement with search terms including *childhood obesity*, *overweight children*, *school nutrition*, *fast food*, *academic achievement*, *academic performance*, and *school-based interventions*. With additional searches I looked for information about and studies that included government programs (such as the Center for Disease Control and Prevention and United States Department of Agriculture). All studies dealing with the relationship between obesity and academic performance were published from 2001 to the present to include the most recent research in this review.

The sample for this review included empirical studies that reported on original data collected through surveys, questionnaires, or health screenings/evaluations or data from the National Longitudinal Study of Adolescent Health or the Early Childhood Longitudinal Study (ECLS-K). Researchers of the studies included in the final sample looked at the following factors: (a) overweight/obesity, (b) academic achievement (i.e., grade point average [GPA], math test scores, reading test scores), and (c) other factors that may affect nutrition and academic performance (e.g., self-esteem, physical activity). Studies also accounted for other variables, including but not limited to race, parental education, family income, school enrollment, and urbanicity.

Once the studies were gathered, information about each study was entered into a spreadsheet, including the author(s), year of publication, size of sample, age of participants, methodology, and outcomes related to academic achievement. See Table 1 for the key information collected from each study. For each study, I reviewed the main findings to see whether or not the results were consistent across the research. The findings that emerged from the review are presented in the following section.

### **Results**

Across nine studies, each indicated a relationship between (a) the nutrition and academic achievement of school-aged children and (b) weight status and academic achievement. Generally, results from across the studies showed a negative relationship between nutrition and obesity (i.e., as the quality of nutrition decreases, the chance of obesity increases). In addition, overall results also showed a positive relationship between nutrition and academic achievement (i.e., as quality of nutrition increases, the chance of higher achievement scores also increases).

Studies indicated that as a student eats more unhealthful foods, the chance of becoming overweight or obese rises significantly as does the chance of lower academic achievement.

### **Connections Among Food Consumption, Weight, and Academic Achievement**

Overweight adolescents between the ages of 12 and 17 consume an additional 700–1,000 calories per day (Bowman, Gortmaker, Ebbeling, Pereira, & Ludwig, 2004). This is beyond what is needed for growth and takes into consideration physical activity. Over the course of 10 years, this could lead to a weight gain of nearly 60 pounds (Bowman et al., 2004). With the growing prevalence of the fast-food industry, people are consuming additional unnecessary calories on a regular basis. In a study of over 12,000 children, Tobin (2013) found that the frequent consumption of fast food (multiple times per week) was significantly related to a decrease in test scores in math and reading, and as the student consumed more fast food, the test scores continued to decrease. Students who had a higher than average intake of fast food had between 5% and 16% percent lower reading test scores and between 6% and 18% lower math test scores (Tobin, 2013).

Similarly, further research has shown that overweight and obese children perform at a lower academic level. Datar, Sturm, and Magnabosco (2004) indicated that overweight kindergartners and first-graders, on average, scored lower in math and reading than students who are of average weight. In addition, the effects of obesity on academics extends beyond early childhood. In a study of 14- to 17-year-olds, findings suggest a negative relationship between body weight and academic achievement among White females (Sabia, 2007). A study of 7,000 third graders, who had originally been tracked in kindergarten, showed that those children who were obese were more likely to repeat a grade than their classmates who maintain acceptable weight (Datar & Sturm, 2006).

### **Connections Among Nutrition, Cognitive Functioning, and Academic Achievement**

Researchers have found that with an increase in obesity comes the development of other diseases, which may also affect academic achievement. For instance, studies have shown that the prevalence of obesity parallels a rise in Metabolic Syndrome (MetS), a disease that increases the risk of cardiovascular disease and diabetes; it is also associated with cognitive impairments in adults. Some believe that the same occurs with adolescents. Adolescents were tested based on a number of different criteria, including intellectual functioning and academic achievement, memory function, executive function, and attention and psychomotor efficiency. In a study conducted by Yau, Castro, Tagani, Tsui, and Convit (2012), adolescents with MetS scored lower than their non-MetS counterparts across all content areas. Children with MetS (i.e., obese children) scored lower in intelligence quotient (IQ), reading, spelling and arithmetic. Children who were obese in this sample also demonstrated shorter attention spans and decreased mental flexibility and tended to have lower estimated intellectual functioning, all of which may present challenges for children's learning (Yau et al., 2012). Findings about nutrition, cognitive function, and academic achievement were consistent with the proposed relationship between academic achievement and obesity.

### **Connections Between Obesity and Other Factors that Affect Academic Achievement**

In addition to food consumption and nutrition, physical activity is a major factor in an individual's weight; as levels of physical activity decrease, the risk of becoming obese increases. Research indicates that children with low motor skills also seem to have higher rates of childhood obesity. As students grow older, their level of physical activity has a positive correlation with GPA. This means that as their amount of physical activity increases, their GPA increases; conversely, as their level of physical activity decreases, their GPA also decreases

(Kantomaa et al., 2013). Students who have lower levels of physical activity are more likely to be obese; students who have lower levels of physical activity are also more likely to have lower GPAs. Although no causal relationship has been established, another connection between weight and academic outcomes seems apparent.

In addition to academic skills, research has shown links between weight status and social and emotional skills and beliefs. For instance, girls who were overweight or obese not only were significantly more likely to score lower on math and reading tests, but they also had struggles related to social and emotional behaviors (Datar & Sturm, 2006). These overweight females struggled to interpret and thus communicate their feelings appropriately as well as connect with their peers. Obese adolescents also face social consequences in addition to academic ones. Although an important area to examine in its own right, social and emotional skills and behaviors contribute to the way children learn in the classroom. According to a study of seventh to 12<sup>th</sup> graders, obese adolescents struggled both academically and socially, receiving lower GPAs. Adolescents at risk of obesity struggled to connect with peers, in particularly those of the opposite sex (Crosnoe & Muller, 2004).

In addition to social problems, obese children and adolescents tend to have lower self-efficacy and self-esteem. Obese adolescent females were nearly twice as likely as average-weight females to report not hanging out with friends, feeling hopeless, having serious emotional problems, and attempting to commit suicide (Falkner et al., 2001). Obese males were nearly two times more likely than their average-weight counterparts to report not similar outcomes. In general, obese girls were also more likely to perceive themselves as below average students and not expect to finish college (Falkner et al., 2001).

In conjunction with lower self-esteem, researchers in Finland found that more than half of teenagers were dissatisfied with their weight. Of the female participants who were dissatisfied, they were more likely to think of themselves as overweight and to engage in the unhealthful behaviors (Mikkila, Lahti-Koski, Pietinen, Virtanen, & Rimpela, 2003). Connecting across these studies, I found an indication that (a) students who are overweight tend to have lower self-esteem and social skills and (b) students with lower rates of self-esteem and social skills are more likely to perform poorly in the classroom. Although another instance in which caution is warranted, evidence across this work indicates another form of connection between obesity and academic achievement.

### **Studies of Prevention and Intervention**

Because of the connections reviewed thus far related to nutrition, weight, and academic outcomes, many have focused on how to prevent—or at least intervene with—problems in what children eat, how much they weigh, and how they do in school. They have aimed to change children's behaviors related to (a) food consumption at home (or otherwise outside of school), including breakfast as well as the amount of fast food eaten, and (b) food consumption in school.

In general, the research indicates that the overwhelming prevalence in obesity stems at least in part from poor nutrition as well as a lack of physical activity, all of which seem to contribute to children's learning and achievement in school. With respect to nutrition, studies have shown a correlation between the children's breakfast consumption and weight status. Students who do not consume breakfast or students who consume a breakfast with poor nutritional quality are more likely to become overweight or obese than children who consume nutritious breakfasts (O'Dea & Wilson, 2006).

In a study of inner-city middle-school students, those who did not consume breakfast tended to have lower academic performance. Students who participated in school breakfast programs had higher levels of nutrient intake, which were associated with improvements in academic achievement and psychosocial functioning (Kleinman et al., 2002). The Food and Nutrition Service of the United States Department of Agriculture (USDA) has instituted National School Breakfast Programs for students, which require schools to offer fruit daily for breakfast (Department of Agriculture, 2012). The findings from the study suggest that the USDA requirement of fruits in school breakfasts has a sincere impact on the learning of children.

In addition, the intake of fast food is prevalent among people of all races, genders, ages, socioeconomic statuses, and regions of the country, indicating that the popularity of fast food is rising (Bowman et al., 2004). The elimination or reduction of fast food and soft drink intake could reduce daily caloric intake by, on average, 300 or more calories, which would aid in lowering the current risk of obesity (Wang, Gortmaker, Sobol, & Kuntz, 2006). The intake of fast food is associated with an intake of soft drinks, so reducing fast-food consumption would likely show a reduction in soft drink consumption as well (Schmidt et al., 2005). Fast-food meals tend to lack fruits and vegetables, so placing a greater emphasis on health foods would encourage a reduction in the intake of fast food.

Not all of the responsibility has, however, been placed specifically upon individuals and families. According to the Surgeon General, “Individuals, families, communities, schools, worksites, health care, media, industry, organizations, and government must determine their role and take action to prevent and decrease overweight and obesity” (Office of the Surgeon General, 2010). To lower the risk of becoming obese, people must incorporate healthful lifestyle choices into their routine, such as physical activity and eating healthful foods. Some recommendations

from the Surgeon General include the following: (a) reduce time spent in sedentary behaviors, such as watching television; (b) incorporate physical activity into daily lifestyles with children getting 60 minutes of physical activity on a daily basis, and (c) promote the choice of healthful foods with an increase in intake of fruits and vegetables as well as reasonable portion sizes (Office of the Surgeon General, 2010).

Over time, more and more schools have turned to healthful lunch options for their students. In 2010, Congress passed the Healthy, Hunger-Free Kids Act Of 2010, noting that school lunches were not to have more than a set number calories. This was done with the intent to increase the amount of healthful food that students were eating so that school lunches could be part of the balanced and healthy diet promoted nationally (“President Obama,” 2010). Students should be provided with foods low in fat, calories, and added sugars, such as fruits, vegetables, whole grains, and low-fat or nonfat dairy foods (Office of the Surgeon General, 2010).

The Surgeon General noted that schools should provide healthful foods and beverages in accordance with the U.S. Department of Agriculture (USDA) regulations (Office of the Surgeon General, 2010). According the USDA,

The Healthy, Hunger-Free Kids Act of 2010 directed USDA to update the [National School Lunch Program]’s meal pattern and nutrition standards based on the latest *Dietary Guidelines for Americans*. The new meal pattern goes into effect at the beginning of [School Year] 2012–13 and increases the availability of fruits, vegetables, and whole grains in the school menu. New dietary specifications set specific calorie limits to ensure age-appropriate meals for grades K–5, 6–8, and 9–12. Other meal enhancements include gradual reductions in the sodium content of the meals. While school lunches must meet

Federal meal requirements, decisions about what specific foods to serve and how they are prepared are made by local school food authorities. (Department of Agriculture, 2012)

Research suggests that state laws regulating nutrition of foods and beverages sold outside school lunches on school premises are associated with lower rates of childhood obesity. These foods, which are available in vending machines or sold as part of fundraisers, compete with the food provided in school lunches. Studies show that the enactment and regulation of these competitive food laws may lead to a decrease in adolescent BMI, if the laws are comprehensive, contain strong language, and are consistent across grade levels and with the standards (Taber, Chriqui, Perna, Powell, & Chaloupka, 2012).

First Lady Michelle Obama has also enacted the Let's Move! Campaign to increase awareness about physical activity and proper nutrition. In addition to increasing awareness, monetary incentive awards became available: Bronze, Silver, Gold, and Gold Award of Distinction. To date, nearly 6,000 schools across the United States have become certified (*Let's Move!*). In addition to proper nutrition, the First Lady provides resources about gardening and food shopping on a budget. Her campaign also allows for easy access to healthful recipes; ideas on how to become active; action plans for parents, schools, community leaders, elected officials, chefs, kids, and healthcare providers; a pledge to commit to the cause; and references and information about the reasoning behind it all (*Let's Move!*).

In addition to focusing on the healthful eating, the American Academy of Pediatrics (2013) encourages schools to schedule recess because daily recess aids in social, emotional, physical, and cognitive development. Recess is a time for students to release pent-up energy as well as communicate with their peers. Students are able to concentrate better in the classroom when given sufficient breaks. Recess should not be withheld as a punitive measure, especially

for academic shortcomings. Recess also should not be treated as a replacement for physical education because recess is generally unstructured and allows children to make personal social choices, whereas physical education is an academic discipline. The American Academy of Pediatrics also maintains that recess, whether structured or unstructured, should be safe and supervised in an environment where students are able to be active without the possibility of injury (Council on School Health, 2013).

In addition to recess, schools and communities are also recommended to create programs related to physical activity as well as food selection and preparation in order to better educate residents and students about healthful lifestyles (O'Dea & Wilson, 2006). According to Brownell and Wadden,

The professional community is concerned with the medical concomitants of obesity, but the psychological and social perils are at least as important to those afflicted by the problem. The reason is clear; society does not tolerate excess weight. The effects of this overt and covert pressure to be thin can be powerful and permanent (as cited in Strauss, 2000, p. 751).

Because this is a time when children and adolescents develop self-esteem, they should be encouraged to make healthful choices. Programs geared toward reducing childhood obesity should emphasize an importance in health, as opposed to looks, and healthful lifestyles as opposed to getting thin. Students who are focused on becoming thin for purely cosmetic reasons may struggle with self-esteem and perform more poorly in school.

### **Effectiveness of School-Based Interventions**

Researchers have found that school-based interventions increase the general well-being of students from an early age. For the most part, these programs increase students' social and

cognitive development, enhance personal health during periods of critical development, encourage healthy behaviors to mold lifetime habits, and decrease the risk of potential adulthood diseases in the future (Veugelers & Fitzgerald, 2005). Researchers have urged principals and policymakers to implement long-term school-based interventions in order to prevent and manage childhood obesity (Gonzalez-Suarez, Worley, Grimmer-Somers, & Dones, 2009), which will hopefully benefit learning and achievement for students, too. Seventy-seven percent of obese children will become obese adults, whereas only 7% of nonobese children become obese adults (Freedman, Dietz, Srinivasan, & Berenson, 1999). These statistics reflect the fact that the behaviors learned at a young age continue to form a person's decisions throughout adulthood. Encouraging more healthful lifestyles from a young age will help to reduce obesity-related healthcare costs and morbidity that these youth may face in adulthood. Obese parents are more likely to have obese children, thus perpetuating the cycle of obesity and potentially lower performing students (Whitaker et al., 1997). Researchers have studied the influence of intervention programs on nutrition, weight, and understanding healthful lifestyle choices but not on academic outcomes. Possible links are discussed in the Discussion section.

One intervention that has been implemented in schools is Planet Health, an interdisciplinary program for sixth- to eighth-grade students that focuses on improving health while studying language arts, math, science, social studies, and physical education. The program incorporates four behavioral changes, including reduced television viewing, increased physical activity, decreased consumption of foods with a high fat content, and increased consumption of fruits and vegetables to the daily recommendation. Results over two years indicated a significant decrease in obesity among females. In comparison to a control school, where obesity rose over 2% in the two-year period, obesity decreased at the Planet Health school by more than 3% in the

same two year period. Overall, the program has indicated encouraging progress as a school-based approach to combating obesity (Gortmaker et al., 1999).

Another school-based intervention program that was studied for effectiveness operated in the United Kingdom—Active Programme Promoting Lifestyle Education in Schools (APPLES). The APPLES intervention comprises nutritional education, healthful school lunches, a program to encourage fitness, extracurricular activities, and enhanced playground equipment (Sahota et al., 2001a). Although no significant changes occurred in BMI, many benefits to the incorporation of the APPLES program emerged. Student improvements, which resulted from the program, included increased vegetable consumption, increased self-esteem, and increased knowledge of the benefits of healthful lifestyles (Sahota et al., 2001b). Throughout the year, school officials were able to make beneficial changes to the physical education curriculum and improve the quality of school lunches, including the incorporation of more fruits, vegetables, and vegetarian options (Sahota et al., 2001a).

The Child and Adolescent Trial for Cardiovascular Health (CATCH), an intervention for students in middle-school grades, was implemented in 56 schools spanning four states over three years (Luepker et al., 1996). CATCH schools offered training to food service personnel in order to improve the quality of nutrition as well as to teachers in order to increase the amount of enjoyable physical activity during physical education and to encourage students to participate. Students in the program consumed food with fewer calories from fat and saturated fat as well as less sodium. The intervention (a) incorporated more physical activity into the daily lives of the students; (b) focused on classroom learning about eating habits, physical activity, and smoking; and (c) illustrated a reduction in the consumption of dietary fat in school lunches, an increase in

physical activity, and an improvement in healthful lifestyle choices during the three-year period (Luepker et al., 1996).

Finally, another school-based intervention, known as Pathways, was specifically geared towards Native American children, who are at high risk for developing heart disease and diabetes (Caballero et al., 2003). Pathways was a three-year trial in 41 schools in Native American communities, focusing on students from third to fifth grades. The intervention consisted of four main components: (a) a modification in dietary intake, (b) an increase in physical activity, (c) curriculum that focused on a healthy lifestyle, and (d) a family involvement program. Over the course of the three years, researchers noted significant improvements: a reduction in fat content of school menus and the ability of teachers to alter the knowledge and behaviors involving healthful lifestyles through classroom education (Caballero et al., 2003). This was an imperative measure to take in this community in order to reduce the possibility of life-altering diseases caused by obesity.

### **Research-Based Recommendations for Practice**

With a limited number of school-based interventions implemented, the outcomes may seem less than desired; and the true effectiveness is still uncertain (Vuegelers & Fitzgerald, 2003). Each intervention method, however, results in the formation of some type of healthful lifestyle habit. Analyses showed that long-running programs were more effective in preventing childhood obesity if they combined physical activity and classroom learning; in fact, the longer the program, the more effective it proved to be (Gonzalez-Suarez et al., 2009). The incorporation of school-based interventions has shown to be advantageous for the beneficiaries of the programs in that they are learning how to live more healthful lives through small changes.

Although these programs are not linked strictly with academic achievement, they encourage healthful lifestyles and educate students and parents how to achieve and maintain health goals.

With children spending a good portion of their time in the classroom, school personnel can be instrumental in changing habits. Schools can offer more nutritional choices for meals and snacks. For lunch and breakfast programs, schools should have adequate fruits and vegetables for their students to consume along with whole grains. School administrators may consider removing vending machines that provide and encourage sugary and fat-laden snacks. For schools that have a built-in snack time, educators should consider encouraging students and parents to pack nutritious snacks. The same should be done for students who bring their lunches because parents may need support in choosing wholesome items for their children. Students and teachers should be encouraged to make healthful choices and learn about nutrition. Furthermore, establishing guidelines for healthful food choices and learning about substitutions or more nutritious alternatives would be optimal for schools that offer cooking classes. Supplementing nutritious options in cooking class will allow for real-world understanding and the use of more nutritious foods in everyday life. School administrator and teachers should provide resources for the family and community encouraging healthy eating, specifically focused on healthful foods on a budget as well as quick and easy-to-prepare nutritious meals. Schools can link families to community resources, such as fitness centers or nutrition clinics.

School administrators should ensure that foods served are nutritious, including what student purchase from vending machines. All foods and beverages should be consistent with the Dietary Guidelines for Americans, which encourage building a plate of nutritious foods; cutting back on foods high in solid fat, added sugars, and salt; and eating the right number of calories for one's body type and needs (USDA, 2011). With the increase of substantially nutritious foods

and the decrease of processed foods, the risk of obesity diminishes. Following these guidelines allows for a healthier lifestyle and supports consumers in the quest to eat nutritious foods.

Modeling the habit of having a healthful lifestyle while students are young encourages them to continue making nutritious choices throughout their lifetime. Incorporating a healthful diet may also motivate students to live more healthful lives, including engaging in the recommended amount of physical activity per day.

### **Discussion**

Findings from across the studies reviewed in this paper indicated a link between nutrition and weight in childhood and academic achievement. Cognitive ability also seems to be influenced by obesity. Research indicates that students with poor nutrition perform poorly in the classroom: Studies have shown that children who are overweight scored lower on math and reading tests when compared to their nonoverweight counterparts. Contributing factors to poor nutrition are numerous, including the consumption of fast food. Students who consumed a higher-than-average amount of fast food demonstrated significantly (5%–18%) lower test scores in math and reading (Tobin, 2013). Both young children and adolescents who are obese earn lower test scores than students who are of average weight. They also tend to display shorter attention spans, decreased mental flexibility, and lower intellectual functioning than their counterparts of average weight. Obesity affects school-age children in multiple aspects of their academic learning and achievement.

However, the impact of obesity does not end there. Not only might obesity affect learning and achievement, but it can also damage self-worth. Obese females were more likely to report repeating a grade and considering themselves poor students. Obese males were also more likely than nonobese students to consider themselves poor students and quit school (Falkner et

al., 2001). In addition, they display delays in social development and psychological impairments. Low self-efficacy affects students' judgment about their ability to perform a particular action, which may hinder their performance academically.

Government regulations have encouraged children to find ways to decrease their caloric intake and increase their physical activity. Children must develop healthful lifestyle choices at a young age to combat these negative consequences. Schools play a major role in the habits of children because students spend a large part of their day in the classroom. School authorities should incorporate nutritious meal choices into school lunches and encourage healthful outside food options along with implementing physical activity in the school day through physical education and recess. These recommendations will help lead to lower rates of childhood obesity, which may in turn have an impact on academic achievement.

### **Limitations**

Although important findings emerged from this review, several limitations must be considered. First, the studies themselves included original data; however, this review did not involve any formal analysis of that data. Future researchers could conduct statistical analyses, such as a meta-analysis, in order to examine the relationships among nutrition, weight status, and academic achievement to provide more support for this body of work.

In addition, the number of studies included in the review was small and cover only the period from 2000 to present. Future scholars should consider expanding upon this research body. Finally, of the studies found, most were correlational in design; thus, evidence of a strong connection was apparent but not a causal relationship.

Finally, factors such as socioeconomic status (SES; i.e., income, parents' education levels, parents' occupations), which contribute to children's weight status and nutrition, were not

directly considered in this review. However, some of the studies reviewed in this paper did consider SES (Falkner et al., 2001; Datar, Sturm, & Magnabosco, 2006). Generally, those researchers controlled for the variable of SES in order to see whether relationships between some aspects of nutrition were statistically significantly related to academic (and other) outcome. Results in these cases showed that, with SES controlled for, the relationship between obesity and academic achievement was still statistically significant. Yet, future researchers may examine in more detail the socioeconomic factors of the child and his/her family that directly and indirectly contributes to a child's nutrition, weight status, as well as school achievement to better understand ways to prevent and intervene at school and/or outside of school.

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## References

- Austin, D. B., Nelson, L. A., Birkett, M. A., Calzo, J. P., & Everett, B. (2013). Eating disorder symptoms and obesity at the intersections of gender, ethnicity, and sexual orientation in U.S. high school students. *American Journal of Public Health, 103*(2), e16–e22.
- Bowman, S. A., Gortmaker, S. L., Ebbeling, C. B., Pereira, M. A., & Ludwig, D. S. (2004). Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. *Pediatrics, 113*, 112–118.
- Caballero, B., Clay, T., Davis, S. M., Ethelbah, B., Rock, B. H., Lohman, T., . . . Stevens, J. (2003). Pathways: A school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *American Journal of Clinical Nutrition, 78*, 1030–1038.
- Center for Disease Control and Prevention. (2013). Childhood obesity facts. *Adolescent and School Health*. Retrieved from <http://www.cdc.gov/healthyyouth/obesity/facts.htm>
- Council on School Health. (2013). The crucial role of recess in schools. *Pediatrics, 131*(1), 183–188.
- Crosnoe, R., & Muller, C. (2004). Body mass index, academic achievement, and school context: Examining the education experiences of adolescents at risk of obesity. *Journal of Health and Social Behavior, 45*, 393–407.
- Datar, A., & Sturm, R (2006). Childhood overweight and elementary school outcomes. *International Journal of Obesity, 30*, 1449–1460.
- Datar, A., Sturm, R., & Magnabosco, J. L. (2004). Childhood overweight and academic performance: National study of kindergartners and first-graders. *Obesity Research, 12*(1), 58–68.
- Davison, K. K., & Birch, L. L. (2001). Weight status, parent reaction, and self-concept in five-

- year-old girls. *Pediatrics*, *107*(1), 46–53.
- Department of Agriculture. (2012). Nutrition standards in the national school lunch and school breakfast programs. *Federal Register*, *77*(17), 4088–4107.
- Ebbeling, C. B., Pawlak, D. B., & Ludwig, D. S. (2002). Childhood obesity: Public-health crisis, common sense cure. *The Lancet*, *360*, 473–482.
- Falkner, N. H., Newmark-Sztainer, D., Story, M., Jeffery, R. W., Beuhring, T., & Resnick, M. D. (2001). Social, educational, and psychological correlates of weight status in adolescents. *Obesity Research*, *9*(1), 32–42.
- Freedman, D. S., Dietz, W. H., Srinivasan, S. R., & Berenson, G. S. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: The Bogalusa Heart Study. *Pediatrics*, *103*(6), 1175–1182.
- Gonzales-Suarez, C. Worley, A., Grimmer-Somers, K., & Dones, V. (2009). School-based interventions on childhood obesity: a meta-analysis. *American Journal of Preventive Medicine*, *37*(5), 418–427.
- Gortmaker, S. L., Peterson, K. Wiecha, J., Sobol, A. M., Dixit, S., Fox, M. K., & Laird N. (1999). Reducing obesity via a school-based interdisciplinary intervention among youth. *Archives of Pediatric & Adolescent Medicine*, *153*(4), 409–418.
- Kantomaa, M. T., Stamatakis, E., Kankaanpaa, A., Kaakinen, M., Rodriguez, A., Taanila, A., . . . Tammelin, T. (2013). Physical activity and obesity mediate the association between childhood motor function and adolescents' academic achievement. *Proceedings of the National Academy of Sciences of the United States of America*, *110*(5), 1917–1922.
- Kleinman, R. E., Hall, S. Green, H., Korzec-Ramirez, D., Patton, K., Pagano, M. E., & Murphy,

- J. M. (2002). Diet, breakfast, and academic performance in children. *Annals of Nutrition and Metabolism*, 46(1), 24–30.
- Let's Move!* (n.d.). Retrieved from <http://www.letsmove.gov>
- Ludwig, D. S., Peterson, K. E., & Gortmaker, S. L. (2001). Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *The Lancet*, 357, 505–508.
- Luepker, R. V., Perry, C. L., McKinlay, S. M., Nader, P. R., Parcel, G. S., Stone, E. J., . . . Wu, M. (1996). Outcomes of a field trial to improve children's dietary patterns and physical activity: The Child and Adolescent Trial for Cardiovascular Health (CATCH). *Journal of the American Medical Association*, 275(10), 768–776.
- McNutt, S. W., Hu, Y. Schreiber, G. B., Crawford, P. B., Obarzanek, E., & Mellin, L. (1997). A longitudinal study of the dietary practices of Black and White girls 9 and 10 years old at enrollment: The NHLBI Growth and Health Study. *Journal of Adolescent Health*, 20, 27–37.
- Mikkila, V., Lahti-Koski, M., Pietinen, P., Virtanen, S. M., & Rimpela, M. (2003) Associates of obesity and weight dissatisfaction among Finnish adolescents. *Public Health Nutrition*, 6(1), 49–56.
- O'Dea, J. A., & Wilson, R. (2006). Socio-cognitive and nutritional factors associated with body mass index in children and adolescents: Possibilities for childhood obesity prevention. *Health Education Research*, 21(6), 796–805.
- Office of the Surgeon General. (2010). The Surgeon General's vision for a healthy and fit nation. Retrieved from <http://www.surgeongeneral.gov/initiatives/healthy-fit-nation/index.html>
- President Obama signs Healthy, Hunger-Free kids Act of 2010 into law. (n.d.). *The White House*.

Retrieved from <http://www.whitehouse.gov/the-press-office/2010/12/13/president-obama-signs-healthy-hunger-free-kids-act-2010-law>.

Rolls, B. J., Engell, D., & Birch, L. L. (2000). Serving portion size influences 5-year-old, but not 3-year-old children's food intake. *Journal of the American Dietetic Association, 100*, 232–234.

Sabia, J. (2007). The effect of body weight on adolescent academic performance. *Southern Economic Journal, 73*(4), 871–900.

Sahota, P., Rudolph, M. C. J., Dixey, R., Hill, A. J., Barth, J. H., & Cade, J. (2001a). Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. *British Medical Journal, 323*, 1027–1029.

Sahota, P., Rudolph, M. C. J., Dixey, R., Hill, A. J., Barth, J. H., & Cade, J. (2001b). Randomised controlled trial of primary school based intervention to reduce risk factors for obesity. *British Medical Journal, 323*, 1029–1032.

Schmidt, M., Affenito, S. G., Striegel-Moore, R., Khoury, P. R., Barton, B., Crawford, P., . . . Daniels, S. (2005). Fast-food intake and diet quality in Black and White girls: The National Heart, Lung, and Blood Institute Growth and Health Study. *Archives of Pediatric and Adolescent Medicine, 159*(7), 626–631.

Strauss, R. S. (2000). Childhood obesity and self-esteem. *Pediatric, 105*(1), E15.

Taber, D. R., Chiqui, J. F., Perna, F. M., Powell, L. M., & Chaloupka, F. J. (2012). Weight status among adolescents in states that govern competitive food nutrition content. *Pediatrics, 130*(3), 437–444.

Tobin, K. J. (2013). Fast-food consumption and educational test scores in the USA. *Child: Care, Health and Development, 39*(1), 118–124.

Wang Y. C., Gortmaker S. L., Sobol A. M., & Kuntz K. M. (2006). Estimating the energy gap among U.S. children: A counterfactual approach. *Pediatrics*, *118*, 1721–1733.

Whitaker, R. C., Wright, J. A., Pepe, S. A., Seidel, K. D., & Dietz, W. H. (1997). Predicting obesity in young adulthood from childhood and parental obesity. *The New England Journal of Medicine*, *337*(13), 869–873.

United States Department of Agriculture. (2011, June). *Let's Eat for the Health of It*. Retrieved from <http://www.cnpp.usda.gov/Publications/DietaryGuidelines/2010/DG2010Brochure.pdf>

Vuegelers, P. J. & Fitzgerald, A. L. (2005). Effectiveness of school programs in preventing childhood obesity: A multilevel comparison. *American Journal of Public Health*, *95*(3), 432–435.

Yau, P. L., Castro, M. G., Tagani, A., Tsui, W. H., & Convit, A. (2012). Obesity and metabolic syndrome and functional and structural brain impairments in adolescence. *Pediatrics*, *130*(4), 856–864.

**Table 1 Summary of 9 research studies on nutrition and academic achievement that included school age children**

<i>Study (author[s] and publication year)</i>	<i>Sample Size</i>	<i>Age of Participants</i>	<i>Methodology</i>	<i>Outcomes Related to Academic Achievement</i>
Crosnoe and Muller (2004)	N= 11,658	Grades 7–12	Correlational	Adolescents at risk of obesity received lower grades in math, science, English, and social studies, resulting in lower GPAs.
Datar and Sturm (2006)	N=around 7000	Kindergarten and again in third grade	Correlational	Female students who became overweight or were always overweight had significantly lower test scores in math and reading than their never overweight female counterparts.
Datar, Sturm, and Magnabosco (2004)	N=11,192	Kindergarten	Correlational	Overweight children scored lower on math and reading tests than their nonoverweight counterparts.
Falkner, Neumark-Sztainer, Story, Jeffery, Beuhring, and Resnick (2001)	N=9943	Grades 7, 9, 11	Cross-Sectional Study	Obese females were more likely to report repeating a grade and consider themselves poor students. Obese males were more likely to consider themselves poor students and quit school.

<i>Study (author[s] and publication year)</i>	<i>Sample Size</i>	<i>Age of Participants</i>	<i>Methodology</i>	<i>Outcomes Related to Academic Achievement</i>
Kantomaa, Stamatakis, Kankaanpaa, Kaakinen, Rodriguez, ... Tammelin (2013)	N=8,061	At age 8 and again at age 16	Correlational	Low motor function in childhood was linked with higher rates of obesity in adolescence. Level of physical activity and GPA positively correlated.
Mikkila, V., Lahti-Koski, M., Pietinen, P., Virtanen, S.M., and Rimpela, M. (2003)	N = 60,252	14-16	Correlational	Low school performance was associated with obesity for males and females.
Sabia (2007)	N = 5129 (Wave 1 only) N = 4218 (Wave 1 and Wave 2)	14-17	Correlational	A negative relationship exists between body weight and GPA among White females.
Tobin (2011)	N=22,666 initially N=12,029 final data	Kindergarten and again in fifth grade	Correlational	Students who consumed a higher-than-average amount of fast food demonstrated significantly (5%–18%) lower test scores in math and reading.
Yau, Castro, Tagani, Tsui, and Convit (2012)	N=128 initial sample N=93 had complete data	14-20 years old	Quasi-Experiment	Children with MetS (obese children) scored lower in spelling and arithmetic. Obese children also had small attention spans, decreased mental flexibility, and tended to have lower estimated intellectual functioning.