

The Genetic and Environmental Factors of Childhood Obesity and Determining its Overall

Effect on Wellbeing

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## The Genetic and Environmental Factors of Childhood Obesity and Determining its Overall Effect on Wellbeing

Childhood obesity is a critical medical disease that can affect both children and adolescents, and it is beginning to become more of a universal health concern/issue. “Obesity is defined as an abnormal or excessive fat accumulation that may impair health” (Childhood Obesity Foundation, 2016). There has been an increase in childhood obesity, and it has become a global epidemic. There are multiple factors and causes of this disease, most of which are speculations. Overweight and obesity in children are known to have a powerful impact on an individual’s mental and physiological health. Furthermore, individuals who become overweight and obese during childhood are more likely to remain obese as an adult. The purpose of this paper is to provide a complete list of the factors which contribute to childhood obesity and use that knowledge to determine ways in which the disease affects an individual’s health, can be prevented, and those with the disease can become healthy.

Obesity in children is a widespread issue not only in the United States but also universally. According to the World Health Organization (2016), over 23 years from 1990 to 2013, the number of infants and young children who were overweight or obese increased from 32 million to 42 million. “It is estimated that if by 2025 if the same tendencies continue, 70 million young children and infants will be overweight or obese” (World Health Organization, 2017). The environment and lifestyle in which children are born into have a severe effect on whether or not they will become obese. Most of the children’s lives are controlled by the choices of their parents or guardians, which dictate how much they exercise and what foods they eat. “Choosing healthy foods for infants and young children is critical because food preferences are established in early life” (Birch, Savage, & Ventra, 2007). Maintaining a balance between

calories consumed and calories burned is essential to a healthy lifestyle. Today children are surrounded by technology from a very young age. Advances in technology have had a significant effect in multiple fields such as medicine, biotechnology, healthcare, communication, and so on, many of which have been beneficial. Technology is excellent in moderation; however, it can quickly lead to dependence, which offers fewer opportunities for exercise.

Without intervention, overweight children will likely remain obese for the rest of their life throughout adolescence and adulthood. “Evidence suggests that weight trajectories are established in early childhood and obesity is difficult to reverse and often persist into adulthood” (Jackson, 2017). This early onset of obesity, along with the combination of lifelong disease, results in the onset of various other diseases for individuals at a younger age. “Obesity in children is associated with several serious health problems, including asthma, and sleep-disordered breathing, menstrual abnormalities, early-onset type 2 diabetes, and metabolic disorders” (Jackson, 2017). These are considered chronic diseases and are very detrimental to children at a young age when you consider the fact that they are still undergoing development. While the increase in childhood obesity has raised significant concern for overall health, understanding the causes of obesity such as genetics, eating and physical activity behaviors, community and neighborhood safety, sleep duration, and mental health can help prevent obesity and offer ways for others struggling with the disease to manage it and become healthy.

### **Defining Childhood Obesity**

Childhood obesity results when excess body fat has a detrimental effect on the health of a child. A child who is above the average weight for his/her height is considered obese. “Body mass index (BMI) is a measure used to determine childhood overweight and obesity” (Centers for Disease Control and Prevention, 2018). According to the Centers for Disease Control and

Prevention (2018), individuals considered to be overweight fall above the 85th percentile, and those who are above the 95th percentile are considered obese. BMI takes into consideration an individual's height and weight "BMI is calculated by dividing a person's weight in kilograms by the square of their height in meters" (Centers for Disease Control and Prevention, 2018). Since adults have completed their development, taking age and gender into account is irrelevant. "Children's body composition varies as they age and varies between boys and girls. Therefore, BMI levels among children and teens need to be expressed relative to other children of the same age and sex" (Centers for Disease Control and Prevention, 2018). These measurements are not of body fat but equivalent to body fat. "Research has shown that BMI is correlated with direct measures of body fat, such as skinfold thickness measurements, bioelectrical impedance, densitometry (underwater weighing), dual energy x-ray absorptiometry (DXA) and other methods" (Centers for Disease Control and Prevention, 2018).

### **Genetics.**

There are various reasons a child may fall within the 95th percentile. Multiple genetic factors have been proven to lead to obesity. BMI used to measure/determine obesity has been proven to be heritable. "Multiple studies...most powerfully adopted twins have all confirmed that heritable factors are likely responsible for 45-75% of the inter-individual variation in body-mass index (the commonly used measure of adiposity)" ((Farooqi & O'Rahilly, 2007). However, genes are not unchanging within an individual throughout time. "Based on twin studies, it has been suggested that heritability of BMI is most pronounced during late childhood and adolescence. The genes relevant for weight regulation are not the same throughout life, according to a large longitudinal twin study only 40% of the genetic factors that influence BMI at age 20 y continue to do so at age 48 y" (Hebebrand, Sommerlad, Geller, Görg, Hinney, 2001). These

discoveries prove exactly why childhood obesity and maintaining a healthy environment for children is critical because more genetic factors contribute to BMI in younger individuals than in individuals of older age groups. Our ancestors can explain weight as a highly heritable trait. “It is very likely that the ability to store fat in times of nutritional abundance was a positive trait selected over thousands of years of evolution only to emerge recently on a large scale as a result of changes in our environment” (Farooqi & O’Rahilly, 2005). However, this evolved trait is not suited for the new changes in our environment; as a result, we are finding ourselves in an ‘obesity epidemic.’

It is now known that what we put into our bodies and how often we do so is involuntary. “The genetic defects found to date all impair satiety, affecting the function of appetite control centers in the brain rather than being due to slow metabolism. This indicates that we must think of human food intake as...one driven by powerful biological signals from relatively primitive brain areas” (Farooqi & O’Rahilly, 2007). When these signals are sent/stimulated, it could become tough to overcome the motivation to eat, leaving us subject to these critical essential areas within our brain. There are also genes and mutations within the human genome which are responsible for fat accumulation or obesity. “In humans, autosomal recessive mutations in the genes for leptin, leptin receptor, prohormone convertase 1 (PC1), and proopiomelanocortin (POMC) have been shown to lead to early-onset obesity” (Hebebrand, Sommerlad, Geller, Görg, Hinney, 2001). According to Farooqi & O’Rahilly (2007), the most common mutation that may be correlated to obesity is that within the melanocortin four receptor gene, which according to their studies, may have been responsible for many thousands of cases in the UK. However, some of these mutations now that they are known are treatable. “Although leptin deficiency appears to be rare, it is entirely treatable with daily subcutaneous injections of recombinant human leptin

with beneficial effects on appetite, fat mass and hyperinsulinemia, the reversal of the immune defects and infection risk and allowing the appropriate development of puberty” (Farooqi & O’Rahilly 2005).

“Genetics is one of the biggest factors examined as a cause of obesity. Some studies have found that BMI is 25-40% heritable. Although, this genetic factor only accounts for less than 5% of cases of childhood obesity” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). Hence, obesity is caused only slightly by genetics and primarily by other factors. For example, “parental obesity is a strong predictor of excess weight gain in children because it reflects not only a genetic predisposition to weight gain but also environmental effects” (Rennie & Johnson, 2005). A study by Martin and Ferris (2007) found that having obese parents and being a girl increased the odds of that individual being overweight. “Having an obese parent in the study was significantly associated with childhood overweight. Among overweight children, 64% had an obese parent in this study” (Martin & Ferris, 2007). This study highlights the vital role of the parents, both genetically and environmentally.

**Environmental Effects.** Adults determine most of the children’s food choices. Adults have the responsibility to purchase and prepare foods. Therefore, the environment and lifestyle in which children are born into have a severe effect on whether or not they will become obese. “It was predicted that children who eat more meals with their families consume healthier diets; therefore, they are less likely to become obese. Other research indicates that Americans are spending more of their food budget on foods eaten away from home, and the dietary quality of away-from-home foods is lower than for those foods prepared in the home” (Gable, Chang, & Krull, 2007). Parents tend to gravitate towards what is convenient at the time, and with the abundance of on the go, fast food restaurants, there are more opportunities now than ever before.

Also, the foods that are being advertised towards kids can significantly affect what they consume, and most of it tends to be fast food. “Food served at fast-food restaurants tend to contain a high number of calories with low nutritional value” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). Research demonstrates that “close to 34% of children and adolescences from ages 2 to 19 eat fast food every day, resulting in a weight gain of 6 pounds per year per child” (Centers for Disease Control and Prevention, 2018). Along with the increase in portion size and availability of cheaper low nutritional calorie-dense foods nationwide, it leads children prone to becoming overweight or obese.

Childhood obesity is said to be caused by food insecurity. Food insecurity attributes to a lack of financial resources, which leads to disruptions in the quality and quantity of the household food supply. “Possible explanations include the fact that high-fat, high-calorie food products cost less than healthful food. In addition, food insecure households may experience disrupted eating patterns (feast or famine) that can have metabolic consequences” (Martin & Ferris, 2007). If the children do not have healthy food available and have an abundance of high-calorie energy-dense food that is cheaper. Then it is more likely that they will indulge in that type of food over healthier options since they do not have access to it. “Availability of, and repeated exposure to, healthy foods is key to developing preferences and can overcome dislike of foods” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). This is why it is especially crucial for families who are feeding/supporting young children to have an abundance of healthy food options. “Choosing healthy foods for infants and young children is critical because food preferences are established in early life” (Birch, Savage, & Ventra, 2007).

The stress families encounter when experiencing a lack of financial resources can also have a significant effect on the child. Obesity can be the result of what is going on within the



child's head. For example, a child experiencing hardships or trauma may turn to food for comfort. Food can be viewed as something that one can control, whereas the environment or other people is not something that one always has power over. Therefore, eating may be used as a coping mechanism and make individuals feel better or manage the stress they experience.

Parents also create opportunities for active and sedentary quests and determine how often and where these activities happen. The amount of activity a child participates in needs to be balanced with how much food they intake or else fat accumulation can occur. Energy consumed and energy expended must be equal, when one eats more calories than they burn off, they develop fat. Physical activity increases energy expenditure, thus, decreasing the fat developed from intaking too many calories. Neighborhood safety has been proven to be directly correlated with childhood obesity. Parental perceptions of neighborhood safety dictate whether or not they let their children play outside or how often they are allowed to do so. According to Gable, Chang, & Krull (2007), those who had parents who believed that their neighborhood was unsafe were granted less outside playtime and, as a result, experienced a higher likelihood of persistent overweight. However, children's health can also dictate whether or not a child gets to partake in physical activity. "Obese children are often excluded from activities, particularly competitive activities that require physical activity. It is often difficult for overweight children to participate in physical activities as they tend to be slower than their peers and contend with shortness of breath" (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). Therefore, it can be hard for children to partake in physical activities even if they choose to because they have medical problems and are discriminated against by others.

The world around us is becoming increasingly digitalized, meaning that younger individuals are becoming more adapt to and reliant on technology. "Robinson, a different

researcher, hypothesizes that time spent in front of the television displaces time spent in physical activity, increases the energy consumed— either while watching television or because of exposure to food advertising—and decreases resting metabolic rate” (Gable, Chang, & Krull, 2007). A majority of technology, such as television, video games, laptops, are associated with sitting down and considered a sedentary activity. “Each additional hour of television per day increased the occurrence of obesity by 2%” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). “The increased amount of time spent in sedentary behaviors has decreased the amount of time spent in physical activity. Research which indicates the number of hours children spend watching TV correlates with their consumption of the most advertised goods, including sweetened cereals, sweets, sweetened beverages, and salty snacks” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). Children’s time could be spent doing physical exercise rather than on devices such as televisions, cell phones, and computers. Individuals could go for a walk, play kickball, or go to a playground. Spending an excessive amount of time on technological devices and not enough time engaging in physical activity is what leads to childhood obesity. Time spent on technological devices is also found to decrease the amount of sleep a child receives because they are spending the hours, they could be sleeping doing other things such as watching television or playing video games. “Sleep loss within children may alter the hypothalamic mechanisms that regulate appetite and energy expenditure” (Hale & Guan, 2014).

**Effects on Health.** Childhood obesity can cause various other problems in other areas. For example, obesity can affect the individual physically, emotionally, socially, and mentally. “Obesity in children is associated with a number of serious health problems, including asthma and sleep-disorder breathing, menstrual abnormalities, early-onset type 2 diabetes, and metabolic disorders” (Jackson, 2017). These diseases were previously only seen in adults but are now being

seen in individuals at a younger age. “Childhood obesity is associated with a higher chance of premature death and disability in adulthood. Overweight and obese children are more likely to stay obese into adulthood and develop medical conditions at a younger age” (World Health Organization, 2017). “Obese children are more likely to develop a variety of health problems as adults. These include cardiovascular disease, insulin resistance, musculoskeletal disorders, some cancers (endometrial, breast, colon) and disability” (World Health Organization, 2017). There are also multiple psychological effects including, depression, low self-esteem, and lower self-reported quality of life, and social problems such as bullying and stigma.

Mental illness is a significant issue, especially for children, they can find themselves confused or trapped, which can, in turn, contribute to problems such as overeating. “Obesity is more prevalent among individuals with mental illness in comparison to individuals without in the US” (Centers for Disease Control and Prevention, 2018). A child may be bullied or not socially accepted, having fewer friends and turn to the safety of their homes where they turn to food for comfort. Bullying can affect a children’s life, making them feel worthless and alone; these feelings are carried with them throughout the rest of their life and can even appear later in life as those who become obese as children remain obese. Childhood obesity has also been found to affect school performance negatively. “A research study concluded that overweight and obese children were four times more likely to report problems at school than their normal-weight peers” (Sahoo, Choudhury, Sofi, Kumar, & Bhadoria, 2015). Additionally, when one takes into account their poor health and risk for chronic diseases, they are more likely to be absent from school.

**Prevention and Change.** Without intervention, the number of individuals with childhood obesity will continue to rise. “It is estimated that if by 2025 if the same tendencies continue, 70

million young children and infants will be overweight or obese” (World Health Organization, 2017). The causes of childhood obesity can be used in prevention strategies. “Overweight and obesity are largely preventable. Supportive policies, environments, schools, and communities are fundamental in shaping parents’ and children’s choices, making the healthier choice of foods and regular physical activity the easiest choice (accessible, available, and affordable), and therefore preventing obesity” (World Health Organization, 2017). Some actions that can be taken towards prevention include advertising healthy food to promote healthy eating. As demonstrated previously, children spend much time watching television or with technology, and as a result, their food choices are greatly affected by what is advertised. Another way to prevent childhood obesity is to introduce healthy food options that are affordable and cheaper than the low nutritional calorie-dense foods. “The food industry can play a significant role in reducing childhood obesity by reducing the fat, sugar and salt content of complementary foods and other processed foods” (World Health Organization, 2017). Altering which food is more widely available will correlate to the one which is more greatly consumed. Changing the menus of fast-food restaurants so that they only sell food with good nutritional value will also have the same effect by eliminating people’s access to food with low nutritional value that is high in calories.

Schools can also have a significant impact on the change in childhood obesity. For example, schools can guarantee that children are receiving at least 60 minutes a day of physical activity. The change in making sure students receive physical activity can be helpful in case they live in an unsafe neighborhood where it is not safe for them to play outside or they do not find time for physical activity during the rest of their day. Schools can also provide only well-developed balanced meals with high nutritional value. Ensuring that children are provided balanced meals at school will make sure that the children are receiving at least one or two

complete meals a day that is not high in fat or sugar. Schools placing policies that prevent the use of vending machines during the hours of meals or restocking the vending machine with only healthy items would also promote healthy eating. If there are systems put in place like reduced or free lunch, which allows children to receive lunch, for little to no money, this policy will make sure that even children whose families struggle from food insecurity have a full meal. Schools should provide well-lit walking routes for children who live nearby, as long as they live in a safe neighborhood in order to offer more opportunities to be physically active.

For children who like to indulge in sedentary activities such as video games, there are some ways they could alter their behavior and lose weight. For example, one could prevent childhood obesity by promoting exercise in video games or while watching TV. “The results of the study found that those who were involved in active screen time, meaning that they were on a treadmill while they watched television or played activity-promoting video games, had significantly higher energy expenditure values in comparison to those who were sedentary” (Lanningham-Foster, Jensen, Foster, Redmond, Walker, Heinz, & Levine, 2006). Incorporating physical activities into video games or technology could be a way to get rid of an individual’s bad habits. Obese children and adolescents have most likely developed tendencies to become engulfed in technology, cellular devices, television, and videogames; this offers a way to get rid of some of the fat accumulation while exercising and doing something that the individual already enjoys.

## References

- Centers for Disease Control and Prevention. (2018, July 3). *Defining Childhood Obesity*. Retrieved from <https://www.cdc.gov/obesity/childhood/defining.html>
- Farooqi, I. S., & O'Rahilly, S. (2007). Genetic factors in human obesity. *Obesity Reviews*, 8, 37-40. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4437561/>
- Farooqi, I. S., & O'Rahilly, S. (2005). New advances in the genetics of early onset obesity. Retrieved from <https://www.nature.com/articles/0803056>
- Gable, S., Chang, Y., & Krull, J. L. (2007). Television watching and frequency of family meals are predictive of overweight onset and persistence in a national sample of school-aged children. *Journal of the American dietetic association*, 107(1), 53-61. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0002822306022826>
- Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: a systematic literature review. *Sleep medicine reviews*, 21, 50-58. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4437561/>
- Hebebrand, J., Sommerlad, C., Geller, F., Görg, T., & Hinney, A. (2001). The genetics of obesity: practical implications. *International Journal of Obesity*, 25(S1), S10. Retrieved from <https://www.nature.com/articles/0801689>
- Jackson, S. L., & Cunningham, S. A. (2017). The stability of children's weight status over time, and the role of television, physical activity, and diet. *Preventive medicine*, 100, 229-234. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5517688/>
- Lanningham-Foster, L., Jensen, T. B., Foster, R. C., Redmond, A. B., Walker, B. A., Heinz, D., & Levine, J. A. (2006). Energy expenditure of sedentary screen time compared with

- active screen time for children. *Pediatrics*, 118(6), e1831-e1835. Retrieved from [https://pediatrics.aappublications.org/content/118/6/e1831?casa\\_token=lqOz2g7xDqcAAA:yEgyaEL7ty0ATtYrwAhudHEuVt0o2tTn-zcYvSJgDpwcC8XCRhpX3LTHkwz4bIBjgZE9Qj7gAVw](https://pediatrics.aappublications.org/content/118/6/e1831?casa_token=lqOz2g7xDqcAAA:yEgyaEL7ty0ATtYrwAhudHEuVt0o2tTn-zcYvSJgDpwcC8XCRhpX3LTHkwz4bIBjgZE9Qj7gAVw)
- Rennie, K. L., Johnson, L., & Jebb, S. A. (2005). Behavioural determinants of obesity. *Best Practice & Research Clinical Endocrinology & Metabolism*, 19(3), 343-358. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1521690X05000357>
- Martin, K. S., & Ferris, A. M. (2007). Food insecurity and gender are risk factors for obesity. *Journal of nutrition education and behavior*, 39(1), 31-36. Retrieved from [https://s3.amazonaws.com/academia.edu.documents/41249175/Food\\_insecurity\\_and\\_gender\\_are\\_risk\\_fact20160115-8784-ud662j.pdf?response-content-disposition=inline%3B%20filename%3DFood\\_Insecurity\\_and\\_Gender\\_are\\_Risk\\_Fact.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20191119%2Fus-east-1%2Fs3%2Faws4\\_request&X-Amz-Date=20191119T043223Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=49eb04f03f04aef699263efabf6b27b99abeca13f2b4a00fd6a760f059ac7122](https://s3.amazonaws.com/academia.edu.documents/41249175/Food_insecurity_and_gender_are_risk_fact20160115-8784-ud662j.pdf?response-content-disposition=inline%3B%20filename%3DFood_Insecurity_and_Gender_are_Risk_Fact.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20191119%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20191119T043223Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=49eb04f03f04aef699263efabf6b27b99abeca13f2b4a00fd6a760f059ac7122)
- World Health Organization (2017). *Facts and Figures on Childhood Obesity*. Retrieved from <https://www.who.int/end-childhood-obesity/facts/en/>
- Sahoo, Choudhury, Sofi, Kumar, & Bhadoria. (2015, April 4). *Childhood Obesity: causes and consequences*. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4408699/>
- Savage, Birch, & Ventra. (2007, May 7). *Influences on the Development of Children's Eating Behaviors*. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678872>