# Childhood Obesity: Impact on Health Care

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- Read the enclosed course.
- Complete the questions at the end of the course.
- Return your completed Evaluation to NetCE by mail or fax, or complete online at www.NetCE.com. (If you are a Florida nurse, please return the included Answer Sheet/Evaluation.) Your postmark or facsimile date will be used as your completion date.
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***Faculty***

**Diane Thompson, RN, MSN, CDE, CLNC**, has an extensive history in nursing and nursing education. She possesses a strong background in diabetes and cardiac care, starting her professional career at the cardiac care area of the Cleveland Clinic in Cleveland, Ohio. Ms. Thompson took the knowledge and experience she learned from the Cleveland Clinic and transferred it into the home health arena in rural Ohio, after which she moved to Florida and obtained further knowledge while working as a PRN nurse in all areas, including medical/surgical, intensive care, emergency, critical care, and cardiology. With a desire to have a specific area to concentrate her profession, Ms. Thompson accepted a position as a pneumonia case manager, which led into a diabetes case manager career.

Ms. Thompson has been employed in diabetes care since 2001, when she was hired as a diabetes case manager. After the completion of 1,000 hours of education to diabetes patients, Ms. Thompson earned her certification as a diabetes educator in 2003. From 2006 to 2018, Ms. Thompson was the Director of Diabetes Healthways at Munroe Regional Medical Center in Ocala, Florida. As the director of the diabetes center, Ms. Thompson was responsible for the hospital diabetes clinicians, hospital wound care clinicians, and out-patient education program. Today, she is the nurse manager of a heart, vascular, and pulmonary ambulatory clinic at Metro Health System in Cleveland, Ohio. Ms. Thompson has also lectured at the local, state, and national level regarding diabetes and the hospital management of hyperglycemia. Ms. Thompson is a member of the ADA, AADE, Florida Nurses Association, and the National Alliance of Certified Legal Nurse Consultants.

Ms. Thompson acknowledges her family as her greatest accomplishment. She is a wife of more than 30 years and a mother of a daughter and son, of which she is very proud. Ms. Thompson credits her husband for the support needed to set a goal and achieve it. He has been by her side through nursing school and completion of her Bachelor's degree and Master's degree, which she was awarded in 2015 from Jacksonville University in Florida.

***Faculty Disclosure***

Contributing faculty, Diane Thompson, RN, MSN, CDE, CLNC, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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***Division Planner/Director Disclosure***

The division planner and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

***Audience***

This course is designed for nurses in all practice settings with a desire to better understand the issues facing obese children and their families and the impact of childhood obesity on national and global health care.



*A complete Works Cited list begins on page 28.*

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### Course Objective

The impact of childhood obesity on an already stressed healthcare system is high and is estimated to rise as the diagnoses of comorbid conditions continue to occur at a younger age. The purpose of this course is to provide nurses with the information necessary to improve the care of children and adolescents who are overweight or obese.

### Learning Objectives

*Upon completion of this course, you should be able to:*

1. Outline the prevalence and cost of childhood obesity in the United States.
2. Analyze the etiology of overweight and obesity in the pediatric population.
3. Identify groups at high risk for childhood obesity.
4. Utilize the criteria for the diagnosis of overweight and obesity in children.
5. Review the findings of research regarding childhood obesity.
6. Describe how obesity contributes to a variety of complications.
7. Identify treatment options and education techniques for children with obesity and their families.

EVIDENCE-BASED PRACTICE RECOMMENDATION

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

## INTRODUCTION

Obesity is one of today's most blatantly visible, yet most neglected, public health problems [1]. Once considered a problem only in developed countries, overweight and obesity are dramatically on the rise in developing countries as well, particularly in urban settings [2]. An escalating global epidemic of overweight and obesity, referred to by some as "globesity," is becoming more prevalent in many parts of the world. Millions will suffer from an array of serious health conditions as a result if action is not taken [3].

Obesity is a complex condition with serious social and psychologic dimensions that affects virtually all age and socioeconomic groups [2]. In 1995, there were an estimated 200 million obese adults worldwide; by 2000, this number had increased to more than 300 million. Today, more than 650 million adults in the world are obese [3; 7; 11]. Additionally, numbers of obese children and teenagers have quadrupled over the past four decades [9; 112]. Models predict that adolescent obesity could potentially be responsible for up to 1.5 million life-years lost in the United States alone, with total costs of $254 billion when lost productivity and medical costs are taken into account [4].

For adults and children, obesity poses a major risk for serious weight-related noncommunicable diseases, including diabetes, cardiovascular disease, asthma, depression, and certain forms of cancer [5]. The chronic consequences of obesity can reduce the overall quality of life [6].

Overweight and obesity are defined as "abnormal or excessive fat accumulation that may impair health" [7]. A person is considered overweight if he or she has a body mass index (BMI) greater than or equal to 25; a BMI of greater than or equal to 30 is considered obese [8]. A woman who is five feet seven inches tall and weighs 175 pounds has a calculated BMI of 27.4 and would be considered overweight [7]. If the same woman gained an additional 20 pounds, she would have a BMI of 30.5 and would be considered obese.

## PREVALENCE

Since 1960, the prevalence of obesity has been on an upward trajectory, with rates increasing dramatically in the past few decades. In 1980, the percentage of obese and extremely obese adults was 15% and 1.4% of the total population, respectively; by 1994, the numbers had increased to 23.2% and 3.0% [9]. Data collected in 2017–2018 show that 42.4% are obese and 9.2% are extremely obese; an additional 31.9% of adults are overweight [9; 10]. That means that more than 83% of Americans 20 years of age or older are above a healthy weight and are at an increased risk for disease and early death.

With race/ethnic origin not factored, the prevalences of overweight and obesity are higher for men (38.2% and 43.0%) than for women (25.8% and 41.9%), but rate of extreme obesity is higher among women [10]. In the overall population, approximately 6.9% of men and 11.5% of women are extremely obese [9; 10].

When considered as a single race, the prevalences of obesity among individuals of African (49.6%) and Hispanic (44.8%) descent are greater than that reported for adults of European or Caucasian descent (42.2%) [10]. Native American/Alaska Natives and Native Hawaiian/Pacific Islanders have an obesity prevalence of 48.1% and 34.6%, respectively [59; 107]. Asian Americans are an exception, with a prevalence of 17.4%, much lower than in the general population. Although the rate of obesity is higher in many American racial/ethnic groups compared to non-Hispanic whites, white individuals make up the majority of cases [10].

The current prevalence of obesity ranges widely worldwide, from 4.7% to 10% of the population in some African and Asian countries to more than 62% percent in Nauru and Samoa, which have the highest known rates [11; 113]. Obesity has infiltrated the developing world in recent years, causing concern to healthcare economists worldwide [2; 11]. This has caused a double burden of disease in low- and middle-income countries, where high levels of infectious disease still occur [7; 11]. Although malnutrition and famine have historically been and continue to be huge health issues in African countries, obesity is now a looming concern as well [7; 11]. In addition to African nations, almost every country in the world is facing an obesity epidemic. The World Obesity Federation estimates that by the year 2025, 1 in 5 adults will be obese, and one-third of those will be severely obese [11]. Furthermore, a report published in 2020 following up on the goal to prevent obesity levels from increasing between 2010 and 2025 globally indicated that most countries have a less than 10% chance of achieving that goal; the United States has a 0.0% chance [11].

This alarming increase is mimicked in the pediatric and adolescent populations worldwide as well [11]. The World Health Organization (WHO) reports that there were 38 million obese or overweight children younger than 5 years of age in the world, with half of those living in Asia and one-quarter living in Africa [7]. The rate of obesity among children 5 to 19 years of age worldwide has increased from 2.9% in 2000 to 6.8% in 2016 and is expected to reach 10.5% by 2025 [11]. The United States has experienced a proliferation of childhood overweight and obesity. Overall, the number of adolescents who are overweight has quadrupled since 1980, and the prevalence among younger children has more than doubled [11; 14; 112]. The prevalence of obesity in children 6 to 11 years of age was 4% in 1968–1970. In contrast, between 2013 and 2014 the prevalence in the same age-group was 17.5% [16]. From 1980 to 2014, the prevalence of obesity among adolescents 12 to 19 years of age increased from 5% to 20.5% [112]. The number of BMIs at or above 120% of the 95th percentile among children and adolescents increased by less than 1% between 2001 and 2014 [16]. As of 2018, Mississippi had the highest rate of obese adolescents (25.4%), followed by West Virginia (20.9%), and Kentucky and Louisiana (both 20.8%). Utah, Minnesota, and Alaska were the only states that had an adolescent obesity rate of less than 10% [114].

The short- and long-term adverse outcomes of overweight and obesity in children and adolescents has resulted in the recognition of the condition as a major public health concern [12]. It has long been observed that approximately 40% of overweight children will continue to have increased weight during adolescence and 75% to 80% will progress to obesity in adulthood [6]. Children who are obese in their preschool years are also more likely to develop diabetes, hypertension, hyperlipidemia, asthma, and obstructive sleep apnea than those who are of normal weight [5]. High BMI in children may also have immediate consequences, such as elevated lipid concentrations and blood pressure [15].

## ECONOMIC IMPACT OF CHILDHOOD OBESITY

The annual direct costs of childhood obesity in the United States as of 2016 are an estimated $14.3 billion [18; 19; 112]. The total economic effects of obesity may be two to three times this figure, when impaired quality of life, reduced longevity, and other costs outside the medical care system (e.g., lost work days, reduced work performance) are considered [4; 20; 21]. Globally, obesity and obesity-related diseases cost $990 billion per year, more than 13% of all healthcare expenditure [11]. These economic burdens are born most heavily by overweight/obese individuals, but also by the general public through higher public and private health insurance costs, diminished employee productivity, and reduced public revenue [22; 23]. As today's children—heavier than any generation in history—reach adulthood, these tangible and intangible costs will escalate [11; 21].

Health insurance expenditures for treating obesity-related diagnoses, including hypertension, type 2 diabetes, and cardiovascular disease, amount to 43% percent of the total annual amount paid, an estimated $75 billion to $149.4 billion; approximately half of these expenditures were financed by Medicare and Medicaid [6; 24; 115; 117]. In addition, children covered by Medicaid are nearly six times more likely to be treated for a diagnosis of obesity than children with private insurance due to the correlation between childhood obesity and lower socioeconomic status [25]. While the current economic climate of the United States, and the world, is worrisome, investing some economic stimulus money into obesity prevention could produce potent short-term economic effects, while also taking action to protect society from the greatest threat to long-term well-being [21].

The incremental lifetime direct medical cost ranges from $12,660 to $19,630 greater for a 10 year old who is obese compared to a 10 year old of normal weight, and indirect medical costs range from $6,441 to $11,557 in adulthood for overweight and obese children [25; 118]. As these children age, they will likely present earlier and with more severe obesity-related conditions than the current adult population, as their obesity will be of longer duration and potentially more extensive [6].

After adjusting for population age and sex differences, average medical expenditures among people with diagnosed diabetes were 2.3 times higher than what expenditures would be in the absence of diabetes [27]. Factoring in the additional costs of undiagnosed diabetes, prediabetes, and gestational diabetes brings the total cost of diabetes in the United States to $327 billion (in 2017) [27].

Children with obesity experience greater rates of hospitalization and greater use of physician services for both privately insured and publicly insured groups [26]. Between 2000 and 2009, the number of hospitalizations of children and youth 2 to 19 years of age for which obesity was listed as a diagnosis more than doubled, from 16,700 to 38,000 [116]. It is important to note that children receiving Medicaid are less likely to visit a physician and more likely to enter the hospital than comparable children with private insurance [26].

## ETIOLOGY

The causes of childhood obesity are multifactorial. Obesity in any individual is the end result of an imbalance between calories taken in and energy expended, but the underlying causes are more complex [8]. Genetic and social factors influence the consumption and expenditure of energy. Overweight in children and adolescents is generally a result of a lack of physical activity, unhealthy eating patterns (i.e., excess energy intake), or a combination of the two [14].

The ecologic framework proposes that multiple factors act at different levels to influence the risk of individual development, which facilitates understanding of the complex nature of the obesity epidemic [28; 29]. Within this paradigm, behavior is recognized as the result of interactions of multiple subsystems interdependent, rather than independent, of the environment [28; 30].

The pathophysiology of obesity in childhood can be viewed from one of three perspectives: as an imbalance in the intricate homeostatic or energy-balance physiology, as an epidemiologic issue, or as a pathologic issue (focusing on the consequences of excess fat on the risk of future disease) [31]. Changes in energy expenditure may be the result of physical or chemical changes, or both. A heterogeneous group of disorders can result from an extended period of time during which energy intake exceeds the expenditures. Essentially, it is superficially apparent that obese people ingest a greater amount of food relative to their needs [32]. However, whether calorie intake differs between overweight and normal-weight individuals has been the subject of debate. Obese individuals may have increased metabolic efficiency, meaning they may expend relatively fewer calories to maintain body weight. This metabolic state may be the result of lean body mass losses after repeated weight reductions attempts, alterations in body composition, and decreased fat-free mass (FFM). Overall, multiple alterations in metabolic rates set the stage for the development of overweight and obesity [6].

As a result of decades of research, there is a greater appreciation of how insulin works within the body and how humans process food and utilize energy [2]. The main determinant of basal metabolic rate is FFM, and the main determinant of energy expenditure is physical activity. It is believed that minor alterations in either of these factors could result in a positive energy balance and lead to obesity over time [33]. For example, decreased obligatory energy expenditure, reflected by a decrease in resting metabolic rate, could be the consequence of an increased metabolic efficiency in obese persons. On the other hand, a reduction of energy expenditures due to a reduction in discretionary physical activity could also lead to an energy balance and weight gain [6; 33]. The resting energy expenditure and baseline activity levels are thought to be genetically predetermined.

Many obesity and diabetes studies have been conducted with the Pima Indian population who reside on the Arizona Gila River Valley Reservation [2]. This group has been of particular interest to researchers focusing on issues of overweight and obesity because, as of 2005, 80% of the Gila River Valley community was overweight. Furthermore, more than 50% of Pima Indians older than 30 years of age and 80% of those older than 55 years of age have type 2 diabetes [2]. There are data indicating that Pima Indians may have a low basal metabolic rate value and, therefore, enhanced metabolic efficiency consumption [34]. Although there appears to be a strong genetic propensity to obesity with this population, there is another group of Pima Indians in Mexico who are thin [2]. These two groups are remarkably different in their average weight and presence of weight-related complications due to the differences in exercise intensity between the two groups. The Pima Indians in Mexico consist primarily of farmers who consume many of the items grown in the fields they tend, such as wheat, squash, beans, and cactus buds [1]. In contrast, the Pima Indians of Arizona have become more "Americanized," consuming highly refined, nutrient-poor foods and adopting a sedentary lifestyle [34].

Interestingly, a research study in the United Kingdom has revealed that the loss of key sections of DNA can lead to severe obesity in children. The researchers scanned the genomes of 300 children who had become severely obese early in life and 7,366 apparently healthy controls for copy number variants (large DNA segments that are either deleted or duplicated in the genome). The researchers identified several deletions that were much more common in patients with early-onset obesity than in controls and found evidence that children with deletions in SH2B1, a gene on chromosome 16 known to play a role in leptin and insulin signaling, had a strong drive to eat and severe insulin resistance that was disproportionate for the degree of obesity [35]. Further research regarding the pathology of obesity in children and adolescents is necessary in order to definitively identify factors that increase the risk of obesity and implement treatment options to address these factors [36].

## RISK FACTORS

There are many factors that are related to an increased risk for overweight and obesity in children and adolescents. Certain ethnicities and races may have an increased risk, but it is important to remember that obesity can affect all races and may be dependent on other genetic or environmental factors [36]. Poverty and lower education level are inversely related to obesity and to a child's BMI.

EVIDENCE-BASED PRACTICE RECOMMENDATION

The Registered Nurses' Association of Ontario recommends assessing the family environment for factors (e.g., parenting/primary caregiver influences and sociocultural factors) that may increase children's risk of obesity.

(https://rnao.ca/sites/rnao-ca/files/Childhood_obesity_FINAL_19.12.2014.pdf. Last accessed November 10, 2020.)

**Level of Evidence**: IV (Evidence obtained from expert committee reports, opinions, and/or clinical experiences of respected authorities)

### CULTURE, RACE, AND ETHNICITY

Obesity and obesity-related complications such as type 2 diabetes disproportionately affect minority populations, specifically black Americans and Hispanic Americans of all ages [30]. Studies have found that 19.5% of non-Hispanic black children and adolescents in the United States (2 to 19 years of age) and 21.9% of Hispanic American children and adolescents (2 to 19 years of age) are overweight [16]. Girls and women, particularly those who are black and Hispanic American, are affected more severely than boys and men.

It is important to understand the impact of cultural perceptions of overweight and obesity. Taking into consideration the impact of overweight and obesity on the Hispanic population in the United States, this is one cultural group that should be examined [14]. There is a widely held belief in many Hispanic cultures that infants and children who are larger or overweight are healthier and stronger. The Hispanic view of overweight is one of health and strength, not of disease or illness [38]. In one study of Hispanic mothers, the women were more likely to consider average-weight children (50th to 75th percentile BMI) too thin or unhealthily thin [38]. When presented with images of children with BMIs in the 95th percentile, the women generally described the children as "slightly overweight" [38].

In many cultures, eating is a social event and is often the center of celebrations. In these contexts, children observe the behaviors and preferences of parents, siblings, other older relatives, and peers, and this can influence future food selections [14].

## GENETICS

It has been shown that parental obesity is related to future obesity in their children [2]. An estimated 80% of children with two overweight parents will be obese; this number is decreased to 40% if only one parent is obese [6]. When both parents are considered a healthy weight, the prevalence of obesity in offspring is diminished to 14% [6]. There is a growing body of evidence that describes obesity as a polygenic disorder, with many genes being linked or associated with a predisposition to adiposity [39]. Scientists have isolated more than 250 genes that influence weight. These genes impact several body systems and processes, including appetite, which partially explains why some infants are indifferent to food while others eat eagerly [2]. Some research has supported the presence of a human obesity syndrome thought to be linked to genetic defects [40]. Many of these genetic differences are manifested in the body's regulatory hormone levels.

Leptin is a hormone that is mainly released by adipose tissue when fat molecules accumulate. It is also produced in the stomach, ovaries, and skeletal muscle. In those of normal weight, leptin inhibits appetite in satiated individuals [2]. In some overweight individuals, the leptin pathway is inhibited, which results in the lack of signaling to stop eating [2]. Leptin receptor mutations and pro-opiomelanocortin deficiency are both associated with overeating and subsequent obesity [39].

In addition to leptin, the hormone ghrelin may impact an individual's risk of developing obesity [41]. It is the only known appetite-stimulating hormone, and when administered to both lean and obese human volunteers, it has been shown to increase food intake [42]. Ghrelin is produced primarily in the stomach and acts as a growth hormone secretagogue. Its receptors are located on hypothalamic neurons and in the brainstem [6; 41]. The primary function of ghrelin is the regulation of pituitary growth hormone secretion independent of growth-hormone-releasing hormone and somatostatin [8]. It has been hypothesized that ghrelin is an endocrine link between the stomach, hypothalamus, and pituitary and is important for the regulation of energy intake/output [6]. Plasma ghrelin concentrations are negatively correlated with body weight, percentage of body fat, and plasma leptin and insulin, suggesting that plasma ghrelin is down-regulated in obesity [6; 41]. Ghrelin antagonists and receptor blockers are a group of molecules that have received interest for development as anti-obesity targets [43].

## SOCIOECONOMIC STATUS

A negative relationship between socioeconomic status (as measured by income, education, and occupational status) and adult overweight and obesity has been well established, and this connection appears to be established for children as well [36]. In the period 2011–2014, obesity prevalence among children whose adult head of household had completed college was 9.6% compared with 21.6% for children whose adult head of household had completed high school or less [36]. Among non-Hispanic white children, the lowest prevalence of obesity was observed among those whose adult head of household completed college; however, this was not the case for non-Hispanic black children [36]. In 2011, obesity prevalence (based on family income) among children 2 to 4 years of age from low-income households ranged from 14.2% (income-to-poverty ratio ≤ 50%) to 185% (income-to-poverty ratio 151% to 185%) [36].

## PUBLIC POLICY, OPINION, AND THE MODERN ENVIRONMENT

Although childhood obesity may be related to specific cultural and national circumstances, universal themes have emerged, including social factors, exercise, advertising, public policy, and the importance of partnership in policy [44]. The obesogenic environment is characterized by increased accessibility and affordability of energy-dense foods in conjunction with declining levels of physical activity [39]. Although community efforts and public policy have been shown to improve childhood obesity rates, studies have indicated that most Americans feel that individuals are responsible for their own obesity and that of their children [30]. However, it is important to recognize that society has created an environment by means of an economic structure that makes processed foods more affordable than fresh foods, and the food industry and mass media market energy-dense foods to children [2]. Evidence is limited regarding specific dietary patterns that may contribute to excessive intake in children and adolescents [36]. There has been considerable debate regarding whether exposure to food advertising affects the incidence of childhood obesity. While a positive correlation between the hours of television viewed, BMI, and obesity has been documented, the exact mechanism by which this occurs are still being investigated [14].

According to the 2017 National Youth Risk Behavior Survey, nearly 6% of high school students had not eaten fruit or drunk 100% fruit juices and more than 7% had not eaten vegetables in the seven days before the survey [45]. Of the same group, 18.7% had consumed a can, bottle, or glass of soda (not including diet soda) one or more times per day in the seven days preceding the survey, and only 27.8% did not consume any soda (not including diet soda) in the seven days preceding the survey [45]. In the past few decades, adolescents consumed twice as much milk as soda; this proportion has completely switched today [45]. Often, individuals do not compensate for the calories consumed in the form of sugar-sweetened beverages with a reduction in solid food intake, partially because liquid forms of energy may be less satiating [46]. In addition to the increase in calorie consumption, average portion sizes have also increased, with sugared drinks increasing from an average 12 ounces to almost 20 ounces [14].

Data from the 2017 National Youth Risk Behavior Survey indicate that, nationwide, 15.4% of students had not participated in at least 60 minutes of any kind of physical activity on at least one day during the seven days before the survey; 46.5% had been physically active at least 60 minutes per day on five or more days; and 26.1% had been physically active for 60 minutes a day on all seven days. The prevalence of having been physically active at least 60 minutes a day on five or more days has not changed significantly between 2015 (48.6%) and 2017 (46.5%) [45]. The current trend is for schools to decrease the amount of free play or physical activity available to children during school hours [14]. Among high schools in the United States, only 4% require daily physical education or its equivalent for students in all grades for the entire year [46]. Furthermore, only 8% of elementary schools schedule recess on a regular basis. While some schools lack the space for free play, others feel that recess is a waste of time [47].

Sedentary activities have become more prevalent with the evolution of technology and its availability to children and adolescents [2]. According to the 2017 National Youth Risk Behavior Survey, 20.7% of high school students watch three or more hours of television per day during the average school week (down from 42.8% in 1999 and 32.5% in 2013). However, it is clear that other screen usage is replacing television among this age group—43.0% play video or computer games or utilize a computer for activities unrelated to school work for three or more hours per school day [45].

Over the past several decades, the number of dual-income families has increased dramatically, as has the number of women serving as the sole provider for their families. It has been hypothesized that the increase in rate and hours of parental employment may be correlated with the increased rate of overweight and obesity in children [14]. Studies have revealed that children residing in a single-parent household are more likely to be obese than children residing in a two-parent household. Several potential mechanisms have been proposed to explain this phenomenon, including [14]:

- Working parents probably rely more heavily than non-working parents on prepared, processed, and fast food, which in general contains increased calories, greater levels of fat, and a decreased nutritional content.
- Children left unsupervised after school may make poor nutritional choices and engage in a greater amount of sedentary activities.
- Childcare providers may not offer as many opportunities for physical activities and may provide less nutritious snack and meal selections.
- Unsupervised children may spend an increased amount of time indoors as a result of safety concerns, watching television or playing video games more readily than engaging in outdoor activities.

As children's television viewing has increased, children have become a marketing target of the food industry. Of the approximately 10,000 food advertisements children view each year, more than 95% are for candy, fast food, soda, sugared cereals, and other unhealthy foods [30]. Furthermore, children's toys and books are linked to beverages and food products, including learn-to-count books branded by candy manufacturers [2]. These changes have impacted the foods available in the homes and the degree of influence parents have when children make food selections [14].

## DIAGNOSIS

There may be a reluctance to label infants as overweight or obese or to delay this diagnosis until toddlerhood. Even if the topic is raised, parents of overweight or obese preschoolers may not perceive their child's overweight status as a problem or health concern and may not be receptive to the discussion. For children, the diagnosis of overweight or obesity is determined with the use of growth charts that give percentages of height, weight, and/or BMI. The Centers for Disease Control and Prevention (CDC) BMI growth charts can be utilized clinically beginning at 2 years of age [48]. BMI is calculated by weight (in kg) divided by height (in meters) squared, or weight (in pounds) divided by height (in inches) squared, which is then multiplied by 703. Diagnosing overweight and obesity in children 5 to 14 years of age may be difficult because there is no standard definition of childhood obesity applied worldwide [7]. Although BMI is utilized in the process of diagnosing overweight and obesity in children, the determination also takes into account age- and sex-specific percentiles. The CDC recommends using the WHO growth charts to diagnose overweight in children younger than 2 years of age and using the CDC charts for children and adolescents older than 2 years of age [48]. Using these growth charts, the following categories have been established [49]:

- Underweight: Less than the 5th percentile
- Healthy weight: 5th percentile to less than the 85th percentile
- Overweight: 85th percentile to less than the 95th percentile
- Obese: 95th percentile and greater

## RESEARCH RELATED TO CHILDHOOD OBESITY

### SPECIAL SUPPLEMENTAL NUTRITION PROGRAM FOR WOMEN, INFANTS, AND CHILDREN PARTICIPANTS AND PROGRAM CHARACTERISTICS (WIC PC)

In the late 1960s, the United States Ten-State Nutrition Survey characterized the nutritional status of children from low-income families as being less than satisfactory [50]. Specifically, calories, calcium, iron, and vitamins A and C were less likely to be consumed in adequate amounts by low-income black and Hispanic children. In response, the CDC began working with five states (Arizona, Kentucky, Louisiana, Tennessee, and Washington) in 1973 to develop a system for continuous monitoring of the nutritional status of selected high-risk populations [51]. This evolved into the Pediatric Nutrition Surveillance System (PedNSS), which provided data on the prevalence and trends of nutrition-related indicators among specific pediatric populations. The PedNSS was the only source of nationally compiled obesity surveillance data obtained at the state and local level for low-income, preschool-aged children participating in federally funded health and nutrition programs. It used existing data from the following public health programs:

- Special Supplemental Nutrition Program for Women, Infants, and Children (WIC)
- Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) Program
- Title V Maternal and Child Health (MCH) Program

A majority of data was from the WIC program, which serves children up to 5 years of age, and the PedNSS has been replaced by the Special Supplemental Nutrition Program for Women, Infants, and Children Participants and Program Characteristics (WIC PC)[52].

In 2007–2008, the prevalence of children 2to 5 years of age participating in WIC was 10.1%, decreasing to 8.4% in 2011–2012 but again increasing to 13.9% in 2015–2016. Although the rates of obesity are still high, data show that the prevalence of obesity among preschool-aged children declined from 15.9% in 2010 to 13.9% in 2016, indicating progress [53]. In that time (2010–2016), 41 of the 56 WIC state or territory agencies reported statistically significant decreases in the prevalence of obesity [53].

### NHANES

The National Health and Nutrition Examination Survey (NHANES) is a program of studies designed to assess the health and nutritional status of adults and children in the United States [13]. The survey is unique in that it combines both interviews and physical examinations. The NHANES program began in the early 1960s and has been conducted as a series of surveys focusing on different population groups or health topics. In 1999, the survey became a continuous program that has a changing focus on a variety of health and nutrition measurements to meet emerging needs [13]. The survey examines a nationally representative sample of about 5,000 persons each year. These persons are located in counties across the country, 15 of which are visited each year [13].

The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiologic measurements, as well as laboratory tests administered by medical personnel [13]. NHANES has established that black and Mexican American adolescents 2 to 19 years of age are more likely to be overweight (20.2% and 22.6%, respectively) compared to non-Hispanic white adolescents in the same age-group (14.1%) [54].

## COMPLICATIONS OF OBESITY IN CHILDREN

Childhood obesity increases the risk of developing a considerable number of chronic health conditions and diseases [6]. The evidence related to the consequences of childhood obesity are the results of observational, typically cross-sectional, studies and do not specifically prove causation [55]. The actual death rate associated with obesity continues to be debated, although there is a general agreement that the impact of this disease is enormous [6]. Obesity is associated with numerous comorbidities, such as cardiovascular disease, type 2 diabetes, hypertension, obstructive sleep apnea, bone and joint pathologies, and depression [56].

### CARDIOVASCULAR DISEASE

With few exceptions, the clinical features of cardiovascular disease are usually not apparent until the third or fourth decade of life. However, there is substantial evidence that the atherosclerotic process is initiated during childhood and may be advanced in the presence of childhood overweight and obesity [6]. As a result, these children may be at an increased risk for metabolic syndrome.

Metabolic syndrome is defined as a cluster of cardiovascular risk factors, including hyperglycemia, central adiposity (increased waist circumference), hypertension, hyperlipidemia, low levels of high-density lipoprotein, and insulin resistance [2]. It is believed to be caused by visceral fat, as chemical signals from adipose cells trigger inflammation [2]. Before the development of comorbidities, children 9 years of age who are obese already demonstrate alarming elevations of inflammatory and prothrombotic factors that correlate with body fat mass. In studies with long-term (60-year) follow-up, it has been shown that being overweight as an adolescent is a more powerful predictor of development of multiple obesity-related diseases than being overweight in adulthood. This risk persists even if the weight is lost during the adult years [57].

Acute inflammation induces a cascade of reactions by the immune system. When too much adipose tissue is present, an individual also has a chronic overabundance of inflammation-triggering chemicals [58]. This, along with the presence of atherosclerotic plaque, results in blood vessel narrowing [6]. Ruptures of these inflamed vessels can cut off the flow of blood to the myocardium or cerebral tissue [2].

In one study of children and adolescents 5 to 17 years of age with obesity, 70% had at least one cardiovascular disease risk factor, and 39% had two or more risk factors for cardiovascular disease [37]. It could be expected that the impact of these risk factors initiating earlier in life, especially during childhood, would result in more dramatic adverse effects over an individual's lifespan [6]. Using current childhood obesity figures, historical trends, and scientific models, researchers at the University of California, San Francisco, project that by 2035 the prevalence of cardiovascular disease in the United States will increase as much as 16%, with more than 100,000 excess cases of the disease attributed to the rise in childhood obesity [20].

### DIABETES

The relationship between obesity, cardiovascular disease, and diabetes is well established [32]. Obesity has been identified as a direct causative factor for many conditions that contribute to the development of diabetes, including hyperinsulinemia, glucose intolerance, elevation in hemoglobin A1C levels, and hyperglycemia [60]. Indeed, glucose intolerance alone in adolescence increases the risk of premature death (before 55 years of age) by 73%, and a BMI in the highest quartile more than doubles the risk of premature mortality [61].

Although only one-third of obese children and adolescents have insulin resistance, it is present with increased frequency and severity in up to 50% in morbidly obese children [6]. This increase in insulin resistance has been a contributory factor in the increased prevalence of type 2 diabetes in children [62]. A 1996 study of 1,027 consecutive records of children up to 19 years of age with diabetes revealed that 16% were diagnosed with type 2 diabetes (while the rest had type 1 diabetes) [63]. As of 2018 in the United States, the total prevalence of diabetes in children and adolescents younger than 20 years of age is [27; 119]:

- About 0.25% of all people in this age-group have diabetes, and approximately 30% of diagnosed diabetes is type 2 in this age-group.
- An estimated 20% of adolescents and 25% of young adults have prediabetes.

Because type 2 diabetes has only relatively recently been recognized in adolescents, it is not possible to forecast what the future holds. However, it is known that 44.4% of adults with adolescent-onset type 2 diabetes will develop diabetic nephropathy after 30 years [62].

## PULMONARY EFFECTS

There has been little focus on the impact of obesity on respiratory diseases; however, there are clear effects on pulmonary function and inflammation, both of which can increase the prevalence and morbidity of lung disease [64]. The work of breathing is increased in obese individuals, and larger body mass places increased demands for oxygen consumption and carbon dioxide elimination [6]. Increased body weight can also lead to worsening of pulmonary function as a result of the mechanical effects of truncal obesity and the metabolic effects of adipose tissue [64]. This is characterized by increased ventilation of upper lobes and increased perfusion of the lower lobes [6].

Abdominal fat may alter the pressure volume characteristics of the thorax and restrict the descent of the diaphragm, thereby limiting lung expansion, especially if the patient is lying on his or her back [64]. Parents of obese children and adolescents report their children snore loudly and may appear to stop breathing during the sleep cycle, which is indicative of sleep apnea [6]. During sleep apnea, oxygen levels in the blood can diminish dramatically [65]. Obstructive sleep apnea occurs in up to 60% of obese children [66].

In addition to obstructive sleep apnea, a significant association exists between excess weight and asthma incidence [6; 65; 67]. It has been suggested that obesity decreases lung volume while increasing resistance, which can lead to symptoms of asthma [64]. An estimated 28% of asthma cases that develop in female patients older than 9 years of age are attributable to overweight [6].

## DEPRESSION

An additional consequence of childhood obesity is the development of depression and anxiety. Obese children and adolescents often become targets of early and systemic social discrimination, and lowered self-image, heightened self-consciousness, and impaired social functioning have been noted in individuals who either develop or remain obese during adolescence [6]. It has been reported that one in five obese children in the United States has a mental health problem resulting in at least mild functional impairment [68]. Research has demonstrated an increased level of depression among children with the greatest BMIs [12].

The psychologic stress of social stigmatization can cause low self-esteem, which can alter academic and social functioning even into adulthood [36]. The social stigma of weight-based teasing has been identified as a key risk for overall negative psychosocial outcomes among the overweight pediatric population [31].

### OTHER MEDICAL CONDITIONS

Overweight and obese children and adolescents have the increased potential to develop orthopedic complications, believed to be primarily related to a mechanical alteration [36]. During childhood, slipped capital femoral epiphysis, Legg-Calvé-Perthes disease, and genu valgum tend to be more common in overweight individuals [6]. Children and adolescents who are obese are more likely to experience persistent symptoms six months after an acute ankle sprain, suggesting increased risk of chronic orthopedic morbidity in obese individuals following acute injury [69].

Obesity has also been identified as a risk factor for pseudotumor cerebri, a condition characterized by idiopathic intracranial hypertension [70]. Although most common in women of childbearing age, this condition can occur in children and adolescents [71]. Signs of pseudotumor cerebri are similar to those seen with brain tumor and include headache, blurred or dimmed vision, nausea, vomiting, and tinnitus. More than 50% of children who develop this disorder are obese, and the only effective treatment is weight loss [70].

Studies have documented a strong relationship between hepatic steatosis and insulin resistance [72]. This may progress over the years from inflammation and fibrosis (non-alcoholic fatty liver disease), to steatohepatitis, fibrosis, cirrhosis, and more rarely, hepatocellular carcinoma [73]. Pediatric non-alcoholic fatty liver disease is the most frequent chronic liver disease in children and adolescents in industrialized countries and is primarily a consequence of childhood obesity and overweight [74].

In one study of adult patients with diabetes and obesity, 100% presented with some degree of steatosis, 50% had steatohepatitis, and 19% had cirrhosis [75]. Liver disease is often clinically silent for many years, although fatty liver, a precursor to non-alcoholic steatohepatitis, has been identified in 22% of obese children 4 to 12 years of age and fatty changes have been documented in 10% to 25% of obese adolescents [73; 74]. The true prevalence could be significantly higher as the hormonal changes in adolescence, especially in boys, favor insulin resistance and fat accumulation in hepatocytes [74].

Insulin resistance and hyperinsulinemia are associated with increased activity of both the renin-angiotensin-aldosterone system and sympathetic nervous system activities, resulting in increased renal sodium reabsorption, fluid retention, and endothelial cell proliferation [73]. Therefore, renal function may be impaired in pediatric patients with obesity and type 2 diabetes, but further studies are needed [76; 77].

## TREATMENT OPTIONS

Numerous factors contribute to childhood obesity, including genetics, environment, metabolic, biochemical, psychologic, and physiologic factors. The complex interaction of all of these possible causes makes it unlikely that a single intervention will be successful for all obese children [78]. In general, the first-line treatment is behavior changes and lifestyle modification. This should include [79]:

- Changes to the family's lifestyle
- Developmentally appropriate approaches, with parents being the "agents of change" for younger children
- Long-term behavioral changes, including monitoring behavior, setting and reviewing goals, rewarding successful changes in behavior, and controlling the environment
- Changes in dietary intake, including modified eating patterns, parental modeling of healthy food choices, consumption of lower fat and lower calorie foods, increased vegetable intake, decreased portion sizes, and reduced intake of sweetened drinks

- Increased unstructured physical activity, through active transport and access to play equipment, and parental role-modeling of an active lifestyle
- Decreased sedentary behavior through limiting combined television and computer (or Internet-connected device) time to less than two hours per day

For patients with moderate-to-severe obesity, use of nonconventional therapies, such as pharmacotherapy, as an adjunct to support lifestyle changes may be necessary. In extreme cases, bariatric surgery may be indicated.

EVIDENCE-BASED PRACTICE RECOMMENDATION

The Academy of Nutrition and Dietetics recommends a registered dietitian nutritionist assess the frequency of fast-food intake of overweight or obese children and adolescents. Limited evidence in populations 8 to 16 years of age at baseline suggests that higher frequency of fast-food consumption, particularly more than twice a week, is associated with increased adiposity, body mass index, or risk of obesity during childhood, adolescence, and the transition from adolescence into adulthood.

(https://www.andeal.org/topic.cfm?menu=5296&cat=5632. Last accessed November 10, 2020.)

**Level of Evidence/Strength of Recommendation**: Weak/Imperative (The recommendation is considered broadly applicable, but the quality of evidence that exists is suspect or well-done studies show little clear advantage to one approach versus another.)

## PHARMACOTHERAPY

Pharmacologic therapy for weight loss in children and adolescents remains an area of research. As of 2023, there are four medications approved by the U.S. Food and Drug Administration (FDA) for weight loss and weight management in adolescents: phentermine, orlistat, liraglutide, and semaglutide [80; 110; 111; 120].

Phentermine is approved for short-term (≤12 weeks) use in obese adolescents 16 years of age and older with a BMI ≥ 30 or ≥ 27 in the presence of other risk factors. A fixed-dose combination product of phentermine/topiramate (3.75 mg/23 mg) is approved for obese adolescents 12 years of age or older [80]. It is approved as an adjunct in a weight-reduction regimen involving exercise, behavior modification, and calorie restriction. Phentermine is an amphetamine analog—a class IV controlled substance [80; 120]. Common side effects may include increased blood pressure and heart rate. There is limited availability of long-term data for phentermine [120].

Orlistat is approved for use in obese adolescents 12 years of age and older with a BMI of at least 30, or 27 in the presence of other risk factors. However, the efficacy of orlistat has not been tested extensively in young patients [12; 80]. Orlistat acts by inhibiting gastrointestinal lipases and blocking the absorption of up to one-third of fat intake. It has no systemic activity, but it is associated with some side effects, including gastrointestinal effects (e.g., flatulence, fecal fat loss, incontinence, and diarrhea), back pain, and upper respiratory infection [80; 81]. Patients using orlistat should take a fat-soluble vitamin supplement [80]. This agent is contraindicated in patients with chronic malabsorption syndrome or cholestasis and should be used with caution in those taking cyclosporine.

In 2020, daily liraglutide injections were approved for patients 12 years of age or older; in 2023, a weekly semaglutide injection was also approved for patients 12 years of age and older [80; 110; 111]. These agents should be used along with lifestyle changes (e.g., diet and physical activity changes). In 2012, lorcaserin was approved to be used, in conjunction with diet modification and exercise, for adults with a BMI ≥ 30 or adults with a BMI ≥ 27 with at least one weight-related comorbidity (e.g., hypertension, dyslipidemia, sleep apnea) [80; 82]. However, was voluntarily withdrawn from the market by the manufacturer in 2020 due to results from safety clinical trials showing an increased occurrence of cancer [123].

Some overweight children or adolescents may be taking metformin, a common medication utilized for type 2 diabetes and insulin resistance [80]. Metformin has been shown to increase cellular sensitivity of insulin, leading to reductions in appetite and body weight in obese children and adults. In a two-month study, metformin 850 mg and a low-calorie diet demonstrated a significant weight loss in adolescents as well as improvements in fasting insulin, leptin, and lipid levels [81]. However, long-term efficacy and safety are unknown [12].

EVIDENCE-BASED PRACTICE RECOMMENDATION

The European Society of Endocrinology and the Pediatric Endocrine Society suggest that FDA-approved pharmacotherapy for obesity be administered to children and/or adolescents only with a concomitant lifestyle modification program of the highest intensity available and only by clinicians who are experienced in the use of anti-obesity agents and are aware of the potential for adverse reactions.

(https://academic.oup.com/jcem/article/102/3/709/2965084. Last accessed November 10, 2020.)

**Level of Evidence/Strength of Recommendation**: 2|⊕○○○ (Suggestion based on very low quality evidence)

## BARIATRIC SURGERY

As obesity rates in children and adolescents continue to increase, the number of bariatric surgeries performed on this population does as well [83]. Weight-loss goals and reduction of morbidity are often achieved with bariatric surgery [31]. Given the unknown long-term risks of bariatric surgery in the still-developing adolescent, more stringent criteria have been proposed for this population. In 2009, the International Pediatric Endosurgery Group (IPEG) published updated guidelines with similar BMI cutoffs for surgery in adolescents as in adults (i.e., BMI >40 or BMI >35 with comorbidities). The IPEG included important stipulations concerning growth, commitment to lose weight, assent for surgery, and long-term follow-up, and added requirements for surgery in adolescents (i.e., Tanner stage 4 or greater, 95% skeletal maturity, demonstrated commitment to lifestyle change, stable psychosocial environment) [84]. The 2012 American Society for Metabolic and Bariatric Surgery (ASMBS) pediatric best practice guidelines largely aligned with those guidelines; however, significant milestones in the understanding of obesity led the ASMBS to update their guidelines in 2018 [121]. The 2018 ASMBS guideline recommends BMI cutoff for surgery in adolescents (i.e., BMI >35 or 120% of the 95th percentile) with clinically significant comorbidities, such as obstructive sleep apnea, type 2 diabetes, pseudotumor cerebri, severe nonalcoholic steatohepatitis, gastroesophageal reflux disease, or hypertension; they also recommend a cutoff BMI of >40 (or 140% of the 95th percentile) regardless of comorbidities [17; 121]. Previous guidelines required a comorbidity with a BMI of >40; however, it was found that requiring a comorbidity puts children at a significant disadvantage to attaining a healthy weight. Earlier surgical intervention (at a BMI of >45) can allow adolescents to reach a normal weight and avoid lifelong medication therapy and end organ damage from comorbidities [17; 121]. In addition, the ASMBS indicates that prior weight-loss attempts, Tanner stage, and bone age should not be barriers to definitive treatment [121].

Contraindications to adolescent bariatric surgery include [84; 121]:

- A medically correctable cause of obesity
- An ongoing substance abuse problem (within the preceding year)
- A disability that would impair adherence to postoperative dietary and medication regimens
- Current or planned pregnancy within 12 to 18 months of the procedure
- An unwillingness to comprehend and acknowledge the procedure's consequences

The importance of adhering to these criteria cannot be understated. Until the long-term outcomes of bariatric surgery in adolescents are known, surgery should ethically be limited to patients with comorbidities [85].

In addition, the American Academy of Pediatrics (AAP) follows the 2018 guidelines from the ASMBS, but also recommends that other factors unique to overweight youths be taken into account [83; 122]. According to the AAP, adolescents being considered for gastric bypass surgery should be assessed for endogenous causes of obesity, as addressing these causes may resolve obesity without the necessity of surgical intervention. All adolescents being considered for surgery and their parents should undergo thorough psychiatric evaluations in order to "facilitate assessment of the family unit, determination of the coping skills of the adolescent, and assessment of the severity of psychosocial comorbidities" [83]. A supportive family environment is necessary for a successful outcome.

Not surprisingly, bariatric surgeries among teens increased eightfold, from 200 procedures in the United States in the year 2000 to more than 1,600 in 2009 [86; 108]. Studies and publications by the AAP and ASMBS indicate that bariatric surgery is safe and effective for adolescents, and the organizations are calling for reduced barriers and improved access [121; 122]. Barriers include insurance coverage and a low referral rate from pediatricians and primary care. While bariatric surgery is now being shown to be safe and effective for adolescents, major health organizations agree that it should be offered only by experienced multidisciplinary teams and presented to families with appropriate informed consent [31; 121; 122].

Various types of surgical procedures have been used to change eating behavior and induce weight loss. The most commonly used procedures are [81; 83; 85; 87; 121]:

- Gastric bypass: The most common form of bariatric surgery, gastric bypass involves creating a small proximal gastric pouch with a tight outlet and a Roux-en-y configuration of the small bowel.
- Laparoscopic adjustable gastric band: Approved in the United States in 2001, this procedure consists of a device placed around the stomach just below the esophagogastric junction, creating a pouch that holds only a few ounces. Saline is used to inflate the band and adjust the diameter of the gastric pouch outlet.
- Vertical sleeve gastrectomy: This technique involves the longitudinal resection of the stomach and sleeving of the remaining portion into a narrow tube.

Many other procedures have been used in bariatric surgery, but for the most part they have fallen out of favor. These include jejunoileal bypass, vertical banded gastroplasty, and biliopancreatic diversion.

Bariatric surgery has been shown to be effective in inducing weight loss in adolescent patients. A study of 13 obese adolescents demonstrated significant weight loss at the 12-month postoperative point, with a reduction in BMI from an average of 59 to 38 [88]. Percentage of body fat also decreased, from 47% before surgery to 36% after. In general, weight loss plateaus after 12 to 18 months. According to evidence related to bariatric surgery in adolescents, patient safety and weight-loss outcomes in extremely obese adolescents are at least as good as those demonstrated in adults [89; 90]. In addition, a study of adolescents who underwent gastric bypass surgery found improvements in depressive symptoms and health-related quality of life within one year of the surgery [91]. A decrease in hypertension, resolution of type 2 diabetes, and improvements in insulin resistance have been noted in adolescents who have undergone bariatric surgery [92; 93; 94; 95; 121].

Although considered safe, complications from these surgeries can occur both immediately following the procedure and over time. Early complications can include leaks, hemorrhage, gastric or bowel perforation, obstruction due to edema, and slippage of the band. Late complications may include ulcers, obstruction, vitamin and mineral deficiencies, hernia, and migration or erosion of the band [96; 97].

Although there are no absolute contraindications to gastric bypass surgery, it is important to assess each patient's risks and willingness to engage in the necessary lifestyle modifications [98]. Contraindications for gastric banding have been established and include [99; 100]:

- Crohn disease or other inflammatory diseases of the digestive tract
- A high risk of upper gastrointestinal bleeding
- Abnormal anatomy of the digestive tract
- Severe heart disease
- Severe lung disease
- Cirrhosis of the liver
- Portal hypertension
- Chronic pancreatitis
- Chronic steroid use or, in some cases, steroid use within 15 days of initial surgery
- Pregnancy
- Current infection

## COUNSELING AND PATIENT EDUCATION

New behavior patterns should be established through counseling and peer support groups to achieve sustained weight loss. Systemic research indicates that inclusion of mental health professionals in the management of childhood overweight and obesity is essential [17; 101]. Although childhood obesity has a clear impact on an individual's health, particularly over many years, the most immediate and common consequences of obesity among children are psychosocial. Therefore, treatment plans for these patients should address psychologic consequences of the disease, including alienation, depression, and anxiety.

During the past century, a comprehensive public health approach utilizing medical and community interventions has been found to provide significant protection and benefit [102]. A collaborative approach provides the greatest potential for success, and involvement by parents, children, healthcare professionals, and the community is needed to provide the basic foundation for a complete paradigm shift [81].

Counseling topics that should be addressed with both parents and overweight or obese children/adolescents include [81]:

- Food management: Diets are more likely to succeed if individualized according to eating patterns, cultural concerns, degree of motivation, intellect, amount of family support, and financial considerations.
- Behavior modification: Behavior and lifestyle modification techniques are utilized to help overweight people cope with an environment that promotes over-eating and inactivity.
- Exercise: Dietary management in childhood obesity should be combined with exercise to promote long-term weight loss.

Of all the studies conducted, positive result findings were significant for the presence of parental involvement, especially when pediatric subjects were 8 years of age and younger [78]. The inclusion of a registered dietician and an exercise physiologist or physical therapist in the interdisciplinary team is also fundamental for patients of any age [17].

## ADVOCACY

Abundant opportunities exist for healthcare professionals to take leadership roles in this critical area of child health, including action in promoting opportunities for physical activity, the fresh food supply, research, and third-party reimbursement [6]. Change is desperately needed in opportunities for physical activity in child-care centers, schools, after-school programs, and other community settings [2]. Some managed care organizations are beginning to offer benefits for the treatment of childhood obesity through better access to established community childhood obesity programs [6]. Foods that are nutrient rich and palatable, yet low in excess calories from added sugars and fat, should be readily available to parents, school and child-care food services, and others responsible for feeding children. Potential affordable sources include urban gardens, community-supported agriculture, and farmers' market projects [103].

Regulation of advertising and promotion of calorie-dense, nutrient-poor food products to children may be necessary. The increase in sugary beverage intake has been linked to obesity; therefore, the sale of such beverages should not be promoted at schools [2]. Healthcare professionals are encouraged to work with school administrators and others in the community on strategies to decrease the dependence on vending machines, snack bars, and school stores for school revenue [104]. Advocacy is also needed for physical education programs that emphasize and model daily activities for personal fitness (as opposed to physical education limited to a few team sports) [103].

Collaboration among nutrition, behavioral health, physical therapy, and exercise physiology professionals is essential [81]. Working with communities and schools to develop needed counseling services, physical activity opportunities, and strategies to reinforce the gains made in clinical management is also important [2]. Pediatric referral centers should develop specialized programs for treatment of complex and difficult cases, and for research into etiology and new methods of prevention and treatment [104].

There are several elements to providing the right care for young children [105]:

- Regular preventive services: Accessing care at recommended intervals allows healthcare practitioners to function as a universal point of contact for young children and their families. This provides the opportunity for screening and responding to a child's physical, social, and developmental needs.
- Comprehensive care: Providing comprehensive, "whole child" care allows healthcare providers to identify and address the full spectrum of factors that affect children's health and well-being. This life-course approach to child health is needed to ensure that all factors affecting children's healthy development are addressed.
- Family-centered care: Practicing family-centered and family-oriented care not only acknowledges parents' central role in setting and maintaining positive health trajectories, it also encourages collaboration with other community service providers and support systems.

Supporting community programs is also a part of advocacy. The National Football League has partnered with several organizations, including the American Heart Association, GENYOUth, Shriners Hospital, St. Jude Children's Research Hospital, United Way, Special Olympics, Subway, GoNoodle, and FitnessGram, to create the NFL Play 60. This initiative develops national public service announcements and online programs and helps implement in-school, after-school, and team-based programs at the local level [106]. This program has supported more than 73,000 schools and has provided resources to increase activity levels to more than 38 million children [106].

## GOVERNMENT PROGRAMS

Due to the potentially devastating effects of childhood obesity on public health, the government has established programs to address the problem. As of 2019, the CDC's Division of Nutrition, Physical Activity, and Obesity (DNPAO) funds 38 states, the District of Columbia, and two Native American tribal groups to create initiatives to decrease obesity and other chronic diseases related to nutrition and exercise [103]. The program has three goals related to risk factors for illness, disability, and premature death [103]:

- Decrease prevalence of obesity through prevention of weight gain and maintenance of healthy weight
- Improve dietary quality to support healthy child development and reduce chronic disease
- Increase health-related physical activity for people of all ages

To meet these goals, strategic public health efforts are aimed at the following program objectives [103]:

- Strengthen public health capacity to promote healthy eating and physical activity
- Support healthy diets through micronutrient fortification and supplementation
- Increase healthy food and beverage purchases
- Promote healthy foods and beverages in schools
- Increase physical activity in worksites
- Make communities more walkable
- Improve child care environments
- Promote food service guidelines
- Increase breastfeeding support

The program focuses on increasing physical activity, reducing obesity, and reducing health disparities, including, but not limited to, those related to race/ethnicity, socioeconomic status, geography, sex, age, and disability [103].

In addition, other options utilizing potential stimulus funding from the federal government have been proposed, focusing on the treatment and prevention of childhood obesity. Projects that could provide immediate economic stimulus and also act as part of a long-term public health strategy for reducing childhood obesity include [21]:

### Improving Food Quality

- Provide loans/grants to revitalize family farming
- Establish local farm-to-community (and school) food distribution systems
- Build community produce gardens
- Build fully functional school kitchens (equipped for more than microwaving or deep-frying food)

### Promoting a Physically Active Lifestyle

- Build sidewalks (where lacking), pedestrian paths, and car-free urban zones
- Build bike paths and lanes (protected from car traffic), and establish bicycle loan stations at convenient locations
- Build parks, sports facilities, swimming pools, and indoor recreational facilities
- Establish nature preserves with hiking trails
- Build integrated public transportation systems that support a healthful lifestyle by linking bike paths, recreational facilities, and community centers

**Comprehensive Approaches**

- Build/enhance community health centers to provide inexpensive, nutritious meals (including takeout), recreational facilities, and counseling/education (e.g., cooking classes) at one location
- Fund integrated, school- and community-based obesity prevention projects

The Child Health Insurance Program Reauthorization Act (CHIPRA) was enacted in early 2009 to increase children's health coverage through Medicaid expansion and the Children's Health Insurance Program (CHIP). The Act includes provisions and some funding to improve child healthcare quality, measure outcomes, and address childhood obesity. In many respects, this starts with the content and quality of primary and preventive health services for children. Having the right care is especially important from birth through 5 years of age, because these earliest years establish health trajectories that extend into adulthood [105]. Likewise, investment of substantial resources will be required to develop effective treatment approaches for normalizing or improving body weight and fitness in children and adolescents and to determine the long-term effects of weight loss on comorbidities of childhood obesity [103].

## WORLDWIDE EFFORTS

The WHO began spearheading a series of expert and technical consultations regarding childhood obesity in the 1990s. Public awareness campaigns were also initiated to sensitize policy-makers, private sector partners, healthcare professionals, and the public at large [2]. Because obesity is predominantly a "social and environmental disease," the WHO is helping to develop strategies that will make healthy choices easier to make. In collaboration with the University of Sydney, Australia, the WHO is calculating the worldwide economic impact of overweight and obesity. It is also working with the University of Auckland, New Zealand, to analyze the impact of globalization and rapid socioeconomic transition on nutrition and to identify the main political, socioeconomic, cultural, and physiologic factors that promote obesogenic environments [109].

Curbing the childhood obesity epidemic requires sustained political commitment and the collaboration of many public and private stakeholders. Governments, international partners, civil society, and the private sector have vital roles to play in shaping healthy environments and making healthier diet options for children and adolescents affordable and easily accessible [109]. Therefore, the WHO's objective is to mobilize these partners and engage them in implementing the Global Strategy on Diet, Physical Activity, and Health (DPAS). The WHO has demonstrated increased support for the designation, implementation, monitoring, and leadership of these actions. The Global Strategy has four main objectives [109]:

- Reduce risk factors for chronic diseases that stem from unhealthy diets and physical inactivity through public health actions
- Increase awareness and understanding of the influences of diet and physical activity on health and the positive impact of preventive interventions
- Develop, strengthen, and implement global, regional, and national policies and action plans to improve diets and increase physical activity that are sustainable, comprehensive, and actively engage all sectors
- Monitor science and promote research on diet and physical activity

## CASE STUDIES

### CASE STUDY 1

Patient T is a newborn boy. At birth he is 20 inches in length and weighs 10 pounds 4 ounces. Everyone who meets Patient T comments on how beautiful he is and how healthy, big, and strong he looks. His mother revels in the comments and expresses pride in her new baby boy.

During Patient T's early childhood, he maintains a weight in the 95th percentile and a height in the 75th percentile on the growth charts. He is a playful, active child with a love for a variety of foods, including apples, pears, bananas, ham sandwiches, potato chips, and pizza. Although the patient's weight is in the 95th percentile, his pediatrician feels he is developing well and does not want to raise any red flags at this point. He does caution Patient T's mother to be attentive to his caloric intake and to ensure that he remains active. The patient's mother is taken aback and a bit offended at the insinuation that her son is "chubby."

Patient T continues to grow and experience a normal childhood, but he is considered a hefty boy when he enters kindergarten. He is quiet and shy at school and soon finds it difficult to make friends. As he continues through elementary school, he becomes the object of taunting from his classmates due to his physical appearance and submissive nature. His grades begin to decline, and he begins to spend more time watching television and playing video games. Snacking on potato chips and soda becomes a source of comfort for Patient T; soon he is consuming eight cans of soda every day. The patient's parents have become concerned but are reassured by family members who attribute the weight gain to a phase or a growth spurt. They are sure that Patient T will grow up big and strong like his father, who is 6 feet tall and 350 pounds.

As a result of Patient T's decreased activity level, his weight continues to increase. By 12 years of age, he is even more withdrawn from social activities and mainly retreats to his virtual world of video games.

In high school, Patient T starts playing football as a defensive lineman. His performances are worthy of college scouts, and there is talk of scholarships. His parents are thrilled that he is finally fitting in and finding acceptance. As a result, Patient T's grades improve and he enjoys an active social life. During his senior year, Patient T is offered a scholarship to play football at a Division I college. When he leaves for college, he is 6 feet 5 inches tall and weighs 315 pounds.

In his second year of college, Patient T hyperextends his knee and tears his meniscus during the homecoming game. The resulting damage ends his football career. He remains focused on his studies, but alcohol and parties become an alternative to the hours previously spent conditioning in the weight room. Beer, buffalo chicken wings, nachos, and pizza become staples in his diet.

At his college graduation, Patient T weighs 400 pounds. He is hired by a large manufacturing firm as an accountant. He is 24 years of age and is looking toward his future.

One year later, Patient T meets some friends after work to play a game of basketball. His knee is still weak, and his weight, still nearly 400 pounds, slows him significantly. However, Patient T remembers the years he spent as a withdrawn child and does not want to revert back to being lonely and unsocial; he is going to play the best he can.

An hour into the game, Patient T feels a strange sensation in his jaw and a sharp pain down his left arm. He is sweating profusely and becomes dizzy. He describes the sensation as an elephant sitting on his chest. His friends call emergency medical services, and Patient T is taken to the hospital. His electro-

cardiogram (EKG) reveals ST segment elevation, indicative of a myocardial infarction. He is admitted to the hospital and undergoes cardiac catheterization and angioplasty. Further testing reveals type 2 diabetes, hyperlipidemia, hypertension, and mild kidney disease.

Despite the seriousness of his condition, Patient T takes the news in stride. He reasons that because he is still young, only 25 years of age, he has plenty of time to make the needed changes. Over the next five years, Patient T does not monitor his blood glucose levels or diet and exercises as time allows. He is started on insulin after six years, although he is resistant to this change. He often misses doses, particularly when he is out with his friends. He has also tried to better monitor his diet, but finds this difficult at restaurants and social events.

After missing two appointments, Patient T returns to his physician's office in order to renew his prescriptions. At this visit, Patient T's A1C is 10.5%, his weight has increased 6 pounds, and his cholesterol is at its highest level ever. Most seriously, however, is the discovery of the early stages of renal failure. Patient T takes the news to heart and makes changes to improve his renal status, but these changes only last a few weeks before he falls back into his old patterns. Weakened by blockages and years of hyperlipidemia, Patient T suffers a mild myocardial infarction the week before his 34th birthday. He is rushed to the hospital for a cardiac catheterization and another angioplasty. Although he recovers from the infarction, the damage to his kidneys is great. With his blood urea nitrogen (BUN) test and creatinine levels dangerously high, Patient T is started on hemodialysis three days a week.

The next five years are spent on this dialysis schedule. Patient T is unable to maintain his job as an accountant and applies for and receives Medicare and Medicaid services. During this time, the patient develops a vascular wound on his left lower extremity that requires a home health nurse to visit twice daily for dressing changes. To complicate matters more, Patient T has begun to show signs of diabetic retinopathy. The patient passes away at 42 years of age as a result of massive myocardial infarction. At the time of his passing, he is blind, on dialysis, and has a chronic open wound. His premature death is a consequence of years of obesity and obesity-related complications that started in the patient's childhood.

**CASE STUDY 2**

Patient E is 15 years of age, 5 feet 10 inches tall, and weighs 370 pounds. He has been overweight his entire life; at 8 years of age he was 4 feet 7 inches tall and weighed 210 pounds. He is currently being home schooled for several reasons, including severe arthritis of the bilateral knees, obstructive sleep apnea leading to severe fatigue, type 2 diabetes requiring four injections of insulin per day, and a history of being bullied. When asked about his quality of life, Patient E states he feels like an old man due to his many health issues and feels like he is existing in the world rather than living in it.

The patient's monthly medical bills average $856 for medications, continuous positive airway pressure (CPAP) machine rental, and physician co-payments. His internal medicine physician introduces the possibility of gastric bypass surgery and explores Patient E's thoughts and feelings regarding the procedure. The patient and his parents agree to talk with a surgeon and explore the possibility further. The thought of regaining a productive life, preventing any further chronic illnesses, and possibly reducing or eliminating some of the diseases that have plagued his young life is intriguing. After a psychiatric evaluation and thorough medical evaluation, Patient E is cleared for gastric bypass surgery. He is scheduled for the procedure at a center with a multidisciplinary team experienced in treating obese adolescents.

Immediately following surgery, Patient E has had a reduction in his insulin requirements and a decrease in his appetite. At his one-month post-surgical evaluation, his weight has decreased 25 pounds and he has discontinued his insulin. He continues to need his CPAP machine at night for his obstructive sleep apnea but feels optimistic about his future for the first time. At his six-month follow-up, Patient E has lost 65 pounds and no longer requires antiglycemic agents of any kind. His knee pain is resolving as his weight decreases, and he reports going to a movie with his cousin for the first time in his adolescence.

After one year, Patient E weighs 260 pounds and no longer utilizes his CPAP machine. His A1C is 6.2% without medications. He is able to exercise without pain or shortness of breath, and he is contemplating attending his local high school the next year. The patient's medical bills are now approximately $150 per month. He has met a girl through his cousin and is actively dating. He is happy and states he is now living in the world instead of watching it go by. For Patient E, gastric bypass appears to have been successful, although he will continue to be monitored for long-term effects and complications.

**CASE STUDY 3**

Patient M is born in Tucson, Arizona, the daughter of second-generation immigrants from Mexico. Her mother did not receive any prenatal care, although she was overweight prior to conception and has a strong family history of diabetes, hypertension, and heart disease. When born, Patient M weighs 10 pounds 6 ounces and is 20 inches in length. Everyone in the family and community admires the infant and comments on how beautiful and healthy she is. Her precious, cherub-like features, specifically her round cheeks, are declared "perfect" and "the picture of health."

*Patient M has many risk factors for obesity, even in her infancy. There is a greater rate of childhood overweight and obesity in Hispanic families, and obese parents impose a great risk that their children will be overweight. Because Patient M had a greater than average weight at birth, it is possible that her mother had gestational diabetes. A prenatal exposure to a sugar-rich environment caused by maternal diabetes can predispose a child to overweight/obesity. Although Patient M was a larger than average infant, the Hispanic view of overweight is generally one of health and strength and is not associated with that of disease or illness.*

During Patient M's early childhood, her weight is maintained in the 95th percentile and her height is in the 70th percentile on the growth charts. She is playful and rambunctious, often playing with her two older brothers outside all day. As a child, the patient's favorite foods are rice and beans and fresh fruits. As is common in their Hispanic community, Patient M admires and looks up to her brothers and wants to mimic them. As a result, she develops a taste for American foods, including potato chips, nachos, soda, and pizza.

*For children, the diagnosis of overweight or obesity is determined with the use of growth charts that give percentages of height, weight, and/or BMI. The CDC's BMI growth charts can be utilized clinically beginning at 2 years of age. Obesity in any individual is the end result of an imbalance between food taken in and energy expended, but the underlying causes are greater in complexity. Children observe the behaviors and preferences of others around them influencing the future of food selection, especially when the role model is perceived as being powerful.*

Although her weight is in the 95th percentile, Patient M's pediatrician is not alarmed because of the amount of outside playtime she receives. When the pediatrician stresses the importance of monitoring the child's weight and physical activity, Patient M's mother thinks it is absurd for an American physician to understand the genetics of a Hispanic person and what is healthy for her daughter.

Patient M continues to grow and experience a normal childhood but is considered overweight when she enters kindergarten. There are a few of the other boys and girls in the classroom who are overweight, which reassures her mother that she is fine and there is nothing to worry about. Patient M is a confident girl, ready to play tough with the boys and join the other girls in playing house. She especially likes to be the cook in the pretend kitchen making all of her favorite foods. At recess, everyone wants Patient M to "make" them a snack.

Before Patient M starts the fifth grade, her father is transferred and the family moves to Miami, Florida. The first few weeks are difficult. She misses her extended family, and life in a big city is different. On the first day of school, Patient M is apprehensive for the first time in her life. When she arrives she notices many of the girls are very thin.

As the school year progresses, Patient M begins to feel self-conscious about her weight for the first time. Eventually, she is able to start making friends and is invited to a beach party. Although Patient M expresses fear of going to a party in a bathing suit, her mother encourages her to embrace her curves.

At the party, some of the boys are joking and teasing the girls, comparing them to different animals. When they compare Patient M to a manatee, she is devastated. Although she holds her head up high and stands up for herself, she is deeply hurt.

*Obese children and adolescents become targets of early and systemic social discrimination. The psychologic stress of social stigmatization can cause low self-esteem, which in turn can alter academic and social functioning and potentially persist into adulthood.*

The next three years are a series of learning experiences for Patient M. Although she has made some good, close friends, the sting of the teasing still penetrates her memory. When the time comes for the end-of-eighth-grade semi-formal dance, all of her friends have dates and Patient M feels left out. Her father reassures her and tells her that the boys just do not realize how special she is yet. Still, Patient M feels less attractive than other girls. One day, her mother sees her examining and critiquing her body in the mirror. When questioned, Patient M says she is fat and starts crying. Devastated, Patient M's mother realizes that her confident daughter is fading away and a change is necessary.

After speaking to a dietitian, Patient M's mother starts to supplement their regular diet with fresh vegetables and to provide fresh fruits for dessert and snacking. She encourages Patient M to find an activity to occupy some of her free time during the summer vacation. Her brothers go to karate class on Tuesdays and Thursdays, and Patient M's father encourages her to join them and start taking karate lessons. She finds she enjoys the precision and strength of karate immensely. Her self-esteem and confidence start to return, and she is laughing and joking more.

*Obesity in any individual is the end result of an imbalance between food taken in and energy expended, but the underlying causes are greater in complexity. Diets are more likely to succeed if individualized according to eating patterns, cultural concerns, degree of motivation, intellect, amount of family support, and financial considerations.*

At the end of the summer, Patient M finds that her school uniforms are too big. Her parents are glad to see how much happier and healthier she seems. Although some of the dietary changes have affected the whole family, Patient M's father has found it difficult to give up some of his favorite comfort foods. Seeing the difference in his daughter, he makes a commitment to try to change his diet and become more active. It is a joyful time for Patient M and her family.

Two months later, Patient M's father falls unconscious and is taken to the emergency department. After undergoing several tests, including a computed tomography scan, he is diagnosed with a cerebral vascular accident. The physician tells the family that Patient M's father has a high blood glucose level and that the stroke may have been caused by long-term uncontrolled type 2 diabetes. When Patient M first visits her father in the hospital, she barely recognizes him. He has a ventilator tube, intravenous lines, and a heart monitor. As a result of the stroke, her father is paralyzed on his right side and is unable to speak. Although he regains consciousness, the paralysis will most likely be permanent and he will be unable to work. Eventually, her father is discharged to a rehabilitation center for therapy.

Needing an income to pay for growing medical expenses, Patient M's mother obtains a job as a legal secretary. With both of her brothers in college and her mother working full-time and caring for her father, Patient M spends an increasing amount of time alone. Most meals come from one of the many fast-food establishments near their home. With the financial difficulties, she also has to stop karate lessons. Patient M feels alone and abandoned; the only place she finds solace is in food. By the end of the school year, Patient M weighs 230 pounds and is 5 feet 3 inches tall. Her grades start to decline, and she finds herself spending more time watching television or on the Internet.

The summer prior to her senior year of high school, Patient M and her friends take a trip to the Florida Keys to camp and snorkel for one week. Although she is hesitant, her mother encourages her to go for a change in scenery and relaxation. Although her friends have always been accepting of her and look past her obesity issues, Patient M is depressed at the image of herself in a bathing suit.

On the last day of the trip, Patient M wakes feeling tired and nauseous. She decides to stay at the camp and sleep while her friends go snorkeling one last time. Over the next two hours, the patient feels simultaneously anxious and fatigued while also experiencing an overwhelming sense of dread. When her friends return to camp and find her looking pale and shaky, they pack and return home in hopes she would start feeling better. When they arrive, Patient M's mother takes her directly to a local emergent center for evaluation. The results of the laboratory test completed at the center are:

- A1C: 9.1% (estimated average glucose: 214 mg/dL)
- Random blood glucose: 345 mg/dL
- Triglycerides: 277 mg/dL
- Low-density lipoprotein: 132 mg/dL
- High-density lipoprotein: 20 mg/dL
- Liver function: Within normal limits
- Renal function: Within normal limits

Patient M is hospitalized until her condition stabilizes. She is diagnosed with type 2 diabetes and is started on simvastatin and metformin. The physician also prescribes diet, exercise, and other lifestyle changes. This diagnosis compounds the patient's depression regarding the future. She can only think of her father, now a resident of a long-term care facility.

After she is diagnosed, Patient M attends education classes and meets with a dietitian to help her understand her disease and the changes she will need to make to control her diabetes and obesity. She has made her mind up to take whatever steps necessary to avoid the path her father has taken. Patient M becomes inspired by her new knowledge and by a television show focusing on adolescents working to control their weight. Starting back at karate class is frightening, but she perseveres and eventually is hired to work with young children just starting in the classes.

Within three months, Patient M's weight is down 15 pounds and her A1C has decreased to 7.5%. She continues to take metformin for her diabetes and simvastatin for hyperlipidemia management. Her goal is to be medication-free by 20 years of age. She exercises daily and has adopted a meal plan she is able to live with. Her long-term outlook is promising because of the decisions she has made and her determination not to face the same future as her father. She is being proactive, which over time should prevent many of the complications of childhood obesity.

## CONCLUSION

Childhood overweight and obesity are largely preventable. It is recognized that prevention is the most feasible option for curbing the childhood obesity epidemic, as current treatment practices are primarily aimed at bringing the problem under control rather than affecting a cure. The goal in fighting the childhood obesity epidemic is to achieve a balance that can be maintained throughout the individual's lifespan. Approaches that can help patients and the general public meet this include [109]:

- Increased consumption of fruit, vegetables, legumes, whole grains, and nuts
- Limited intake of total fats, particularly saturated fats and trans fats
- Decreased intake of sugar
- Increased level and frequency of physical activity (at least 60 minutes each day of regular, moderate- to vigorous-intensity developmentally appropriate activities)

Healthcare professionals, parents, and teachers should be aware of the risk for impaired health-related quality of life among obese children and adolescents in order to target interventions to improve present and future overall health [6].

**Implicit Bias in Health Care**

The role of implicit biases on healthcare outcomes has become a concern, as there is some evidence that implicit biases contribute to health disparities, professionals' attitudes toward and interactions with patients, quality of care, diagnoses, and treatment decisions. This may produce differences in help-seeking, diagnoses, and ultimately treatments and interventions. Implicit biases may also unwittingly produce professional behaviors, attitudes, and interactions that reduce patients' trust and comfort with their provider, leading to earlier termination of visits and/or reduced adherence and follow-up. Disadvantaged groups are marginalized in the healthcare system and vulnerable on multiple levels; health professionals' implicit biases can further exacerbate these existing disadvantages.

Interventions or strategies designed to reduce implicit bias may be categorized as change-based or control-based. Change-based interventions focus on reducing or changing cognitive associations underlying implicit biases. These interventions might include challenging stereotypes. Conversely, control-based interventions involve reducing the effects of the implicit bias on the individual's behaviors. These strategies include increasing awareness of biased thoughts and responses. The two types of interventions are not mutually exclusive and may be used synergistically.

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