LEARNING OUTCOME AND OBJECTIVES: Upon completion of this course, you will have increased your knowledge about obesity, including its prevalence, consequences, contributing factors, interventions, and approaches to prevention and treatment. Specific learning objectives to address potential knowledge gaps include:

- Describe the prevalence of overweight and obesity in U.S. adults, children, and adolescents.
- Examine the pathogenesis of overweight and obesity.
- Discuss the comorbidities and consequences of obesity.
- Explain the psychosocial effects of stigma and weight bias.
- Describe components of assessment for overweight or obesity.
- Summarize strategies for management and treatment of overweight and obesity in adults, children, and adolescents.
- Discuss considerations in caring for the bariatric patient.
- Outline ways to prevent overweight and obesity in adults, children, and adolescents.

INTRODUCTION

According to the World Health Organization (2018a) obesity has reached epidemic proportions around the globe, nearly tripling since 1975. Once considered a problem only in high-income countries, overweight and obesity are on the rise in low- and middle-income countries as well, particularly in urban settings. Worldwide there are more people who are obese than underweight,
and this is happening in every region except parts of sub-Saharan Africa and Asia, the poorest and least urbanized areas in the world.

The fundamental cause of overweight and obesity is an energy imbalance that results from consuming more calories and expending less energy. Around the world there has been an increase in the intake of energy-dense foods and a decrease in physical activity due to the increasingly sedentary nature of many types of work, changing modes of transportation, and increasing urbanization. These are often the result of environmental and societal changes associated with development and the lack of supportive policies in the areas of health, agriculture, transport, urban planning, environment, food processing, distribution, marketing, and education (WHO, 2018b). This global problem has profound social, economic, and health implications for individuals and communities.

Obesity is a complex, multifactorial disease scientifically shown to be brought on and sustained by many factors that are both within and beyond an individual’s control. But despite what we know, there remains a societal stigma against persons who are overweight or obese. This is, in part, attributable to ongoing public misperceptions about the causes of and solutions to obesity. Such solutions emphasize an individual-oriented responsibility while ignoring the powerful societal factors that have created the current obesogenic environment. Uniquely for a major disease that causes multiple pathologies, the prevailing perception of obesity is as a cost to healthcare and a burden on society, rather than its disabling and distressing effect on individuals. Indeed, there is controversy about whether or not the condition of overweight and obesity should even be given the label disease at all.

The American Medical Association (2013) classified obesity as a disease in 2013 after an overwhelming vote in favor and defined it as a state of excessive fat accumulation that presents a risk to health. Classifying obesity as a disease is the first step toward objectively assessing the factors that lead to it and working toward its prevention and treatment. Some have countered this by saying that obesity is a risk factor for disease but not a disease itself. By such reasoning, however, a condition such as hypertension should not be classified as a disease.

Arguments for why obesity is a disease and not merely an aesthetic issue are:

- It is associated with impaired body function and self-care.
- It results from dysfunction of a complex physiologic regulatory system, precipitated by multiple factors in our modern environment.
- It causes, exacerbates, or accelerates more than 160 comorbid conditions that arise as metabolic, structural, inflammatory, degenerate, neoplastic, or psychological complications of obesity and significantly affect quality of life or impair longevity. (Jain, 2018)

It is imperative, therefore, that healthcare professionals become educated about the multiple factors involved in the development of this condition and the complexity of providing individualized management of it in order to be prepared to have a positive impact on the physical
and psychological well-being of their patients who are challenged to overcome obesity (Puhl, 2016; Obesity Society, 2018).

**DEFINING OVERWEIGHT AND OBESITY**

The term *overweight* refers to increased body weight from fat, muscle, bone, water, or a combination of these factors in relation to height, which is then compared to a standard of acceptable weight. *Obesity* is defined by the Obesity Medicine Association (2018) as “a chronic, relapsing, multifactorial, neurobehavioral disease, wherein an increase in body fat promotes adipose tissue dysfunction and abnormal fat mass physical forces, resulting in adverse metabolic, biomechanical, and psychosocial health consequences.”

A common, inexpensive, albeit imperfect measure of obesity is the body mass index (BMI), a person’s weight (in kilograms) divided by the square of his or her height (in meters). A person with a BMI ≥25 kg/m² is considered overweight, ≥30 obese, and ≥40 severely (morbidly) obese (WHO, 2019a).

For example, a person who weighs 132 kg (291 pounds) and stands 1.83 meters tall (6 feet) has a BMI of 132 divided by 1.83², or 39.4 kg/m², which is considered obese.

**SCOPE OF THE PROBLEM**

**Globally**

World Health Organization (2018a) statistics from 2016 indicate that globally:

- More than 1.9 billion adults (ages 18 years and older) were overweight, and over 650 million of those adults were obese.
- 39% of men and 40% of women were overweight.
- About 13% of the world’s adult population (11% of men, 15% of women) were obese.
- Over 340 million children and adolescents ages 5 to 19 were overweight or obese.
- The prevalence of overweight and obesity among children and adolescents ages 5 to 19 rose from 4% in 1975 to just over 18% in 2016. This rise occurred similarly among both boys and girls.
- An estimated 41 million children under the age of 5 years were overweight or obese.
- In Africa, the number of overweight children under 5 increased by nearly 50% from 2000 to 2016.
- Nearly half of the children under 5 who were overweight or obese in 2016 lived in Asia.
In America

The prevalence of obesity in the United States remains higher than the Healthy People 2020 goals of 14.5% among youth and 30.5% among adults. Data from the National Health and Nutrition Examination Survey indicate the following prevalence figures for obesity in 2015–2016:

Of children:
- Ages 2 to 5, 13.9% were obese and nearly 2% were severely obese.
- Ages 6 to 11, 18.4% were obese and 5.2% were severely obese.
- Ages 12 to 19, 20.6% were obese and 7.7% were severely obese.

Of adults:
- Ages 20 to 39, 35.7% were obese and 7.8% were severely obese.
- Ages 40 to 59, 42.8% were obese and 8.5% were severely obese.
- Ages over 60, 41.0% were obese and 6.3% were severely obese.
- Ages 20 and older, 71.6% were classified as overweight.
(CDC, 2018a)

OBESITY PREVALENCE BY AGE AND GENDER

Among children, the prevalence of obesity and severe obesity increases generally with age. In 2015–2016:

- Boys were slightly more likely to be obese than girls.
- School-aged boys had a higher prevalence of obesity than preschool-aged boys.
- Adolescent girls had a higher prevalence of obesity than preschool-aged girls.

Among adults in 2015–2016:

- Of those age 20 and older, 41% of women were obese, compared with 37.9% of men.
(CDC, 2018a)

The latest Youth Risk Behavior Surveillance System data show that high schoolers who were male, black, Latino, and lesbian/gay/bisexual had particularly high levels of obesity in 2017. Male students who were Latino and male students who were gay or bisexual had the highest rates among these groups (CDC, 2018b).
OBESITY AMONG RACIAL AND ETHNIC GROUPS

The prevalence of overweight and obesity has increased among Americans of all ethnic and racial groups. Black and Latino populations of all ages, however, continue to have higher rates of obesity than white and Asian populations.

In 2017, the overall prevalence of obesity was higher among non-Hispanic black and Hispanic adults than among non-Hispanic white and non-Hispanic Asian adults. The same pattern was seen among youth.

Women had a higher prevalence of obesity than men among non-Hispanic black, non-Hispanic Asian, and Hispanic adults, but not among non-Hispanic white adults. Among youth, there was no significant difference in obesity prevalence between boys and girls of the same race and Hispanic origin (CDC, 2018a).

OBESITY PREVALENCE BY EDUCATION/SOCIOECONOMICS

The association between obesity and educational level or income is complex and differs by gender and race/ethnicity.

In 2017 the obesity prevalence decreased by level of education. Overall, men and women with college degrees had lower obesity prevalence compared with those with less education. Self-reported obesity rates among adults according to educational level were:

- Without a high school degree or equivalent, 35.6%
- High school graduates, 32.9%
- Some college, 31.9%
- College graduates, 22.7%

By race/ethnicity, the same obesity and education pattern was seen among non-Hispanic white, non-Hispanic black and Hispanic women, and non-Hispanic white men, although the differences were not all statistically significant. Among non-Hispanic black men, obesity prevalence increased with educational attainment, but again, the difference was not statistically significant.

Among non-Hispanic Asian women and men and Hispanic men, there were no differences in obesity prevalence by education level.

Obesity prevalence was lower among men in the lowest and highest income groups compared with the middle-income group. This same pattern was evident among non-Hispanic white and Hispanic men. Obesity prevalence was higher in the highest income group than in the lowest income group among non-Hispanic black men.

Among women, obesity prevalence was lower in the highest income group than in the middle- and lowest-income groups. This pattern was seen among non-Hispanic white, non-Hispanic
Asian, and Hispanic women. Among non-Hispanic black women, there was no difference in obesity prevalence by income (CDC, 2018a).

GEOGRAPHIC DISPARITIES

Obesity prevalence varies across states and territories. Regionally, the South (32.4%) and the Midwest (32.3%) had the highest prevalence of adult obesity, followed by the Northwest (27.7%).
The states with the highest rates of obesity for 10- to 17-year-olds were:

- Mississippi (26.1%)
- West Virginia (20.3%)
- Kentucky (19.3%)

The states with the lowest rates of obesity for 10- to 17-year-olds were:

- Utah (8.7%)
- New Hampshire (9.8%)
- Washington (10.1%)
  (CDC, 2018a)

The latest data for children ages 2 to 4 years of age show that the state with the highest obesity prevalence is Virginia (20.0%) and the lowest is Utah (8.2%) (CDC, 2018c).

**Economic Impact**

A recent report shows that the annual costs and the economic impact of obesity in the United States exceed $1.4 trillion. This includes costs associated with obesity treatment and obesity-
related conditions as well as costs associated with attendance and productivity at work as they relate to obesity. Of this total:

- $150 billion: Annual cost of healthcare related to obesity
- $1 billion: Annual cost of healthcare and lost productivity among obese military service members and their families
- $8 billion: Average related costs due to severe obesity for state Medicaid programs, ranging from a low of $4 million in Wyoming to a high of $1.3 billion in California
- $6.3 billion: Indirect costs associated with absenteeism attributable to obesity (COPC, 2018)

Children covered by Medicaid are almost six times more likely to be treated for a diagnosis of obesity than children covered by private insurance. Annual health costs for childhood obesity and related conditions among Medicaid beneficiaries are about 80% higher than the costs for privately insured children. Annual healthcare costs are about $6,700 for children treated for obesity covered by Medicaid and about $3,700 for obese children with private insurance, which can be attributed to the fact that children on Medicaid who are obese are less likely to visit a doctor and more likely to enter a hospital than comparable children with private insurance (Maul & Chazin, 2015).

The National League of Cities reports that childhood obesity alone is responsible for $14 billion in direct medical costs, and in the 10 cities with the highest obesity rates, the direct costs connected with obesity and obesity-related diseases are roughly $50 million per 100,000 residents. These costs are expected to rise significantly, as today’s obese children are likely to become tomorrow’s obese adults. In addition to growing healthcare costs attributed to obesity, the nation can expect to incur higher costs for disability and unemployment benefits (NLC, 2018).

**PATHOGENESIS OF OBESITY**

Obesity pathogenesis involves two related but distinct processes: 1) sustained positive energy balance (energy intake greater than energy expenditure), and 2) resetting of the body-weight set point at an increased value. The latter process explains why weight lost through changes of diet and/or lifestyle tends to be regained over time, a major obstacle to effective obesity treatment. How the increased body weight comes to be biologically defended remains uncertain, although ongoing research is beginning to throw some light on the underlying mechanisms (Schwartz, 2017).

Humans have what is referred to as evolutionary physiology, which means they are predisposed to conserve body fat as important for survival. In our current environment, there is easy access to an abundance of calories, and a large segment of the human species appears to be biologically predisposed to gain excessive weight.
Studies have shown that individuals who are obese and individuals who are not both appear to use the same homeostatic mechanisms to defend different levels of body-fat mass. This suggests there is a dysfunction of the energy homeostasis system that is necessary for the biological defense of elevated body weight in individuals who are obese. It remains unclear as to how this dysfunction is linked to factors that enable excess weight gain (Hamdy et al., 2018; Schwartz et al., 2017).

**Genetics**

Twin and adoptee studies have demonstrated the strong heritability of obesity. Metabolic rate, physical activity, and thermic response to food seem to be inherited to a certain degree. The percentage of obesity that can be attributed to genetics varies from 6% to 85% depending on the population examined. Even though there have been decades of molecular genetic investigation, a very small fraction of genes associated with obesity have been identified (Proença da Fonseca et al., 2017).

Genes provide instructions to cells on how to make important proteins—complex molecules that trigger various biological actions. A gene mutation is a permanent alteration in the DNA sequences that make up a gene so that the sequence differs from what is found in most people. Hereditary mutations are those passed down from a parent and are present throughout the person’s life in every cell in the body.

**Genetic disorders** of obesity are different from common obesity. They are characterized by early-onset, severe obesity and often are associated with hyperphagia (insatiable hunger). Each disorder appears to have a unique phenotype, but most patients present with rapid weight gain early in childhood and present with a BMI greater than the 95th percentile for their age. Onset is usually between 2 and 5 years of age, although some cases show onset as early as 6 months or as late as prepubescence.

- Genetic defects in the **POMC** gene cause deficient signals involving a wide range of processes, including regulation of body weight, adrenal steroidogenesis, and hair pigment.

- The **MCR4** gene is expressed in the neurons of the hypothalamus and is essential for regulation of appetite and energy expenditures. The data implies that an estimated 5% of children who are severely obese have MCR4 or POMC mutations.

- Any mutations in the **LEP** gene have an adverse effect on the energy regulation pathway, leading to severe, early-onset obesity. Leptin is a protein that acts on the hypothalamic regions of the brain (which control eating behavior) and that plays a critical role in the regulation of body weight by inhibiting food intake and stimulating energy expenditures. Leptin gene mutations causing leptin deficiency have been found to be the cause of obesity in rare instances. It is accompanied by metabolic, neuroendocrine, and immune dysfunction, and is extremely sensitive to injections of leptin, which reduce dietary intake and result in profound weight loss.
• Loss-of-function mutation in the **SIM1** gene causes early-onset obesity and developmental delay.

• Mutation in the **SNRPN** gene causes Prader-Willi syndrome, a rare genetic condition caused by deletion of paternal DNA that affects the endocrine and neurological systems, metabolism, and behavior. Affected infants have poor muscle tone and feed poorly at birth. Later they develop abnormal behavioral and developmental problems, have extreme difficulty controlling body weight, and have a powerful compulsion to eat large quantities of food. It is the most common genetic cause of morbid obesity in children.

• Mutation in the **PC1** gene causes alterations in an enzyme critical in protein processing. Individuals with this rare mutation and resultant alterations in this enzyme have obesity (one of the few types of obesity that is not associated with insulin resistance), hypogonadotropic hypogonadism (little or no sex hormone production due to a problem with the pituitary gland or hypothalamus), and central adrenal insufficiency as a result of low ACTH.

• The **PARG** gene encodes a protein that is a regulator of adipocyte differentiation. Adipocytes are cells found in connective tissue that are specialized for storage of fat. PPARG plays a pivotal role in adipogenesis, inflammatory response, and cell differentiation. All persons with this mutation described so far have had severe obesity (Hamdy et al., 2018, Schwartz et al., 2017).

• The **ADIPOQ** gene encodes the hormone adiponectin, which is produced exclusively in adipose tissue and released into plasma for distribution. Its receptors are mainly found in the liver and skeletal muscle. Adiponectin modulates sugar and fat metabolism by increasing insulin sensitivity and fatty acid breakdown.

• The **FTO** gene has been connected with obesity in children and adults of different ethnicities. In addition, it has been associated with increased BMI and related anthropometric measures, caloric intake, and compulsive hyperphagia behavior.

• Alström syndrome 1 is a disorder caused by mutations in the **ALMS1** gene. In addition to severe obesity beginning in early life, the disorder results in short stature in adulthood, progressive visual and auditory impairment, insulin resistance, type 2 diabetes, hyperlipidemia, and progressive kidney dysfunction.

• More than 150 different mutations in the **COH1** gene cause Cohen syndrome, also known as Pepper syndrome. It is a rare disorder that affects motor skills, mental development, and behavior. Beginning in late childhood, the child begins to put on weight in the torso and without intervention becomes obese. The arms and legs, however, remain slender.

• Mutations in the **PNPLA6** gene cause Laurence-Moon syndrome, which results in webbed fingers, extra fingers, intellectual disability, and obesity.
Pathogenic mutations in any of the 19 BBS genes are known to cause Bardet-Biedl syndrome, which affects many body systems. It is characterized chiefly by obesity, vision loss, extra fingers or toes, intellectual disability, and abnormalities of the genitalia. (Perreault, 2018a; Kohlsdorf et al., 2018)

Epigenetics

Epigenetics affects how genes are read by cells and subsequently how they produce proteins. Epigenetics is the study of gene expression, the switching on and off of gene action without causing a mutation (a change in the genetic code, or DNA). Gene expression signals the cells in the body on how and when to differentiate, a process through which a cell changes to become a more specialized type of cell. When gene expression is altered—for example, by exposure to certain chemicals, radiation, or dietary nutrients—abnormal development of cells, organs, and systems can occur.

Environmental epigenetics looks at how chemicals or other environmental exposures can interfere with gene expression and thereby disrupt development. Currently there are wide gaps in knowledge regarding how human epigenetic changes are related to obesity, and evidence of the role of epigenetics in obesity comes mainly from animal models (Lima et al., 2017).

Chemical Obesogens

An obesogen is an exogenous chemical substance that alters lipid homeostasis and fat storage, changes metabolic setpoints, disrupts energy balance, or modifies the regulation of appetite and satiety, promoting fat accumulation and obesity (Janesick & Blumberg, 2016).

Obesogens are classified as endocrine disruptors (EDCs) or metabolic disruptors (MDCs). They are chemicals found in a wide variety of consumer products, and exposures are often widespread. The National Institute of Environmental Health Sciences (2018) reports there are more than 80,000 chemicals registered for use in the United States, some of which are toxic to animals and humans and some that interfere with how the body’s hormones function.

Of particular importance is the evidence that the critical window of exposure to these chemicals is either during the prenatal or neonatal period, when the body’s weight control mechanisms are being developed, which can induce effects that manifest later in life.

Obesogens are believed to work in several different ways. They may alter how a person’s fat cells develop by increasing fat storage capacity or increasing the number of fat cells. Obesogens may make it more difficult to maintain a healthy weight by altering hormonal control of appetite and satiety or by increasing the effects of high-fat and high-sugar diets. Obesogens can also act indirectly to promote obesity by altering basal metabolic rate and altering gut microbiota to promote food storage.
OBESOGENIC EXPOSURE AND ANIMALS

The obesity epidemic is not limited to humans but has also been observed as upward trends in body weight among primates and rodents living in research colonies as well as among feral rodents, horses, domestic dogs and cats, and aquatic animals as a result of exposure to the same obesogenic chemicals that humans are exposed to (NIEHS, 2018; Capitão et al, 2017).

Chemicals that are classified as obesogens include:

- **Cigarette smoke** (nicotine, polycyclic aromatic hydrocarbons [PAHs], acrylamide)

- **Outdoor pollution**:
  - Byproducts of fossil fuel burning, including diesel exhaust
  - Noxious gases (sulfur dioxide, nitrogen oxides, carbon monoxide, chemical vapors, diesel exhaust, etc.)
  - Ground-level ozone (a highly reactive form of oxygen and a primary component of urban smog)

- **Tributlylin (TBT)** is a chemical widely used as a fungicide and heat stabilizer in polyvinyl chloride (PVC) piping. Placental TBT has been found to be associated with a trend toward higher weight gain, but only in the first three months of life. Prenatal exposure to TBT results in increased lipid accumulation, increased adipose tissue mass, and reduced muscle mass.

- **Flame retardants**. There are hundreds of different flame retardants, which are grouped based on whether they contain bromine, chlorine, phosphorus, nitrogen, metals, or boron. Many flame retardants have been removed from the market or are no longer produced, but they do not break down easily and can remain persistent in the environment for years. They can also bioaccumulate (build up in people and animals over time).

- **Phthalates** are a broad class of chemicals that are added to many consumer products to make them softer and promote flexibility, such as in tubing and vinyl flooring. Fragrances and a variety of household and personal care products as well as food packaging also contain phthalates.

- **Bisphenol A (BPA)** is produced in large quantities and used primarily in the production of polycarbonate plastics and epoxy resins. They are included in some food and drink packaging, such as water and infant bottles and coated metal products (food cans, bottle tops, and water supply pipes), and are used as a developer in cash register receipts. They are also used in some dental sealants and composites.

- **Pesticides** include herbicides, insecticides, fungicides, disinfectants, and compounds used to control mice and rats (NIEHS, 2018; Heindel et al., 2017).
• **Polychlorinated biphenyls (PCBs)** are industrial chemicals used widely in the past in products such as paints, cements, fluorescent light ballasts, sealants, and adhesives. They were banned in 1970 but are still present in the air, water, soil, homes, communities, and bodies since they do not break down easily (Fox-Rawlings, 2018). The National Center for Health Research (2018) reports that although it is illegal to purposely make PCBs, some continue to be produced in the process of making pigments (e.g., for paints, inks, cosmetics, etc.).

• **Perfluorooctanoic acid (PFOA)**, found in microwave popcorn bags, nonstick cookware, and stain-resistant fabrics, is suspected to increase insulin and leptin, causing increased appetite and fat production (Pingping et al., 2018).

**Endocrine Diseases**

Obesity is associated with several endocrine diseases, including:

- Hypothyroidism
- Laurence-Moon syndrome
- Prader-Willi syndrome
- Polycystic ovarian syndrome
- Cushing’s syndrome
- Central hypothyroidism
- Hypothalamic disorders
- Growth hormone deficiency
- Pseudohypoparathyroidism (Schwartz et al., 2017)

The mechanisms for the development of obesity vary in accordance with the endocrine condition. Hypothyroidism, for example, involves an accumulation of fluid-retaining hyaluronic acid and is associated with changes in body weight and composition, body temperature, energy expenditure, food intake, and glucose and lipids metabolism.

The pathophysiology of obesity associated with polycystic ovarian syndrome remains complex, as obesity itself may simultaneously be the cause of the syndrome.

In Cushing’s syndrome, an interaction with thyroid and growth hormone plays an important role in addition to increased adipocyte differentiation and adipogenesis. Increased levels of cortisol lead to a build-up of fat in characteristic sites such as the face, upper back, and abdomen (Sidhu et al., 2017).
Hypothalamic Obesity

Hypothalamic obesity is a rare syndrome caused by damage to the ventromedial or paraventricular region of the hypothalamus or the amygdala as a result of trauma, tumor, inflammatory disease, surgery in the posterior fossa, or increased intracranial pressure. These regions of the brain are responsible for the integration of metabolic information concerning nutrient stores with afferent sensory information about food availability. When this area is damaged, hyperphagia develops and obesity follows (Perreault, 2018a).

Inflammation and Infection

There is data suggesting that an inflammatory, and possibly infective, cause may exist for obesity. The adipose tissue is known to be a storage place for various cytokines, especially interleukin 6 (IL6) and tumor necrosis factor (TNF). Chronic exposure to elevated IL6 is associated with the development of insulin resistance, metabolic syndrome, and type 2 diabetes.

A high-normal level of procalcitonin (PCT) reflects a state of inflammation and has been shown to be associated with central obesity but not with insulin resistance in obese patients.

Adenovirus-36 infection is associated with obesity in animal studies and in humans. The prevalence of this infection is 20% to 30% in people who are obese vs. 5% in people who are not. The role of infection in the pathogenesis of obesity, however, remains unclear (Hamdy et al., 2018).

Stress

Research has shown that stress response may play a major role in the development and maintenance of obesity due to increased glucocorticoid exposure. There are many pathways that connect stress and obesity:

- Stress interferes with cognitive processes such as self-regulation abilities to control food intake.
- Stress can affect behavior by:
  - Inducing overeating and consumption of foods that are high in calories, fat, or sugar
  - Decreasing physical activity
  - Shortening sleep
- Stress triggers physiological changes in the hypothalamic-pituitary-adrenal axis, reward processing in the brain, and possibly the gut microbiota.
- Stress can stimulate production of biochemical hormones and peptides such as leptin, ghrelin, and neuropeptide Y, all of which are involved in regulating food intake. (Tomiyama, 2018)
Gut Microbiota

The human gastrointestinal tract is populated densely with bacteria, fungi, archaea, and viruses, collectively referred to as gut microbiota. These microorganisms are important for body homeostasis. Because acids in the stomach and bile acids and pancreatic juice in the duodenum and jejunum can inhibit the growth of microorganisms, most inhabit the large intestine. Each person acquires their own unique microbiota, which is influenced by such factors as the type of delivery, breastfeeding, age, use of antibiotics, and diet—dietary habits being the main contributors to the diversity of the human gut microbiota.

Endogenous microbiota can impact body immune response and metabolic homeostasis. Certain gut microbial strains have been shown to inhibit or attenuate immune responses related to chronic inflammation in experimental models, suggesting that specific species may play either a protective or pathogenic role in the progression of obesity. Obese patients have been found to have less diversity and richness in the bacterial component of their gut microbiota than normal-weight subjects and also show an increased ratio of Firmicutes/Bacteroidetes (the most common organisms in the fecal microbiota) regardless of dietary intake (Al-Assal et al., 2018).

Clinical trials currently are underway using fecal microbiota transplants, a relatively uncomplicated therapy that manipulates the human gastrointestinal microbiota by transferring healthy donor microbiota into an existing but disturbed microbial ecosystem (dysbiosis) (Kang & Cai, 2017).

Prenatal Factors

Intrauterine environment can shape the trajectory of weight gain and body fatness through the life course. Three prenatal factors are the mother’s smoking habits, weight gain, and blood sugar levels during pregnancy.

MATERNAL PRENATAL SMOKING

Maternal passive and active smoking during pregnancy (even when limited only to early pregnancy) slows the rate of fetal growth, and the children of women who smoke during pregnancy are more likely to be obese than the children of women who do not smoke. In a meta-analysis of 14 studies, maternal smoking during pregnancy was associated with a 50% higher risk of childhood obesity. These studies looked at obesity from ages 3 all the way to young adulthood. Maternal smoking during pregnancy is also associated with increased odds of gestational diabetes in adulthood (Harvard T.H. Chan, 2018a; Kataria et al., 2018).

MATERNAL WEIGHT

Increasing evidence implicates maternal obesity as a major determinant of health in offspring during childhood and later adult life. Both pre-pregnancy obesity and maternal weight gain during pregnancy play important roles in determining birth weight. Maternal obesity is a particular concern because nutritional excess and development in an obesogenic intrauterine environment may lead to permanent changes of fetal metabolic pathways and thereby increase...
the risk of childhood and adult diseases related to these pathways, such as obesity, diabetes, hypertension, and cardiovascular disease (Ramsey & Schenken, 2018).

MATERNAL BLOOD SUGAR LEVELS

Weight gained during pregnancy is primarily adipose (fat) tissue. Proliferation of adipose tissue is often accompanied by a state of relative insulin resistance starting in midpregnancy. This adaptive response allows for more efficient transfer of glucose and other fuels across the placenta so the fetus can grow. But it may also subject the fetus to periods of high blood glucose and elevated insulin, which can lead to increased body fat, generally manifested as larger size at birth. Maternal diabetes mellitus during pregnancy (gestational diabetes) is associated with an increased BMI in adult male offspring, independent of maternal BMI in early pregnancy (Klish, 2018).

Postnatal Factors

There are three postnatal factors during infancy that influence weight in later life. These include how rapidly an infant gains weight, how long an infant is breastfed, and how much an infant sleeps.

INFANT WEIGHT GAIN

Rapid weight gain during the first weeks or months of life is associated with higher BMI or obesity later in life. Review of studies of infant weight-gain patterns and later obesity risk showed 70% of the infants with more rapid early growth had a higher risk of later obesity than infants with normal growth (Harvard T.H. Chan, 2018a).

BREASTFEEDING

Breastfeeding initiation and duration may influence obesity in later life. In two meta-analyses of breastfeeding vs. bottle feeding, breastfeeding was associated with a 13% and a 22% reduced risk of obesity in later life. Another analysis of 17 studies of breastfeeding duration found that each additional month that infants were breastfed was associated with a 4% lower risk of obesity later in life. However, it is not clear that breastfeeding itself actually prevents obesity, as both breastfeeding and obesity may be influenced by similar socioeconomic and cultural factors (Harvard T.H. Chan, 2018a).

MODERN HISTORY OF BREASTFEEDING

Historically, breastfeeding in America has been heavily influenced by culture and the manufacture of formulas, which began at the turn of the century. Manufacturers promoted baby formulas and suggested that their use was an improved, modern way to feed babies. This commercialization and also the medicalization of infant care established an environment that encouraged bottle feeding as the best and most necessary way to feed infants. By 1950 more than half of the babies in the United States were fed some form of baby formula (Apple, 1987).
By the 1970s, however, years of research showed that breast milk was best, and the pendulum began to swing back toward breastfeeding. The American Academy of Pediatrics now recommends that infants be exclusively breastfed for about the first six months, with continued breastfeeding alongside the introduction of complementary foods for at least one year. Among infants born in 2015, 4 out of 5 mothers began breastfeeding at birth. Of these, over half were still breastfeeding at 6 months, and over one third were still breastfeeding at 12 months (CDC, 2018d).

INFANT SLEEP DURATION

It has been found that infants who slept fewer than 12 hours a day had double the odds of being overweight by the age of 3, compared with infants who slept more than 12 hours a day. Factors that were associated with shorter sleep duration included maternal depression during pregnancy, early introduction of solid foods (before 4 months), and television viewing from birth to 2 years (Harvard T.H. Chan, 2018a).

Ultra-Processed Foods

Recent research provides fairly consistent support for the association of ultra-processed food intake with obesity, and almost 60% of calories consumed in the United States come from ultra-processed foods (Baraldi et al., 2018). According to the NOVA classification system, ultra-processed foods are industrial formulations made entirely or mostly from substances extracted from foods (e.g., oils, fats, sugar, starch, and proteins); derived from food constituents (e.g., hydrogenated fats and modified starch); or synthesized in laboratories from food substrates or other organic sources (e.g., flavor enhancers, colors, and several food additives used to make the product hyperpalatable) (Ministry of Health of Brazil, 2015). They typically contain little or no intact foods and are ready to drink, eat, or heat up. Examples of ultra-processed foods include:

- Sodas and sweetened drinks
- Sweet or savory packaged snacks
- Confectionery and industrialized desserts
- Mass-produced packaged breads and buns
- Packaged meatballs
- Poultry and fish nuggets and other reconstituted meat products
- Meat products that contain preservatives other than salt
- Frozen or shelf-stable instant meals
- Instant noodles and soups

Additionally, there are many other ready-to-consume formulations of several different ingredients. Besides large amounts of salt, sugar, oils, and fats, these foods include substances.
not commonly used in food preparation, such as modified starches, hydrogenated oils, protein isolates, and classes of additives whose purpose is to imitate sensorial qualities of unprocessed or minimally processed foods and their cooking preparations or to disguise undesirable qualities of the final product. These additives include:

- Dyes
- Flavorings
- Nonsugar sweeteners
- Emulsifiers
- Humectants
- Sequestrants
- Firming agents
- Bulking agents
- Defoaming agents
- Anticaking agents
- Glazing agents

Unprocessed or minimally processed food represent a small proportion of, or are even absent from, the list of ingredients of ultra-processed foods (Poti et al., 2017).

As an example, in a home-made hamburger roll, there are normally six ingredients that are unprocessed or minimally processed: water, butter, flour, yeast, salt, and a bit of sugar. The following is a list of ingredients that make up the ultra-processed hamburger bun from a Big Mac sandwich, with a description of what they are and the purpose for their inclusion:

<table>
<thead>
<tr>
<th><strong>“BIG MAC” PROCESSED HAMBURGER BUN INGREDIENTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ingredient</strong></td>
</tr>
<tr>
<td>Unbleached wheat flour</td>
</tr>
<tr>
<td>Water</td>
</tr>
<tr>
<td>High fructose corn syrup</td>
</tr>
<tr>
<td>Yeast</td>
</tr>
<tr>
<td>Soybean oil</td>
</tr>
<tr>
<td>Salt</td>
</tr>
<tr>
<td>Wheat gluten</td>
</tr>
</tbody>
</table>
Calcium sulfate | Close relative of plaster of Paris or gypsum | Acidity regulator, flour stabilizer
Ammonium sulfate | From heated reaction of ammonia with sulfuric acid, plus nitrogen | Dough conditioner, surfactant, supplies nitrogen for yeast, promotes browning and shelf life
Sesame seeds | Nutty seed of the sesame plant | Adds flavor, texture, visual contrast

**May Contain One or More of the Following Chemical Compounds:**

<table>
<thead>
<tr>
<th>Sodium stearoyl lactylate</th>
<th>Combined lactic acid and stearic acid</th>
<th>Emulsifier, stabilizer and surfactant, dough strengthener, shelf life enhancer</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATEM</td>
<td><em>Diacetyl tartaric acid esters of monoglycerides</em></td>
<td>Dough conditioner, improves volume and uniformity</td>
</tr>
<tr>
<td>Ascorbic acid</td>
<td>Vitamin C</td>
<td>Improves volume, crumb softness; increases mold-free shelf life</td>
</tr>
<tr>
<td>Mono and diglycerides</td>
<td>From animal fats or vegetable oils, or synthetically made</td>
<td>Emulsifiers to improve volume and create soft crust</td>
</tr>
<tr>
<td>Monocalcium phosphate</td>
<td>Inorganic compound used as superphosphate fertilizer</td>
<td>Fast-acting leavening aid</td>
</tr>
<tr>
<td>Enzymes</td>
<td>Natural protein catalysts</td>
<td>Improve texture</td>
</tr>
<tr>
<td>Calcium peroxide</td>
<td>Combined calcium salts and hydrogen peroxide used to aid extraction of precious metals from ores</td>
<td>Strengthens gluten structure, preservative</td>
</tr>
<tr>
<td>Calcium propionate</td>
<td>Calcium salt of propionic acid from fermentation of corn meal mash</td>
<td>Preservative</td>
</tr>
</tbody>
</table>

Source: McDonald’s, 2018.

A large body of research supports the hypothesis that changes in intestinal flora, fed by the nutrients and substances in ultra-processed foods, may explain the link between these foods and obesity, the most important of which may be bacteria’s role in inflammation.

Gut bacteria adjust their metabolism according to both the substances produced by other microbes and the nutrient supply, which may produce effects that influence metabolic and inflammatory pathways in the human body. Both human and animal studies have demonstrated that pathogens, pathobionts, and other members of the microbiome can respond to a change in their environment (e.g., the presence of some emulsifiers) by increasing their expression of virulence factors, thereby increasing the proinflammatory potential of the microbiome. Inflammation makes the intestines more permeable, allowing both intestinal bacteria and toxins they produce to leak into the bloodstream.
Recent studies in rodents have demonstrated that the loss of microbiota diversity due to dietary changes can be transferred to later generations of the microbiota with progressive loss of diversity. Also, such a diet could lead to a permanent loss of bacteria important to microbiome function and possibly induce inheritable metabolic changes via the epigenome. Essentially, the environment created in the gut by ultra-processed foods could be an evolutionarily unique selection ground for microbes with behaviors that promote diverse forms of inflammation-related disease (Zinöcker & Lindseth, 2018; Aguayo-Patrón & Calderón de la Barca, 2017).

**Addictive Potential of Processed Foods**

One potential contributing factor to overweight and obesity is that certain foods may be capable of triggering an addictive response in some individuals, which may lead to unintended overeating. Human bodies are biologically “wired” to seek out high-fat, high-salt, and high-sugar foods. Sugar, salt, and fat have been so important in human evolution that brains respond to these nutrients by “rewarding” us with the release of endorphins and an increased desire for more. In combination, these nutrients act synergistically and are far more addictive than any one alone.

It has been proposed that processed food addiction in humans is much like caffeine or nicotine addiction. From an evolutionary viewpoint, addiction is a normal trait that permitted humans to survive primitive conditions when food was scarce. With cultural evolution, the neural circuits involved in addictive behaviors became dysfunctional, and instead of helping us survive, they are now compromising our health (Wiss et al., 2018).

**SALT**

The importance of salt to overall health may explain why salty foods are so tasty and “you can’t eat just one.” Sodium is essential and required for a range of general physiologic and cellular functions. Sodium appetite is an important instinctive behavior with high survival value. Although opioid stimulation in salt appetite has been identified in animals, the exact contribution made by different opioid receptor subtypes within specific brain regions is not fully understood.

It has been found that when salt is ingested, the central amygdala is activated, and the endogenous mu-opioid receptor signaling within this region promotes sodium intake. The reward results in craving more salt, resulting in the response of overeating (Smith et al., 2016).

**VEGETABLE OIL**

Plant-based vegetable oils, especially soybean oil, are heavily used in processed foods, margarines, salad dressings, and snacks. Of all the vegetable oils, soybean oil produces the most negative metabolic effects, and the omega-6 and omega-3 oxylipins have been implicated in soybean oil–induced obesity in mice (Deol et al., 2017).

Research has shown that the body utilizes these constituents in most vegetable oils to manufacture endocannabinoids, the same psychoactive compounds found in marijuana. Endocannabinoids play a key role in memory, mood, brain reward systems, drug addiction, and metabolic processes, such as the breakdown of fats into fatty acids and glycerol, glucose
metabolism, and energy balance. Cannabinoids interact with neurotransmitters in neural networks that control energy metabolism and feeding behavior. Endocannabinoid receptor activation increases food intake and also increases food odor detection in the olfactory bulb, which increases appetite (Koch, 2017).

**SUCROSE AND HIGH-FRUCTOSE CORN SYRUP**

Sucrose, broadly known as *granulated sugar*, comes from cane or beets. It is made up of two molecules: glucose and fructose. The glucose molecule provides fuel and suppresses the hunger hormone ghrelin, which stimulates leptin production. Leptin tells the brain that we are full and decreases appetite. Fructose is a sugar found naturally in fruit, honey, and fruit juice. Unlike sugar, fructose does not trigger satiating hormones. While glucose is metabolized in every cell in the body, the fructose molecule is only metabolized by the liver.

Fructose corn syrup adds unnatural amounts of fructose to the diet, which the human body has not evolved to handle well. Fructose does not stimulate insulin secretion or enhance leptin production like glucose does. It also converts to fat more readily than any other sugars. Fructose has no effect on the hunger hormone and can interfere with leptin levels, leading to overeating.

High-fructose corn syrup (HFCS) is a highly processed syrup sweetener derived from cornstarch, usually a combination of 55% fructose and 45% sucrose. The syrup is widely added to many kinds of processed foods, including soft drinks, breads and cereals, processed meats, dairy products, condiments and sauces, processed fruits and vegetables, crackers, candy, jam, and jellies.

HFCS increases appetite and contributes to diabetes, inflammation, and obesity. When sugar and HFCS are consumed to a specific threshold, the brain’s neurochemistry is altered. HFCS may affect central appetite regulation by altering specific components of the endocannabinoid system. By stimulating this hedonic pathway, habituation and possibly dependence is created (addiction). There is also recent evidence that shows a negative effect of free fructose consumption on cognitive function (Freeman et al., 2018).

**CASEIN**

Casein is a protein naturally found in milk and used in producing fast-food items, such as french fries, buns, milkshakes, creamy salad dressings, whipped toppings, and more. Over the last 30 years, casein has been used in foods to enhance physical properties such as whipping and thickening and to enhance nutritional value.

Casein contains opiates, and as it is digested, it breaks apart to release tiny opiate molecules called *casomorphins*. One of these compounds has about one tenth the opiate strength of morphine. The addicting power of cheese, for example, may be caused by adding calcium hydrogen phosphate to remove water, lactose, and whey products, which then concentrates casein. Because of the reward (casomorphins) received from eating products containing casein, overconsumption is encouraged, leading to an energy intake and use imbalance that contributes to overweight and obesity (PCRM, 2018).
PROCESSED FOODS CONTAINING CAFFEINE

The combination of sugar and caffeine in beverages raises the risk of being overweight. Children who drink one or more 12-ounce sweetened soft drink daily have a 60% higher chance of becoming obese. Young people consume the largest amounts of caffeinated sugar-sweetened beverages and have experienced the greatest relative gains in obesity. Evidence of the addictive properties of both caffeine and sugar have been documented. Withdrawal symptoms develop, including headache and decrease in motivation, contentment, ability to concentrate, and overall well-being, leading to increased cravings and greater consumption (Falbe et al., 2019).

Medications

Certain medications can cause individuals to gain weight. Medications that can affect the body’s metabolism, stimulate appetite, or alter how the body stores and absorbs sugars and other nutrients include:

- Drugs for diabetes (e.g., insulin, thiazolidinediones, sulfonylureas)
- Antipsychotic drugs (e.g., haloperidol, clozapine, lithium)
- Antidepressant drugs (e.g., amitriptyline, paroxetine, sertraline)
- Drugs for epilepsy (e.g., valproate, carbamazepine)
- Steroid hormone drugs (e.g., prednisone, birth control pills)
- Blood pressure–reducing drugs (e.g., beta-blockers)
  (URMC, 2018)

Decreased Physical Activity

Regular physical activity is a vital necessity for good health. Physical activity helps to reduce blood pressure; reduce risk for type 2 diabetes, heart attack, and stroke; relieve symptoms of depression and anxiety; and maintain a healthy weight.

Research has indicated that physical activity prevents obesity in the following ways:

- By increasing total energy expenditure, decreasing fat around the waist as well as total body fat, and slowing abdominal obesity development
- By building body mass through muscle-strengthening activities and thus increasing the energy the body burns even at rest
- By reducing depression and anxiety, which may boost motivation to stick with an exercise regimen
  (Harvard T.H. Chan, 2019a)
Physical activity refers to any body movement that burns calories, whether for play or for work. Exercise, a subcategory of physical activity, refers to planned, structured, and repetitive activities with the goal of improving physical fitness and health. Globally, people are less active than they were in the past. Physical activity associated with home, work, and transportation has declined because of economic growth, technological advancements, and social changes.

In the United States 60 to 70 years ago, 30% of Americans worked in high-activity occupations, but 50 years later that number declined to 22%. Over that time period, the percentage of people working in low-activity occupations increased from 23% to 41%. Driving cars increased from 67% of all trips to work in 1960 to 88% in 2000. About 40% of children walked or rode their bikes to school in the 1960s, and by 2001, only 13% did so (Harvard T.H. Chan, 2019a; SRTS Guide, 2019).

Recent statistics show that:

- 28% of Americans aged 6 and older are physically inactive.
- 22% of 6- to 19-year-old children and adolescents attain 60 or more minutes of moderate-to-vigorous physical activity on at least 5 days per week.
- 53% of high school students participate in muscle strengthening exercises on 3 or more days during the week.
- 29.8% of high school students attend physical education classes daily.
- Only six states (IL, HI, MA, MS, NY VT) require physical education in every grade, K through 12.
- <5% of adults participate in 30 minutes of physical activity each day.
- 1 in 3 adults receive the recommended amount of physical activity each week.
- 35% to 44% of adults 75 years or older and 28% to 34% of adults 65 to 75 are physically active.
- >80% of adults do not meet the guidelines for both aerobic and muscle-strengthening activities.
- 26% of persons with a disability reported being physically inactive during a usual week, compared to 12.8% of those without a disability. (CDC, 2018e; PCSFN, 2017)

The “energy out” side of the energy balance equation has tilted severely toward weight gain. The more active people are, the more likely they are to maintain a steady weight. The more sedentary, the more they are likely to gain weight over time (PCSFN, 2017).
Obesogenic Environment

An obesogenic environment is the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity. This includes the physical surroundings as well as the conditions in which an individual lives or works. These factors influence the development of a person or a group of persons and how they feel or function (Mackenback, 2016).

BUILT ENVIRONMENT

The built environment underwent changes beginning early in the 20th century when motor vehicles began to take over the streets. As a result, many aspects of today’s built environment—housing, roads, walkways, density, transportation, shops, parks, and public spaces—do not encourage walking, biking, or other physical activities. Many communities are built in ways that make it difficult or unsafe to be physically active. It may be hard for families to get to parks and recreation centers, and public transportation may not be available. The decline in physical activity has contributed to the weight gain of Americans in recent decades.

Zoning laws have separated residential, commercial, and industrial uses and have increased the distances between homes, jobs, and shops. Many towns and cities have become spread out along roads, making it necessary for people to have to drive just about everywhere. This urban sprawl and lack of mixed land use have been found to be associated with overweight or obesity more than any other physical environmental factor.

There is agreement among researchers that a properly designed neighborhood tends to be related to lower BMI of both genders. Studies also consistently show that increased access to and use of public transportation correlate with lower BMI, while people of both genders who use their own vehicles have higher BMI (Lamamsha et al., 2018; NASEM, 2018).

“SCREEN TIME”

Multiple studies have found a positive relationship between the amount of television viewed and obesity in children and adults. How television and other screen-time activities are related to obesity remains unclear. However, several hypotheses have been put forth:

- Decreased physical activity due to time spent on sedentary activities
- Snacking behavior while watching television
- Food advertising encouraging consumption of less healthy foods
- Decreased metabolism
  (MDH, 2018)

Most research has focused on children, and television viewing in childhood has been associated with obesity in adults. Children now spend more than 7-1/2 hours a day in front of a screen (TV, videogames, computer, phone), and nearly one third of high school students play video or computer games for 3 hours on an average school day (PCSFN, 2017).
The American Academy of Pediatrics (2015) research shows that in both kindergarten and first grade, children viewing as little as one hour of TV daily were 50% to 60% more likely to be overweight and 58% to 73% more likely to be obese compared to those watching less than one hour. Furthermore, children who watched one hour or more of TV daily were 39% more likely to become overweight and 86% more likely to become obese between kindergarten and first grade. Computer use, however, was not associated with higher weight.

FOOD AND NUTRITION ENVIRONMENT

What people choose to eat plays a large role in determining risk of overweight or obesity. People’s choices are shaped by the world in which they live. In the United States, physical and social surroundings influence what one eats and can make it difficult to choose healthy foods over unhealthy foods. The food and nutrition environment includes all the factors involved in the ability to access foods, the availability of foods, culture and ethnicity, parenting, marketing, and other significant factors.

**Food Availability and Access**

Studies have provided evidence that neighborhoods with a high proportion of low-income or minority residents have fewer supermarkets but more convenience stores relative to more advantaged areas. But they have also found that new supermarkets produced increased perceptions of access to healthy food without actual changes in consumption of healthy food or BMI.

Although eating fast food has been shown to increase caloric intake and the risk of becoming obese, it is not clear that living or working closer to fast food restaurants has the same effect. Fast food restaurants located near schools, however, have been linked to increased risk of obesity in schoolchildren (Harvard T.H. Chan, 2018b).

Studies have found a strong link between the availability of fruits and vegetables in the home and whether children, adolescents, and adults eat these foods. Eating meals together as a family has been linked with increased child and adolescent intake of fruits, vegetables, and other healthy foods, and increased frequency of family meals has also been linked with lower BMI in some studies (Harvard T.H. Chan, 2018b).

Often single parents work full time and take care of children, leaving less time for healthy meal preparation and other household chores.

Worksites often provide easy access to unhealthy food in vending machines and limited access to healthier options. Most schools sell foods to students outside of the school meal programs that are widely available in the cafeteria, vending machines, and school stores. Despite recent reductions in the supply of sugary beverages, schools continue to offer students unhealthy sugar-sweetened beverages.

Approximately 2 million U.S. households live more than a mile from a supermarket and do not have cars or access to cars. Some studies have found that living in these “food
deserts” is associated with lower-quality diets and increased risk of obesity. Convenience stores often offer less variety, high prices, and lower-quality produce than supermarkets (Harvard T.H. Chan, 2018b).

Food insecurity is an outcome of social and economic processes that lead to lack of access to food. Access to healthy foods may result from lack of adequate education and living wages. There is evidence that individuals with lower income/and or education levels are disproportionately more likely to be obese. The relationships between obesity and income and obesity and education are complex, differing among population subgroups (Ogden et al., 2018).

**Culture and Ethnicity**

Culture is a set of rules learned by the shared experience of a group of people and used to guide behaviors. Food is an expression of cultural identity and a means of preserving family and community unity. How a group defines what is an acceptable way of eating, the foods one should eat, and how they appear to others is what makes the group unique.

People from the same cultural background tend to live in the same neighborhoods and tend to eat foods that are familiar to them. These food choices may or may not be healthy, but they are comforting and may be eaten in quantities that are excessive (Gambini, 2015). However, while consumption of traditional food with family may lower the risk of obesity in some groups (e.g., Asian), it may increase the risk of obesity in others (e.g., African Americans).

Cultural norms may lead parents to remain satisfied with the weight of their children or they may even want them to be heavier. Body image development takes place in a cultural context, and research has shown that ethnic/cultural groups differ in their shared understanding of an ideal body weight.

- African American women generally consider an ideal body size to be significantly larger than what white women consider ideal. Similarly, African American men are more likely to say they favor women with a larger body size.
- The mean BMI at which African American women typically express body dissatisfaction is significantly higher than for white women.
- Hispanic parents may not consider a child’s obesity problematic, instead viewing an active but “chubby” child as healthy.
- Women of Mexican heritage may be comfortable with a larger body size.
- Women of Caribbean heritage may prefer a slimmer body size than women from Mexico and Central America. (NCEMCH, 2018)
Parenting Style

Studies have looked at different parenting styles in relation to eating and childhood obesity. Parenting style categories include:

- Authoritative (demanding and responsive)
- Authoritarian (demanding but not responsive)
- Permissive (responsive without being demanding)
- Neglectful (neither demanding nor responsive)

Overall, studies show that preschool- and school-age children born to authoritarian parents are more likely to be obese than those with authoritative parents. Authoritarian parents may not respond to a child’s cues of hunger and/or feeling full and may demand or control the child’s energy intake, leading to poor eating regulation and a greater tendency to overindulge. Permissive parenting styles were also associated with risk of overweight and obesity.

Studies indicate that an authoritative parent may model healthy eating behaviors and monitor their child’s eating behaviors more closely. Authoritative feeding styles have been suggested to be protective against the risk of obesity and associated with a higher consumption of fruits and vegetables (Sokol et al., 2017).

WORK ENVIRONMENT AND OCCUPATION

The type and place of work have been recognized as sources of adverse environmental exposures associated with overweight and obesity.

- Working more than 40 hours a week has been associated with obesity. Older employees who work more than 59 hours per week are 23% more likely to gain weight as compared to those who work less. Among employed women, increasingly long working hours are associated with more weight gain, especially high levels of weight gain.

- Shift work has been identified as a risk factor for being overweight or obese. Rotating shift patterns demonstrate significant positive association with obesity, and there is an increasing risk of both overweight and obesity with increased duration of rotating shift work.

- Working permanent night shifts increases the risk of obesity/overweight (particularly abdominal obesity) by 23%, and there is a positive correlation between the number of night shifts worked and BMI. The risk for overweight/obesity is more prominent among long-term night shift workers.

- Many workers report having only 15 minutes to eat throughout their work schedule making it difficult to prepare and eat healthy food. Other workers, including night shift workers, may have limited access to healthy foods.
• Sedentary occupations may lead to a higher incidence of obesity.

• Occupations related to food preparation—such as chefs, cooks, clerks in businesses that sell food, etc.—may provide eating opportunities that facilitate an increase in consumption.

• Occupations that have obligations for employees to eat to perform their jobs, such as salespeople who are expected to wine and dine clients, increase the risk for overweight and obesity.
  (Yarborough et al., 2018; Grundy et al., 2017; Sun, Feng, et al., 2017)

**FOOD MARKETING**

Food marketing is everywhere. It is powerful and effective, especially for children and adolescents, who are a vulnerable audience. Marketing plays an important role in the selection of the foods people choose to eat and can contribute to unhealthy diets, risk of poor health, and obesity. Research has indicated that there is a direct and automatic effect of food ads on consumption behavior, and that this is true for adults as well as children. Children and adolescents are important groups for this industry since they can directly buy the products, manipulate and influence their parents into buying them, and remain consumers in the future.

In 2014 the food industry spent a total of $15 billion on all food, beverage, and restaurant marketing in the United States. Marketing expenditures of $1.8 billion were aimed at children and adolescents and included:

• <1% of advertising on fruits and vegetables
• 40% on fast foods
• 51% on sugary drinks, sugary cereals, sweets, and snacks
• 9% on other foods
  (LoDolce, 2018)

Food marketers use several channels, such as television advertising, marketing in schools, marketing through the Internet, sponsoring and placing products, and promotions. Of these channels, the most frequently used is television advertising. Internet marketing is playing an ever-increasing role among children and adolescents. Tactics used in Internet marketing utilize interactive tools to appeal to children and adolescents, such as games, puzzles, contests, or music clips (Herédia et al., 2017).

**SLEEP DEPRIVATION**

There is a growing body of research that suggests a link between how much people sleep and how much they weigh. In general, children and adults who get too little sleep tend to weigh more than those who get enough sleep.
In a nurses’ health study, researchers followed 60,000 women over a period of 16 years. At the start of the study, all the women were healthy and none were obese. At the end of the study it was found that women who slept five hours or less each night had a 15% higher risk of becoming obese, compared to women who slept seven hours per night. Possible explanations for this finding included:

- Sleep-deprived people may be too tired to exercise.
- People who do not get enough sleep may take in more calories than those who do, simply because they are awake longer and have more opportunities to eat.
- Lack of sleep disrupts the balance of key hormones that control appetite.
  (Harvard T.H. Chan, 2018c)

Another study found that adults who sleep fewer than 7.7 hours a night are more likely to have a high BMI. The association between lack of sleep and obesity is the result of a decrease in the level of leptin and an increase in the level of ghrelin, both of which stimulate appetite. Leptin and ghrelin are influenced by orexin (hormones produced by the hypothalamus), which may be altered by changes in sleep and circadian processes. The guidelines for sleep duration for adults recommend that young adults (18 to 25) and adults (26 to 64) both get 7 to 9 hours of sleep each night. Older adults (65 and older) should get 7 to 8 hours (National Sleep Foundation, 2018a & 2018b).

Short sleep duration is a risk factor or marker of the development of obesity in infants, children, and adolescents. The most recent National Sleep Foundation guidelines recommends that:

- Infants (4–11 months) get between 12 and 15 hours of sleep nightly
- Toddlers (1–2 years) get 11–14 hours of sleep
- Children in pre-school (3–5 years) get 10 to 13 hours and school-aged children (6–13 years) between 9 and 11 hours
- Teenagers (14–17 years) are advised to get 8 to 10 hours

At all ages short sleepers have been found to have gained more weight and overall were 58% more likely to become overweight or obese (Miller et al., 2018; National Sleep Foundation, 2018b).

**CIRCADIAN MISALIGNMENT**

Circadian alignment is crucial for body-weight management and metabolic health. Circadian alignment in this context involves sleep, meal patterns, and physical activity. The circadian clock is located in the anterior hypothalamus, and light is the synchronizer for the clock. Circadian rhythm is important in determining sleep-wake patterns and is set by the light-dark cycle over 24 hours.
Physiologically, humans are meant to eat during the light cycle and to fast and sleep during the dark cycle. Metabolism of food is most efficient during the natural, sunlight-driven light cycle. Modern humans, however, live with artificial light well into the dark evening hours and as a result are awake and active long after the light cycle has ended. Blue light, which comes from LED lights and electronic devices with screens, is most disruptive to the circadian rhythm at night.

During these late hours, people may continue to eat well into the night, when they should ideally be asleep and fasting. Misalignment of this evolutionarily driven circadian rhythm can result in overeating, alterations in blood sugar, insulin resistance, and obesity (Westerterp-Plantenga, 2016; Harvard Medical School, 2017).

**COMORBILITIES AND CONSEQUENCES OF OBESITY**

**In Adults**

Obesity is associated with poorer health outcomes and reduced quality of life and is the leading cause of death in the United States and worldwide. Obesity among adults is associated with a profound reduction in life expectancy for both men and women. A recently reported study done in Australia estimated lost years of life will be approximately 3.3 years among adults currently aged 20 to 29 who are overweight and 8 to 10 years among those currently aged 20 to 39 years who are severely obese (Perreault, 2018c, Lung et al., 2018).

**DISEASES AND HEALTH CONDITIONS**

People who are obese are at increased risk for many serious diseases and health conditions.

**Cardiovascular**

- Essential hypertension
- Coronary artery disease
- Left ventricular hypertrophy
- Cor pulmonale
- Obesity-associated cardiomyopathy
- Accelerated atherosclerosis
- Pulmonary hypertension of obesity

**Gastrointestinal**

- Gallbladder disease (cholecystitis and cholelithiasis)
- Non-alcoholic steatohepatitis (NASH)
• Fatty liver infiltration
• Reflux esophagitis

Respiratory
• Obstructive sleep apnea
• Obesity hypoventilation syndrome (Pickwickian syndrome)
• Increased predisposition to respiratory infections
• Increased incidence of bronchial asthma

Central nervous system
• Stroke
• Idiopathic intracranial hypertension
• Meralgia paresthetica (tingling, numbness, and burning pain in the outer part of the thigh)

Orthopedic
• Osteoarthrosis (noninflammatory joint disease)
• Coxa vera, a deformity of the hip
• Chronic lumbago (pain in the muscles and joints of the lower back)

Metabolic
• Insulin resistance
• Hyperinsulinemia
• Type 2 diabetes mellitus
• Dyslipidemia

Reproductive
• Anovulation
• Infertility
• Hyperandrogenism and polycystic ovaries in women
• Hypogonadotropic hypogonadism in men
Obstetric and perinatal
- Pregnancy-related hypertension
- Fetal macrosomia (significantly larger than average) resulting in dystocia (difficult birth)

Increased surgical risk and postoperative complications
- Wound infection
- Deep vein thrombosis
- Pulmonary embolism
- Postoperative pneumonia

Pelvic
- Stress incontinence

Cutaneous
- Intertrigo
- Acanthosis nigricans
- Hirsutism
- Increased risk for cellulitis
- Carbuncles

Malignancies
- Some cancers (endometrial, breast, colon, kidney, gallbladder, liver and pancreas)

Extremities
- Venous varicosities
- Lower extremity venous and/or lymphatic edema

Psychological
- Mental illness such as chronic depression, anxiety, and other mental disorders

Miscellaneous
- Reduced mobility
- Difficulty maintaining personal hygiene

(Hamdy et al., 2018; CDC, 2018f)
COGNITIVE EFFECTS

People with high BMI in midlife have lower global cognition than normal-weight individuals, and midlife obesity is related to accelerated cognitive aging. Independently, both age and BMI contribute to decreased brain volume in middle-age (approximately 40 to 65 years) and older adulthood (65 years and older), and obesity in midlife is related to an increased pace of deterioration in executive functions. An increase in waist-to-hip ratio has been found to be associated with substantial reduction in total brain volume.

Both age and BMI contribute independently to decreased brain volume in middle-age and older adulthood. Midlife overweight/obesity is related to an increased pace of deterioration in executive functions, and an increase in waist-to-hip ratio is associated with substantial reduction in total brain volume. Obesity may also affect brain structure, leptin and insulin dysregulation, oxidative stress, cerebrovascular function, blood-brain barrier, and inflammation.

There is research that suggests that obesity-related changes in metabolism interact with age to impair brain functions. Midlife overweight/obesity, particularly with metabolic abnormality, is associated with higher dementia risk in older adulthood. High midlife BMI is related to neuron and myelin abnormalities. These factors indicate that midlife is a critical period in which overweight/obese status can predict a person’s cognitive functions and brain health in later life (Wang et al., 2016).

MOTOR EFFECTS

In middle-age and older adults, a combination of high BMI (or waist circumference) and high blood pressure is related to lower speed and poorer manual dexterity. Obese individuals require greater attention resources in order to maintain balance (Wang et al., 2016).

In Children and Adolescents

Obesity is the most prevalent nutritional disorder among children and adolescents in the United States, resulting in several comorbidities and consequences, which include abnormalities in the endocrine, cardiovascular, gastrointestinal, pulmonary, orthopedic, neurologic, dermatologic, and psychosocial systems.

Endocrine

- Prediabetes, which increases the risk for developing type 2 diabetes mellitus
- Type 2 diabetes mellitus, which leads to more rapid progression of diabetes-related complications in later life
- Metabolic syndrome—a cluster of risk factors for type 2 diabetes and atherosclerosis—which includes abdominal obesity, hyperglycemia, dyslipidemia, and hypertension
- Hyperandrogenism in females and a risk for early onset polycystic ovary syndrome characterized by hirsutism, menstrual irregularities, and dermatologic problems
• Gynecomastia in males related to the stimulating effects of fat on estrogen production
• Abnormalities in growth and puberty, with accelerated linear growth and bone age and early onset of sexual maturation

**Cardiovascular**
• Essential hypertension
• Dyslipidemia, particularly in those with central fat distribution and increased adiposity, including elevated concentrations of LDL cholesterol and triglycerides and decreased concentration of HDL cholesterol
• Alterations in cardiac structure and function similar to those seen in middle-aged adults, including increased left ventricular mass, increased left ventricular and left atrial diameter, greater epicardial fat, and systolic and diastolic dysfunction
• Endothelial dysfunction of the blood vessels, with aortic intima-media thickening, development of early aortic and coronary arterial fatty streaks and fibrous plaques, as well as increased arterial stiffness

**Gastrointestinal**
• Nonalcoholic fatty liver disease, the most common cause of liver disease in children, resulting in fatty infiltration and inflammation of the liver
• Cholelithiasis (gallstones), with obesity being the most common cause of gallstones in children without predisposing conditions, and the risk increasing with BMI and being greater for girls than boys

**Pulmonary**
• Obstructive sleep apnea (complete obstruction of the upper airway during sleep and cessation of air movement despite ongoing respiratory effort)
• Obesity hypoventilation syndrome (Pickwickian syndrome) and alveolar hypoventilation during wakefulness, often with severe oxygen desaturation, occurring in the absence of airway obstruction, perhaps due to the restrictive ventilatory defect caused by obesity (abdominal distribution of fat is associated with this finding, which is a rare but life-threatening occurrence requiring prompt diagnosis and therapy)
• Increased predisposition for respiratory infections and incidence of bronchial asthma

**Orthopedic**
• Slipped capital femoral epiphysis, typically occurring in early adolescence, related to increased shear forces at the capital femoral growth plate
• Idiopathic genu valgum (commonly called “knock-knee”), characterized by deviation of the knees toward the midline of the body
• Tibia vara (Blount disease), characterized by progressive bowing of the legs and tibial torsion as a result of excessive abnormal weight bearing, more common among black than non-black individuals

• Fractures, since bone development is not always able to compensate for excess weight, with the resulting imbalance putting undue stress on developing bones, also increasing risk for joint damage or osteoarthritis in adulthood

Neurologic

• Idiopathic intracranial hypertension (pseudotumor cerebri), which presents with signs and symptoms of a brain tumor

• Multiple sclerosis, with susceptibility confirmed for females who are obese, but mixed in males

Dermatologic

• Intertrigo (both bacterial and/or fungal), an inflammatory rash caused by skin-to-skin friction in warm, moist areas of the body

• Furunculosis (boils), or small abscesses involving hair follicles

• Hidradenitis suppurativa, or inflammatory nodules or deep fluctuant cysts in the skin of the axillae and groin

• Acanthosis nigricans, or areas of dark velvety discoloration in body folds and creases, particularly the armpits, groin, and neck, associated with insulin resistance

• Striae distensae (stretch marks) caused by mechanical factors, possibly acting in concert with hormonal factors such as high levels of adrenocorticosteroids

(Klish, 2017; Schwartz et al., 2017; WHO, 2018b; Gianfrancesco & Barcellos, 2016)

The most significant health consequences of childhood overweight and obesity that often do not become apparent until adulthood include cardiovascular diseases (mainly heart disease and stroke), diabetes, musculoskeletal disorders such as osteoarthritis, and certain types of cancer (endometrial, breast, and colon).

Studies demonstrate that the early onset of dyslipidemia and high blood pressure in children is associated with premature atherosclerosis in adults. An increased risk of death from coronary artery disease has been consistently observed in males (but not in females) who were obese during adolescence (WHO, 2018b; Singer & Lumeng, 2017).

Adolescent obesity increases the risk for gout and colorectal cancer, and there is evidence that men and women who were obese or overweight in late adolescence had up to a four-fold increased risk for subsequent pancreatic cancer in early adulthood (Castellino & Barclay, 2018).
All of the above comorbidities and consequences result in an increased risk of obesity during adulthood, with all the attendant long-term health risks. This increase appears to be most pronounced for adolescent males with moderate to severe obesity. Generally, the proportion of children with obesity who have obesity as adults increases with increased age at onset of obesity.

- 26% to 41% of preschoolers with obesity have obesity as adults.
- 42% to 63% of school-aged children with obesity have obesity as adults.
- The higher the degree of obesity during childhood, the higher the risk of adult obesity.
- Individuals aged 18 years with a BMI at or above the 95th percentile have a 66% to 78% risk of being obese at age 35 years. (Schwarz, 2018c)

**COGNITIVE EFFECTS**

Childhood obesity is related to reduced executive function, attention, mental rotation (a function of visual representation), and mathematics and reading achievement. Obese adolescents have deficits in a range of cognitive functions, including attention. Studies have shown that obesity affects cognition by altering brain function. Many factors, such as insulin-leptin dysregulation and inflammation, mediate the effect of obesity and cognition (Wang et al., 2016).

**MOTOR EFFECTS**

Besides the effects on cognition, obesity has been shown to affect motor control capabilities. Children who are obese or overweight have poorer gross motor control and delayed motor development. The negative impact of excessive body weight is stronger for gross motor skills that involve dynamic body movements than for stationary object control skills. Fine motor skills appear to be relatively independent of the constraints imposed by excessive body weight.

Obese children also have problems with postural coordination and a heightened dependency on vision when moving about which is automatic in normal-weight children (Wang et al., 2016; Matarma et al., 2018).

**Psychosocial Effects of Overweight and Obesity**

Psychosocial dysfunction is a concern among people who are overweight or obese. For instance, researchers have found overweight females, in comparison to their non-overweight peers, to:

- Have completed less schooling
- Be less likely to marry
- Have higher rates of household poverty

Overweight males were also found to have a decreased likelihood of being married (Schwarz, 2018c).
Other psychosocial consequences of overweight and obesity include:

- Alienation
- Distorted peer relationships
- Poor self-esteem
- Distorted body image
- Anxiety and depression
- Disordered eating
- Unhealthy weight control behaviors

**STIGMATIZATION**

Prejudice against “fat” people is one of the deepest and most widely shared prejudices the public holds. The pervasively hostile, discriminating environment that marginalized people find themselves in is a source of constant physical and psychological stress. Studies indicate that this prejudice is learned in early life, and that children as young as 3 years exhibit anti-fat attitudes, having picked them up from cues in their environment. Sadly, even parents discriminate against their own overweight children (Ryan et al., 2018; Luck-Sikorski et al., 2017).

Microaggressions against obese people are so pervasive and normalized that people often do not recognize them as stigmatizing. In fact, the negative attitudes are so embedded that many obese individuals are complicit in their own stigmatization, believing they deserve it or that those expressing prejudice are simply stating a fact. Studies show that obesity is generally viewed as a self-inflicted condition and is under the individual’s control. Many people do not consider obesity a disease but rather a moral failing, believing these individuals have a flawed character (i.e., that they are lazy, indulgent, gluttonous, weak-willed, undisciplined, and have no self-control) (Jain, 2018).

Research has documented that obese adults who experience weight stigmatization have higher rates of depression, anxiety, and social isolation and poorer psychological adjustment. Some obese adults may react to weight stigma by internalizing and accepting negative attitudes against them, which may in turn increase their vulnerability to low self-esteem.

Stigma may also negatively affect eating behaviors by interfering with weight-loss attempts and leading some adults to eat more food in response to stigmatizing encounters. Stigma has been implicated in physical health in the context of avoidance of healthcare services due to bias in medical settings (Obesity Society, 2018).

**Children and adolescents** with obesity report high levels of weight stigma coming from peers, family, teachers, healthcare workers, and the general public. Among children and adolescents, weight stigma has a major impact on quality of life. Stigmatization drives social isolation, depression, and body dissatisfaction, and increases the risk for suicidal ideation. In addition, it
has been found to adversely affect peer relationships and social bonding among children, academic performance, physical health outcomes, and participation in physical activity. It can also lead to disordered eating behaviors such as binge eating, purging, and the use of diet pills or laxatives (Skinner et al., 2017).

The American Academy of Pediatrics states that some children who are overweight might seek emotional comfort in eating, which compounds the problem of obesity. In addition, it is noted there are repercussions that continue well into adolescence and beyond in discrimination in admission to prestigious universities and reduced job opportunities. Also, people who are overweight tend to earn less money and marry less often than their peers of average weight (AAP, 2017a).

**BULLYING**

Childhood obesity is the most common reason that children and adolescents are bullied. Weight-based victimization occurs in school more often than victimization related to race/ethnicity, sexual orientation, religion, or disability. Verbal teasing is the most frequent type of victimization reported by adolescents, followed by relational aggression (damaging one’s relationships or social status), cyberbullying, and physical aggression (Puhl et al., 2016).

Girls who are 6 years and older with a higher BMI are more likely to be victims of bullying, but the same does not appear to be true for boys. Girls who experience bullying were found to be more likely to gain even more weight over time, which then leads to more bullying. Males who are severely obese have been found to be more involved in the double role of bully and victim (Cote-Lussier et al., 2015).

**WEIGHT BIASE IN HEALTHCARE**

Overweight and obese individuals are targets of bias and stigma in multiple domains of living, including employment, educational institutions, mass media, interpersonal relationships, and even medical facilities. Biased attitudes toward obese patients have been documented among physicians, nurses, psychologists, dietitians, and medical students. Among many healthcare providers, obese patients are viewed as unintelligent, unsuccessful, weak-willed, unpleasant, overindulgent, and lazy (Obesity Society, 2018).

In a study that surveyed more than 2,400 adult women about their experiences of weight bias, 69% reported that physicians were a source of weight bias and 52% reported they had been stigmatized by a doctor on multiple occasions. Doctors were the second most reported source of bias out of a list of more than 20 possible sources (OAC, 2018).

Studies of self-reported attitudes among nurses also indicated:

- 31% “would prefer not to care for individuals affected by obesity”
- 24% agreed that individuals affected by obesity “repulsed them”
- 12% “would prefer not to touch individuals affected by obesity”

(OAC, 2018)
More than 33% of healthcare providers do not consider obesity to be a disease state. Eighty percent believe obesity is always the result of poor lifestyle choices, and only 12% indicate that their obese patients always or often succeed at long-term weight management. Despite this, one third do not offer counseling to their obese patients and only about 30% recommend surgery for help with weight loss (Jain, 2018).

The effects of this stigma are both immediate and long-term. The more direct effects of provider attitudes may be a reduction in the quality of the patient encounter that harms patient outcomes and reduces patient satisfaction. Research has indicated that obese people who feel stigmatized may experience a high level of stress, which can contribute to impaired cognitive function and the ability to effectively communicate, resulting in failure to recall advice or instructions and reduced adherence to prescribed treatment.

There is also evidence that obese women are less likely to seek recommended screenings, that heavier patients are more likely to cancel and delay appointments and preventive healthcare services, and that some patients may avoid getting medical care altogether. The long-term result of avoidance and postponement of care is that people with obesity may present with more advanced conditions that are more difficult to treat.

When people who are overweight or obese do seek medical care, it is often inferior compared to the care provided to those of normal weight. Studies show that healthcare providers report lacking deep knowledge of effective obesity management. They overwhelmingly feel inadequate in treating obesity and feel discomfort in even discussing weight-related issues (Obesity Society, 2018; Watman, 2018).

### CASE: Stigmatization

At the Longview Bariatric Center, in order for the bariatric team to better understand the issues of stigma and discrimination, a group counseling session was offered to participants willing to talk about their experiences of being overweight. The session was scheduled to last 90 minutes and was headed by Bria, a bariatric nurse practitioner. Seven individuals were enrolled, four women and three men between the ages of 23 and 42.

Following introductions, Bria explained the purpose of the session and asked the participants to describe some of their experiences of interactions socially, at work, in education, and in healthcare. Initially, people were reluctant to share these feelings because, as Sheila said, “It’s so hard to talk about.”

Bria asked her to explain, and Sheila replied, “Well, I know people look at me and think, ‘She’s fat and ugly.’ It’s written on their faces—a look of pity or disgust. They don’t say it, but it’s obvious.” Another member of the group, Rick, added, “Sometimes they don’t even try to hide it.”

Everyone in the group described how their social interactions were impacted, with the strongest impact being on the younger women in the group. “People just don’t want to spend time to get to know you when you’re big,” said Jenny.
Among the group, many had experienced discrimination in looking for employment as well as in their workplaces. Helene reported that when she had applied for a job once, “They said they couldn’t employ me because I was too big to sit at their reception desk. I didn’t project the image they wanted for the company. I felt mortified.”

In the area of schooling, Lisa said, “I remember getting teased in school about my weight and coming home every day in tears. Sometimes the other kids would call me ‘rhinoceros’ or ‘tubby.’ I would hide in the bathroom at lunchtime so I didn’t have to go to the playground.”

When Bria asked the group about their experiences with healthcare professionals and in medical settings, it led to a vigorous discussion. The majority in the group said they didn’t like having their doctors bring up their weight because they didn’t have any useful advice and didn’t say anything they did not already know.

Sheila: “Oh, they say, ‘You just have a virus, and maybe you should lose some weight’.”

Rick: “Yeah, you go in because you’ve got a bad headache, and the doc says, ‘It’s because you’re overweight.’”

Lisa: “They think you’re stupid! They say, ‘You need to stop eating so much. You need to get out and be more active. You should do this … you should do that’ … stuff all of us already know. Get this! I went to my doctor a while back for a prescription for birth control pills, and he looked at me and said, ‘You mean you’re having sex?!’”

Logan: “Oh, yeah, people look at us like we’re some kind of asexual creature.”

Mason: “I was in the hospital two months ago for surgery on my foot. The hospital gowns were too small and the bed was too small!”

As Bria listened, many of the participants expressed how they felt judged and thought of as being lazy and stupid. They expressed negative feelings about average-weight people, and Jenny said, “Don’t you just hate them!” Bria understood those statement to be an indication of the severity to which the participants felt victimized and judged by others.

At the end of the 90 minutes, Bria thanked them all for their willingness to talk about their experiences and offered to meet with them again should they wish to do so.

(Adapted from Hayden et al., 2010)

ASSESSING FOR OVERWEIGHT AND OBESITY

Nurse practitioners, office and clinic nurses, school nurses, hospital nurses, physical therapists, and occupational therapists, among others, all play a role in the assessment and treatment of children, adolescents, and adults for overweight or obesity.
Assessment guidelines include:

- Body mass index or other screening or diagnostic tool measurement
- Classification of overweight and obesity
- Past medical history
- Family history
- Social history
- Review of systems
- Physical examination
- Diagnostic testing for comorbidities

**Body Mass Index (BMI)**

The primary way a person is categorized as overweight or obese is by calculating body mass index, which expresses the relationship (or ratio) of weight to height. BMI is calculated as:

\[
\text{(Weight in pounds ÷ height in inches}^2) \times 703
\]

or

\[
\frac{\text{Weight in kg}}{\text{height in meters}^2}
\]

BMI continues to be used as a screening tool because it is inexpensive and easier than other methods and does not require technical equipment and training. However, **BMI can be misleading because it does not directly calculate body fat and is not, therefore, diagnostic.**

The CDC indicates that BMI may not be the best measure of body fat and overall health in:

- Asians
- Athletes
- Women who are pregnant or nursing
- Nonpregnant women compared with men
- People over the age of 65
  
  - (CDC, 2017)

**BMI AND WEIGHT STATUS FOR ADULTS**

BMI for adults 20 years and older is interpreted using standard weight status categories. These categories are the same for men and women of all body types and ages. The standard weight status categories are shown in the table below.
ADULT WEIGHT STATUS CATEGORIES

<table>
<thead>
<tr>
<th>BMI</th>
<th>Weight Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;18.5</td>
<td>Underweight</td>
</tr>
<tr>
<td>18.5–24.9</td>
<td>Normal or healthy weight</td>
</tr>
<tr>
<td>25.0–29.9</td>
<td>Overweight</td>
</tr>
<tr>
<td>≥30.0</td>
<td>Obese</td>
</tr>
<tr>
<td>≥40</td>
<td>Severely (morbidly) obese</td>
</tr>
</tbody>
</table>

Sources: CDC, 2017; WHO, 2019b.

BMI AND WEIGHT STATUS FOR CHILDREN

BMI is interpreted differently for children and teens even though it is calculated in the same manner as adult BMI. The BMI in children and teens needs to be age- and sex-specific since the amount of body fat changes with age and differs between boys and girls. All children older than two years should have their BMI calculated at least annually from measured height and weight.

After BMI is calculated for children and teens, it is expressed as a percentile. The percentile can be obtained from either a graph or a percentile calculator, which expresses a child’s BMI relative to other children of the same age and sex. BMI-for-age percentile growth charts are the most commonly used indicator to measure the size and growth patterns of children and teens in the United States.
Example of BMI growth chart. (Source: CDC.)

## CHILD WEIGHT STATUS CATEGORIES (Ages 2 to 19*)

<table>
<thead>
<tr>
<th>BMI Percentile</th>
<th>Weight Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5th percentile</td>
<td>Underweight</td>
</tr>
<tr>
<td>5th to &lt;85th percentile</td>
<td>Normal or healthy weight</td>
</tr>
<tr>
<td>85th to &lt;95th percentile</td>
<td>Overweight</td>
</tr>
<tr>
<td>≥95th percentile</td>
<td>Obese</td>
</tr>
</tbody>
</table>

*For children under 2 years of age, consult WHO Child Growth Standards.

Source: CDC, 2018g.
OBESITY CLASSIFICATIONS

There are several classifications for degrees of obesity, and the most widely accepted being those from the World Health Organization (WHO) based on BMI (see table below).

### WHO OBESITY CLASSIFICATIONS

<table>
<thead>
<tr>
<th>BMI</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>25–29.9</td>
<td>Overweight or pre-obese</td>
</tr>
<tr>
<td>30–34.9</td>
<td>Class I obese</td>
</tr>
<tr>
<td>35–39.9</td>
<td>Class II obese</td>
</tr>
<tr>
<td>≥40</td>
<td>Class III obesity (commonly called severe or morbid obesity)</td>
</tr>
</tbody>
</table>

Source: WHO, 2019b.

The surgical literature often uses a different classification to recognize particularly severe obesity (see table below).

### SEVERE OBESITY CLASSIFICATIONS

<table>
<thead>
<tr>
<th>BMI</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;40 kg/m²</td>
<td>Severe obesity</td>
</tr>
<tr>
<td>40–50 kg/m²</td>
<td>Morbid obesity</td>
</tr>
<tr>
<td>&gt;50 kg/m²</td>
<td>Super obese</td>
</tr>
</tbody>
</table>

Source: Hamdy et al., 2018.

Other Screening and Diagnostic Tools

BMI has long been used as a way to define obesity in the United States, but experts are becoming increasingly critical of the approach, saying it does not paint a full picture of our health. Other tools are available, and the choice of the method for measuring weight or body fat composition depends on whether it is being obtained for clinical purposes or research and what degree of precision is required.

Other options that can be used to determine overweight or obesity include the following:

- **Skinfold thickness** uses calipers to determine how much body fat sits on top of muscle. It is a useful way of figuring out where the biggest fat deposits are, but it requires significant training to do it properly and then retraining to ensure healthcare workers continue to do it correctly.

- **Dual energy X-ray absorptiometry (DXA body scan)** is more accurate than BMI but also much more expensive. It is generally the preferred method in a clinical setting when...
a more rigorous determination of body composition is needed. It uses a very low dose of radiation and is fairly simple for an operator to perform. It is widely considered the gold standard for measuring body tissue, bone, muscle, and fat.

- **Waist circumference** measurement can be used, and the National Heart, Lung and Blood Institute recommends that waist circumference be less than 40 inches for men and less than 35 inches for women. There is ethnic variability in these values that predict increased risk. For example, Japanese Americans and Indians from South Asia have more total fat and visceral fat and thus may be at higher risk of developing type 2 diabetes for a given BMI than whites.

- **Waist-to-hip ratio** (waist circumference divided by hip circumference) is used by the World Health Organization. High risk categories include a ratio >0.85 for women and >0.9 for men. Measurement of the waist-to-hip ratio provides no advantage over waist circumference alone and is infrequently used by clinicians.

- **Bioelectrical impedance analysis** is simple and widely used and relies on an electrical current to measure the fat and fat-free mass of the body. Accuracy in placement of electrodes is essential, as variations can result in large errors.

- **CT or MRI imaging techniques** can reliably determine patterns of body fat distribution.

- **Nuclear magnetic resonance** spectroscopy is similar in technology to MRI but is capable of discerning fat and glycogen within tissues as well as fat and lean mass overall.

- **Hydrodensitometry** (underwater weighing) partitions fat and fat-free components of the body and involves weighing a person on dry land and again after complete submersion under water. Underwater weighing was long considered to be the gold standard for determining body composition but has largely been replaced by newer methods.

- **Whole-body plethysmography** uses air displacement rather than water displacement. The person is placed inside a device and sensors determine the amount of air displaced by the person’s body. Body fat and lean muscle mass can then be calculated. This method works well in adults, school-aged children, and infants (using a device specifically designed for this age group) (Perreault, 2017; Phillips & Shulman, 2017).

- **Relative fat mass index** (RFM) is a newer, better measure of body fatness than many indices currently in use, including BMI. RFM closely matches results obtained by DXA body scan. RFM is obtained simply by measuring height and waist circumference and plugging the figures into the following formula:
  
  - Men: 64 – (20 x height/waist circumference) = RFM
  - Women: 76 – (20 x height/waist circumference) = RFM

(Woolcott & Bergman, 2018)
Assessment of Fat Distribution

Identifying the location and type of fat deposits can provide important information about the risk of comorbidities not found in the simple BMI measurement. Anatomic differences in fat deposition is a better indicator of the health hazards of obesity than is the absolute amount of body fat.

Individuals with excess fat located in the central abdominal area (apple shape) have a significantly greater risk for diabetes, hypertension, hypertriglyceridemia, ischemic heart disease, some cancers, and death from all causes. Excess fat in the lower extremities, around the hips or gluteal region (pear shape), commonly found in females, lowers the risk of metabolic disease. The distribution of body fat concentrated in the interscapular area, face, neck and trunk may suggest Cushing syndrome (Lee et al., 2016).

There are also biochemical differences in regional fat deposits. The substances released from abdominal fat are absorbed through the portal vein and therefore have a direct access to the liver. Fatty acids taken up by the liver may lead to insulin resistance and increased synthesis of triacylglycerols, which are released as very-low-density lipoprotein. In contrast, free fatty acids from gluteal fat enter the general circulation and have no action on hepatic metabolism (Intl. CMR, 2018).

Abdominal fat cells are much larger than lower-body fat cells. There is a higher rate of fat turnover of abdominal fat cells, and adipocytes are hormonally more responsive than fat cells in the legs and buttocks. The ability of a fat cell to expand is limited, and when its maximum size is reached, it divides, increasing the absolute number of cells. These new fat cells are never lost. When an obese individual loses weight, the size of the fat cells is reduced but the number of cells is not affected. This is why formerly obese patients have a particularly difficult time maintaining their reduced body weight (Jeffery et al., 2015).

Past History

Determining a patient’s past history is focused on investigating the cause of obesity or overweight and should include:

- **Age of onset of weight gain.** The risk for any given degree of obesity seems to be greater in patients whose obesity begins before the age of 40 years, allowing a longer time period over which comorbid conditions can develop. Children with a low birth weight and those whose weight rises more rapidly in their first 10 years are at high risk for diabetes as adults. Even very modest weight gain after age 18 years is also important, increasing the risk of cardiovascular disease and type 2 diabetes at all levels of initial BMI.

- **Family history.** The risk of comorbidities of obesity is greatly influenced by family history. Obesity in one or both parents is a predictor for the persistence of a child’s obesity into adulthood. Family history should include information about obesity in first-degree relatives (parents and siblings) and common comorbidities of obesity in first- and second-degree relatives (grandparents, uncles, aunts, half-siblings, nephews, and nieces).
• **Developmental history.** For children it is important to include history of growth delay and pattern of weight gain, as well as history of asthma or childhood cancers, both of which may contribute to the development of childhood obesity.

• **History of weight-loss attempts** can provide relevant insights into current weight-loss management strategies as well as evidence of eating disorders such as bulimia nervosa and binge eating.

• **Dietary history** includes an assessment of eating patterns (timing, content, and location of meals and snacks) and identification of foods that should be reduced, eliminated, or replaced.

• **History of physical activity** includes an assessment of frequency, duration, and intensity of physical activities such as formal exercising, transportation, occupation, household tasks, recreation, and time spent in sedentary activities. In addition, for children and adolescents, this history includes evaluations of time spent in play, school recess, physical education, and after-school and weekend activities.

• **Current and past medications.** Medication-related weight gain is not uncommon, especially for certain types of drugs, including some diabetic medications, antipsychotics, antidepressants, and antiepileptics.

• **Current health habits,** including tobacco use, drug and alcohol use.

• **History of smoking cessation.** Cigarettes reduce appetite, and nicotine speeds up metabolism, increasing the number of calories used. On average, people gain 5 to 10 pounds in the months after they give up smoking. (Perreault, 2018c; Vorvick, 2018; Klish, 2018)

**Review of Body Systems**

An inventory of body systems is completed in order to identify signs or symptoms a person may be experiencing or has experienced related to overweight and obesity, including:

• Obesity secondary to genetic syndromes, hormonal disease, iatrogenic medications

• Polycystic ovary syndrome (oligomenorrhea or amenorrhea)

• Obstructive sleep apnea, hypoventilation syndrome

• Osteoarthritis in adults

• Foot, hip, or knee pain (orthopedic issues, slipped capital femoral epiphysis in children)

• Urinary stress incontinence

• Abdominal pain (gastroesophageal reflux disease, gallbladder disease)
• Disability/immobility
• Psychological disorder and/or stigmatization, anxiety, depression, social isolation
• Polyuria, polydipsia, polyphagia (type 2 diabetes mellitus)
• Headaches (idiopathic intracranial hypertension, aka pseudotumor cerebri)
• Obesity secondary to genetic syndrome
  (Apovian et al., 2015)

Physical Examination

Physical examination includes obtaining vital signs, height, weight, and BMI, and a complete head-to-toe examination in order to rule out any medical conditions that can be the cause of obesity and to assess for comorbid conditions.

General

• Sex, race, body build
• Obvious dysmorphic or distinguishing features that may suggest a genetic syndrome
• State of development in relation to chronological age (especially important in childhood and adolescence regarding evidence of secondary sex characteristics)
• Functional mobility, posture, gait
• Hygiene

Vital Signs

• Blood pressure. Elevated blood pressure may be a sign of Cushing syndrome. Normal blood pressure in adults ranges from 110/75 to 130/85. Normal blood pressure values for children and adolescents are shown in the table below:

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>98/52</td>
<td>98/54</td>
</tr>
<tr>
<td>3</td>
<td>101/58</td>
<td>102/60</td>
</tr>
<tr>
<td>5</td>
<td>103/63</td>
<td>104/64</td>
</tr>
<tr>
<td>7</td>
<td>106/68</td>
<td>106/68</td>
</tr>
<tr>
<td>9</td>
<td>107/70</td>
<td>108/71</td>
</tr>
<tr>
<td>11</td>
<td>110/74</td>
<td>111/74</td>
</tr>
<tr>
<td>≥13</td>
<td>120/80</td>
<td>120/80</td>
</tr>
</tbody>
</table>

Source: Flynn et al., 2017.
Head, Eyes, Ears, Nose and Throat

- Microcephaly, a feature of Cohen syndrome (aka Pepper syndrome)
- Poor linear growth in children, which may be due to hypothyroidism, Cushing’s syndrome (high levels of cortisol), or Prader-Willi syndrome (a rare disorder present at birth)
- Papilledema, an optic disc swelling secondary to elevated intracranial pressure seen in patients with pseudotumor cerebri
- Nystagmus or visual complaints, which may be related to hypothalamic-pituitary lesion
- Clumps of pigment in the peripheral retina, which may indicate retinitis pigmentosa (Bardet-Biedl syndrome)
- Tonsillar enlargement secondary to sleep apnea
- Erosion of tooth enamel resulting from self-induced vomiting in those with an eating disorder

Skin and Hair

- Acanthosis nigricans, seen in those who have diabetes or prediabetes. Children with acanthosis nigricans are at high risk of developing type 2 diabetes later in adulthood.
- Hirsutism and excessive acne, which may be related to polycystic ovary syndrome
- Skin tags, seen commonly with insulin resistance
- Purple striae on the abdomen, lower flank, breasts, hips, buttocks, shoulders, upper thighs, upper arms, and axillae, which is caused by rapid weight gain due to Cushing’s syndrome

Cardiac and Respiratory

- To exclude cardiomegaly and respiratory insufficiency

Abdomen

- Abdominal tenderness, which may be related to gallbladder disease, GERD, or nonalcoholic fatty liver disease
- Hepatomegaly and hepatic tenderness due to nonalcoholic fatty liver disease

Genitourinary

- Undescended testicles, small penis, or scrotal hypoplasia, which can occur in children with Prader-Willi syndrome
- Small testes, which may suggest Bardet-Biedl syndrome
- Delayed or absent puberty
• Precocious puberty

Extremities

• Limited hip range of motion, which could suggest a slipped capital femoral epiphysis
• Lower-leg bowing caused by Blount disease, in which the medial side of the tibia, immediately distal to the knee joint, fails to develop normally
• Pes planus (flat feet) and pronation of the feet, common in obese children
• Dorsal finger callouses, which may indicate self-induced vomiting
• Malformed or misshapen body parts (extra digit next to the fifth digit may present in Bardet-Biedl syndrome, small hands and feet in Prader-Willi syndrome)
• Evidence of osteoarthritis
  (Hamdy et al., 2018; Perreault, 2018c; Klish, 2018)

Laboratory Studies

ADULTS

Standard laboratory studies in the evaluation of an adult patient with obesity include:

• Fasting lipid panel. At minimum fasting cholesterol, triglycerides, and high-density lipoprotein cholesterol (HDL-C) levels should be done. Increased low-density lipoprotein cholesterol (LDL-C) and normal or marginally increased total cholesterol are not uncommon among obese individuals.

• Liver function studies results are normal in most obese patients. However, elevated transaminase levels may indicate nonalcoholic steatohepatitis (NASH) or fatty infiltration of the liver.

• Thyroid function tests. Although hypothyroidism itself rarely causes more than mild obesity, these tests can rule out primary hypothyroidism. Screening with a serum thyrotropin level is recommended as adequate. TSH levels are commonly elevated in persons with obesity.

• Glucose and insulin studies. All patients with obesity should be screened for diabetes and prediabetes, including a fasting glucose and hemoglobin A1C (HbA1C).

Other laboratory tests should be done as indicated by clinical findings and suspicions. When Cushing syndrome or other hypercortisolemic states are suspected, a 24-hour urinary free-cortisol test should be included (Hamdy et al., 2018).
CHILDREN AND ADOLESCENTS

Laboratory evaluation for children with obesity is not fully standardized. The following is the suggested routine screening:

- **Fasting lipid panel.** Done once between the ages of 9 and 11 and again between 17 and 21. Children over 2 years old are tested if they are overweight or obese or have diabetes or hypertension.

- **Glucose and insulin studies,** i.e., fasting glucose level, hemoglobin A1C, or glucose tolerance test (AACC, 2018; Klish, 2018).

- **Liver function studies.** Nonalcoholic fatty liver disease for all obese and overweight children with additional risk factors beginning between ages 9 and 11 years. An earlier screening age is suggested for patients at high risk, such as children with severe obesity or panhypopituitarism. The recommended screening test is alanine aminotransferase (ALT) using sex-specific upper limits of normal (Shah et al., 2018).

In addition to the above, the following studies are included based on history and physical examination:

- Serum leptin level (recognizing that a genetic mutation lowers leptin level leading to decreased satiety)
- Adrenal function tests (recognizing that cortisol levels are commonly elevated in patients with obesity)
- Karyotype with florescence in situ hybridization (FISH) for Prader-Willi
- Assessment of reproductive hormones, including prolactin
- Serum calcium, phosphorus, and parathyroid hormones to evaluate for suspected pseudohypoparathyroidism
- MRI of the brain, with focus on the hypothalamus and pituitary (Schwarz, 2018a)

**CASE**

**Kevin, Age 7**

Kevin was screened for overweight and obesity at school. He and his parents were referred to the nurse practitioner for assessment because he had a steadily increasing BMI over the past six months. At the initial appointment, height and weight were obtained and BMI was calculated and added to his current chart. He is now in the 92nd percentile, which classifies him as overweight.

In taking a family history, the nurse practitioner learned that Kevin’s mother, age 32, has always been overweight and is constantly dieting to maintain her weight. She is also taking
Kevin’s father is 33 years old. His weight has been normal all his life and his blood pressure is normal. Kevin’s maternal grandmother, age 57, is overweight and has type 2 diabetes. His maternal grandfather is 58 and of normal weight; he recently suffered a stroke. Both paternal grandparents are in their late 50s and are of normal weight. The grandfather suffers from angina pectoris. Grandmother is in good health. The nurse discussed Kevin’s increased risk for obesity and comorbidities based on this history.

A review of systems reveals that Kevin enjoys school and has a number of friends he plays with both at school and after school. His mood is most often upbeat. He has no symptoms of diabetes and denies headache or breathing difficulties. He sleeps 8 to 10 hours every night. Kevin denies any abdominal discomfort and reports he has regular bowel movements. He denies any foot, hip, or knee pain. Kevin has no allergies to medications and is currently on no medications.

On physical examination Kevin is a white, well-developed, overly nourished, smiling young boy with a small frame and normal musculature, round trunk, and protruding abdomen. There are no obvious dysmorphic features. He has a normal gait, erect posture, and shows good hygiene.

- Vital signs: within normal limits, BP 105/65
- HEENT (head, ears, eyes, nose, throat): face is symmetrical with no abnormalities; eyes, PERRLA, no papilledema; no tonsillar enlargement; thyroid normal; lungs, normal breath sounds. Teeth in good repair
- Skin: overall even color; no areas of hyperpigmentation, growths, or striae; normal hair distribution
- Heart: normal heart sounds, regular rhythm, no murmurs
- Lungs clear to A and P
- Abdomen: presence of excess adipose tissue, normal bowel sounds, no evidence of discomfort or tenderness to palpation, no hepatomegaly
- Genitalia: normal for age penis, both testes descended, no hernias
- Extremities: no edema, normal pulses, no deformities, no gait deviations observed

Because Kevin is in the 92nd percentile for BMI and has risk factors (maternal overweight and hypertension and family history of stroke, cardiovascular disease, and type 2 diabetes mellitus), a fasting lipid panel and glucose levels were obtained. Liver function studies were deferred at this time. Fasting blood glucose was 80 mg/dl, cholesterol 150 mg/dl, and LDL 100 mg/dl, all of which were in the normal range.
MANAGEMENT AND TREATMENT OF OBESITY IN ADULTS

Effective management, as with all chronic medical conditions, must be based on a partnership between a highly motivated patient and a team of health professionals that may include a physician, psychologist, psychiatrist, advanced practice nurse, social worker, case manager, pharmacist, physical therapist, occupational therapist, dietitian, and other specialists depending on the person’s comorbidities.

Management strategies include:

- Lifestyle interventions using diet and physical activity
- Behavioral therapy, including assessing readiness for change
- Pharmacotherapy
- Surgery

**Lifestyle Intervention for Adults**

Initially, management requires the recognition that medical advice to “just eat less and exercise more” is not effective for patients to succeed at losing weight and maintaining that weight loss. Most individuals who are overweight or obese have already tried self-help approaches well before medical intervention is considered.

The patient’s weight management history can be a starting point in determining the choice of a treatment plan, which should begin with comprehensive lifestyle management.

**WEIGHT-LOSS GOALS**

An individual’s body weight and body fat are steadfastly regulated, and this is the basis of the challenge in losing weight and maintaining weight loss. Because of this, current thinking in the medical management of obesity has moved from a goal of massive weight loss to one of eliminating obesity-related comorbidities or reducing them to a minimum. Data previously suggested that approximately 10% of body weight loss in persons who are obese is associated with substantial health benefits. Newer guidelines indicate that clinically meaningful health improvements can even be seen with weight loss in the range of 2% to 5% (Hamdy et al., 2018).

The weight-loss goal for each patient must be individualized; however, a reasonable goal in the setting of a medical treatment program is approximately 1 to 2 pounds per week. Factors that are considered in setting a weight-loss goal include the weight of other family members as well as the patient’s cultural, ethnic, and racial background. There is evidence that greater weight loss can be achieved with a culturally adapted weight-loss program than with a more general health program.
Diet

Current findings indicate that many types of diet can be successful in losing weight. The best predictor of success is dietary adherence. Therefore, providers are advised to recommend diets to improve adherence according to patient preference.

Diet composition is important, but the key factor in promoting weight loss is a negative energy balance. Conventional diets can be classified broadly into two categories: 1) balanced, low-calorie diets (or reduced portion sizes) and 2) diets with different macronutrient compositions such as low-fat, high-protein, or low-carbohydrate diets.

**Low-Calorie and Reduced-Portion Diets**

Balanced, low-calorie diets and reduced-portion diets are those that dietitians and other weight-management professionals most commonly recommend. These diets underlie most of the commercial weight-loss programs, such as Weight Watchers, Take Off Pounds Sensibly (TOPS), and Overeaters Anonymous (OA). They are useful for short-term weight loss, but none of them are associated with reliable sustained weight loss. Diet-induced weight loss can result in increased levels of hormones that increase appetite. After successfully losing weight, these circulating levels of hormones do not decrease to levels prior to the weight loss, thus requiring long-term strategies to prevent obesity relapse.

Low-calorie diets involve reducing daily caloric intake to about 1,000 to 1,200 calories per day for women and 1,200 to 1,600 calories per day for men. They are associated with a mean weight loss of 1 to 2 pounds per week. A low-calorie diet may consist of a mix of meal replacements and regular foods divided among three or more meals throughout the day. Potential complications of these diets can include:

- Vitamin deficiency
- Starvation ketosis
- Electrolyte derangements
- Cholelithiasis

**Low-calorie** versions considered healthy include:

- Mediterranean diet
  - High level of monosaturated fat
  - Moderate consumption of alcohol, mainly as wine
  - High consumption of vegetables, fruits, legumes, and grains
  - Moderate consumption of milk and dairy products, mostly cheese
  - Low intake of meat and meat products
  (Anton et al., 2017)
• Dietary Approaches to Stop Hypertension (DASH) diet
  o 4–5 servings of fruit
  o 4–5 servings of vegetables
  o 2–3 servings of low-fat dairy
  o Less than 25% dietary intake from fat
    (Perreault, 2018d; Anton et al., 2017)

**Reduced-portion diets** may be based on regular, everyday foods; by participation in a structured weight-loss program (e.g., Jenny Craig, Nutrisystem); or by incorporating products such as meal-replacement shakes, prepackaged meals, and frozen entrees (e.g., Lean Cuisine, Healthy Choice). Alcohol, sodas, most fruit juices, and highly concentrated sweets are calorie dense and nutrient deficient and are generally prohibited or reduced to a minimum (Hamdy et al., 2018; Ryan & Kahan, 2018).

**Very low-calorie diets** (VLCDs) are best used in an established, comprehensive program. They involve reducing caloric intake to 800 calories per day or less. VLCDs are associated with profound initial weight loss of up to 3 to 5 pounds per week, much of which is from loss of lean tissue mass in the first few weeks. Most VLCDs use meal replacements such as formulas, soups, shakes, and bars instead of regular meals in order to ensure adequate intake of nutrients.

VLCDs are “drastic measures” recommended only for adults who are obese and need to lose weight quickly for health reasons. They are often used before weight-loss surgery and are only recommended for a period of up to 12 weeks. Compliance beyond a few weeks is poor, and close supervision is required. Adverse effects can include hair loss, skin thinning, hypothermia, cholelithiasis, electrolyte derangement, and emotional problems.

The VLCDs should **not** be followed by individuals who:

• Have a circulatory problem
• Experienced a heart attack
• Have juvenile-onset diabetes
• Are pregnant
• Take certain medications
• Have emotional problems
• Are older adults (over 50)
• Are children and adolescents
  (Perreault, 2018d; Hamdy et al., 2018)
Diets with Different Macronutrient Compositions

Macronutrients refer to carbohydrates, fats, and proteins. Some diets emphasize manipulation of these macronutrients in order to promote weight loss. It is not certain how these diets impact weight change, and there is debate as to whether low-fat or low-carbohydrate diets can better result in weight loss and sustainability over the long term. The success of these diets may depend on the type of carbohydrates or the types of fats that are eaten (Perreault, 2018d; Hamdy et al., 2018).

The long-term safety of diets that are low in carbohydrates and high in fat and protein is controversial. Low-carb diets might be useful in the short term to lose weight, lower blood pressure, and improve blood glucose control, but studies suggest that in the long term they are linked with an increased risk of death due to cardiovascular disease, cerebrovascular disease, and cancer (ESC, 2018).

Low-Carbohydrate Diets

A low-carbohydrate diet is variously defined as consuming no more than 20 to 70 grams of carbohydrates per day. Once a desired weight is achieved, carbohydrate intake can be increased to 50 grams per day. Low-carbohydrate diets with healthy fat and protein choices may reduce the risk of developing type 2 diabetes, coronary artery disease, and some cancers, particularly if care is taken in the selection of the type as well as the quantity of carbohydrate that is consumed. Low-carbohydrate diets promote weight loss by:

- Lowering calorie intake (higher protein intake decreases calorie intake by suppressing appetite)
- Increasing satiety due to a high intake of certain types of fiber
- Fighting cravings for carbohydrates and sugar
  (Leidy et al., 2015)

A low-carbohydrate diet focuses on:

- Proteins, including meat, poultry, fish, and eggs
- Excludes or limits:
  - Fruits
  - Breads
  - Sweets
  - Pastas
  - Starchy vegetables
  - Sometimes nuts and seeds
Low-carbohydrate diets may be associated with more frequent side effects, including:

- Constipation
- Headache
- Halitosis (bad breath)
- Muscle cramps
- Diarrhea
- General weakness
- Rash

Very low–carbohydrate diets lead to glycogen mobilization, and if carbohydrate intake is less than 50 grams per day, ketosis will develop (a metabolic state that is typically pathological in diabetes, when a build-up of ketones can result in ketoacidosis, a condition that can lead to coma or death). In a few rare cases, ketoacidosis has been reported to occur in nondiabetic individuals following a very low–carbohydrate diet (Hamdy et al., 2018; Perreault, 2018d; AND, 2016; Mayo Clinic, 2017a; von Geijer & Ekelund 2015; Hitoshi et al., 2017).

Types of low-carbohydrate diets include:

- **Atkins diet**, a high-protein and/or high-fat very low–carbohydrate diet that induces ketosis. The very low carbohydrate content is critical in inducing short-term weight loss in the first 2 to 4 weeks. The premise behind this diet is that protein is less prone to fat storage than are carbohydrates. Adherence to this diet is poor, and the noncompliance rate is close to 50%.

- **South Beach diet** allows for a more liberal carbohydrate intake and distinguishes between “good” and “bad” carbohydrates on the basis of their glycemic index (the value assigned to a food based on how slowly or how quickly it increases blood glucose levels).
  
  (Hamdy et al., 2018; Anton et al., 2017)

**Low-Fat Diets**

Low-fat dietary guidelines recommend a reduction in daily intake of fat to less than 30% of energy intake per day, and very low–fat diets provide less than 10% to 15%. The main premise behind this recommendation is that fat provides a higher number of calories per gram (9) compared to proteins and carbs (4). People who reduce their calorie intake by eating less fat do lose weight, and although the average loss is small, it is considered relevant for health. A low-fat diet may consist of:

- Grains, vegetables, and fruit at every meal
- Beans, peas, lentils
• Limited intake (6 ounces per day) of lean meat, fish, poultry, and eggs
• No more than 3 teaspoons of fat per day (vegetable oils)
• Low-fat or fat-free sweets and snack foods in moderation
• Fat-free or low-fat dairy
  (Perreault, 2018d)

Types of low-fat diets include:

• **Ornish diet**, a very low–fat vegetarian diet allowing 10% of calories from fat, 20% from protein, and 70% from carbohydrates. Foods include all dried beans, legumes, fruits, grains, and vegetables needed to feel full and low-fat or nonfat dairy products such as milk, cheese, and yogurt in moderation (Anton, 2017).

• **Therapeutic Lifestyle Changes (TLC) diet** allows for less than 7% of the day’s total calories from saturated fats and 25% to 35% of daily calories from total fat. Foods include lean meats, low-fat dairy products, grains, legumes, fruits, vegetables, nuts, and seeds, and avoid trans fats, added sugars, salt, and alcohol (Perreault, 2018d; Anton et al., 2017).

**High-Protein Diets**

High-protein diets have been recommended for obesity treatment because they can help build lean muscle (which increases the number of calories burned throughout the day) and are more satiating. High-protein diets may also improve weight maintenance. Like low-carbohydrate diets, high-protein diets can produce a state of ketosis. Some high-protein foods include:

• Legumes
• Dried beans
• Salmon
• Potatoes
• Meat
• Fish
• Eggs
• Dairy
• Peanut butter
• Tofu
  (Perreault, 2018d)
High-protein diets include:

- **Protein Power diet**, which allows for approximately 26% protein, 16% carbohydrates, 54% fat, and 4% alcohol. This diet allows all types of meat, fish, poultry, eggs, cheese, nonstarchy vegetables, butter, oil, and salad dressing, as well as alcohol in moderation. Foods to be avoided include fruits, starchy vegetables, grains, and milk (Zelman, 2018)

### Intermittent Fasting

Intermittent fasting is an eating plan that cycles between periods of fasting and eating. There are various methods, including:

- **The 16/8 method** requires skipping breakfast and restricting daily eating to eight hours, subsequently fasting for the remaining 16 hours of the day.
- **Eat-stop-eat method** involves 24-hour fasts once or twice per week on nonconsecutive days.
- **5:2 diet** restricts intake to 500–600 calories on two nonconsecutive days of the week, with no restricted intake on the five remaining days.
- **Warrior diet** involves eating small amounts of raw fruits and vegetables during the day and one large meal at night.

Advantages of intermittent fasting are satisfaction without food restriction and an increase in metabolic rate of 3.6% to 14% in the short term. A disadvantage of intermittent fasting is that it is not appropriate for people with diabetes, pregnant and breastfeeding women, older adults, individuals with eating disorders, and those in need of regular food intake to take medications (Perreault, 2018d; Johnstone, 2015; Ganesan et al., 2018).

### PHYSICAL ACTIVITY

Physical inactivity is a primary contributor to obesity and is often targeted for intervention because it is modifiable at the individual level. Creating a negative energy balance by decreasing calorie consumption and increasing activity is a common strategy in the management of overweight and obesity. Physical activity is an important lifestyle behavior associated with long-term weight loss and prevention of weight gain following initial weight loss.

Weight loss by diet without physical activity, especially in older people, can increase frailty due to age-related losses in bone density and muscle mass. Adding aerobic and resistance activity counters such loss.
Physical activity prevents obesity by:

- Increasing total energy expenditure
- Decreasing fat around the waist and total body fat
- Slowing the development of abdominal obesity
- Helping build muscle mass, which increases energy burned even when at rest
- Reducing depression and anxiety, which can help with motivation

Current evidence indicates that physical activity should be moderate to vigorous in intensity to influence body-weight regulation. There is also evidence that physical activity can be accumulated throughout the day in short periods of time rather than during a longer, structured period (Jakicic et al., 2018; Chin et al., 2016; Harvard T.H. Chan, 2019a).

The U.S. Department of Health and Human Services (2018) recommends the following for most healthy adults:

- **Aerobic activity.** 150 minutes per week of moderate activity or 75 minutes per week of vigorous activity. This can be spread out over the course of the week in sessions at least 10 minutes long.

- **Strength training.** At least twice a week. No specific amount of time is specified.

While performing physical activity at a moderate level, the breathing and heart rate should be noticeably faster, but the person is able to converse. During vigorous activity, the heart rate is increased substantially and breathing is too fast and hard to allow for conversing (Mayo Clinic, 2017b).

For those who are keeping track of calories taken in and expended, it is helpful to know approximately how many calories are burned during a chosen activity in 30 minutes (see table below).

<table>
<thead>
<tr>
<th>Activity</th>
<th>125-pound person</th>
<th>155-pound person</th>
<th>185-pound person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleeping</td>
<td>19</td>
<td>23</td>
<td>28</td>
</tr>
<tr>
<td>Computer work</td>
<td>41</td>
<td>51</td>
<td>61</td>
</tr>
<tr>
<td>Watching TV</td>
<td>23</td>
<td>28</td>
<td>33</td>
</tr>
<tr>
<td>Cooking</td>
<td>75</td>
<td>93</td>
<td>111</td>
</tr>
<tr>
<td>Food shopping</td>
<td>105</td>
<td>130</td>
<td>155</td>
</tr>
<tr>
<td>Low impact aerobics</td>
<td>165</td>
<td>205</td>
<td>244</td>
</tr>
<tr>
<td>High impact aerobics</td>
<td>210</td>
<td>260</td>
<td>311</td>
</tr>
</tbody>
</table>

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### THE ROLE OF PHYSICAL THERAPY

Physical therapists are an important part of the multidisciplinary team working with individuals who are dealing with obesity. Physical therapists assist patients to become more physically active by teaching ways to exercise without causing pain and that are enjoyable. Therapists determine an appropriate treatment program for each individual that includes aerobic exercise and strength training.

Physical therapists also help patients explore the underlying reasons for their behaviors and to identify barriers to developing more healthy habits. They work with the patient to set individualized, realistic goals and assist the patient to stay with the program. The following are ways in which physical therapists work with bariatric patients:

- **Pain reduction.** By designing a personalized exercise program, the therapist can help with the performance of activities with the least amount of pain. Although the person may experience pain with activity, the activity itself may help reduce pain.

- **Cardiovascular health.** Physical therapists develop aerobic exercise programs that are heart-healthy, elevate metabolism, and burn more calories.

- **Movement.** Physical therapists work with patients to help restore normal range of motion of the joints, progressing from passive exercises to active exercises.

- **Muscle strength.** Physical therapy helps to improve muscle strength by addressing muscle weakness and developing gentle and low-impact forms of weight training to improve overall strength and relieve joint discomfort. Because muscle burns more calories than other body tissues, muscle building exercises can benefit weight-loss efforts.

- **Flexibility and posture.** The physical therapist works with patients to gently stretch tight major muscles and to improve and maintain proper posture, which is essential in performing difficult activities with ease, less discomfort, and respiratory function. (APTA, 2019)
Behavioral Modification

Changing behavior, especially long-term, habitual patterns, and getting oneself to do something different even when it is known to be the best thing to do, depends on an individual’s mindset. Mindset refers to the belief in one’s limitations. A fixed mindset focuses on what is known and the belief that basic abilities and talents are fixed traits that cannot be changed. A growth mindset focuses on improving what and how one does things. In order to lose weight and keep it off, people often must learn to think differently about what they eat, when they eat, and how they eat.

ASSESSING READINESS TO CHANGE

Efforts aimed at behavioral change begin with the clinician’s determination of a patient’s readiness to change as well as the readiness of parents and families of obese children and adolescents to change. One model for assessing such readiness is the Transtheoretical Model, which explores the individual’s feelings, awareness, judgments, perceptions, and behavior and describes the process of change using five stages.

1. **Precontemplation.** Individuals in this stage have no intention of changing or taking action within the near future. People are often uninformed about the consequences of overweight and obesity, they may have failed in the past to make changes or lose weight, or they may avoid seeking any information that would help change behavior. People in this stage often underestimate the pros and place more emphasis on the cons of changing behavior. The person in the precontemplation stage should be engaged and provided with information about the need for change and given personalized information about the benefits of change and the risks if change is not made.

2. **Contemplation.** The person is considering making changes within the next 6 months and is aware of both the positive effects of making change and the negative effects of failing to change. The person may be uncertain about which approach to follow, resulting in procrastination and inability to make a move toward change. At this stage, the individual should be encouraged to set goals and make specific plans.

3. **Preparation.** An individual in this stage of readiness is determined to take action within the next month and has usually begun to prepare a plan of action, such as a weight-loss or exercise program. Individuals in this stage require assistance in the development and implementation of specific action plans and in setting realistic goals.

4. **Action.** The person in this stage of readiness has made significant modifications in behavior and lifestyle over the past 6 months or longer and intends to keep moving forward. Assisting a person can include providing problem-based learning experiences, support, and feedback.

5. **Maintenance.** The person has made significant modification in behavior and lifestyle and has actively worked to prevent a relapse for more than 6 months. The individual is confident that change can be maintained. At this stage, it is important to continue to provide support, assist with problem-solving, positively address slips and relapses, and employ reminder systems or performance support tools.

(LaMorte, 2018)
INTERVENTION STRATEGIES

Interventions aimed at behavioral modification are considered essential in the management of the patient who is overweight or obese. Behavioral modification methods can be used either alone or in conjunction with other treatments, working to create goals, helping to maintain goals that have already been achieved, preventing possible relapses, and managing difficult situations.

Behavioral modification interventions include face-to-face contact and are often conducted in group sessions, which may be available at local hospitals, through commercial programs, or in office settings. While some patients might prefer individual therapy, the group setting may be more cost effective, and there is insufficient evidence to conclude that one is better than the other. All interventions use similar strategies, which include the following elements:

- **Collaborative setting of realistic and achievable goals**, which is meant to increase motivation and adherence.
- **Accountability** for each of the goals through contact with the provider for assessment.
- **Self-monitoring** of food intake, weight, and activity (which is the most important step in successful behavior therapy). Self-monitoring slows down decision-making, allowing time to make healthier choices and alerting the individual about overconsumption and nutritional content of foods. Tools for self-monitoring can include keeping food diaries and activity records.
- **Stimulus control**, by altering the person’s environment to help make better choices. This may involve removing less-healthy foods from the home.
- **Eating style**, which involves slowing down the eating process.
- **Nutrition education and meal planning** with a registered dietitian for assessment of knowledge and preferences.
- **Problem-solving and troubleshooting** specific eating situations to develop a specific plan for a desired behavior and learning skills for dealing with eating outside the home and in social settings. This is best accomplished in a group setting where individuals can learn from each other.
  (Perreault, 2018e; Castelnuovo et al., 2017; Kelley et al., 2017)

MOTIVATIONAL INTERVIEWING (MI)

While behavioral interventions provide a variety of strategies for change, motivational interviewing addresses the specific challenges of motivation, confidence, treatment readiness, ambivalence, and resistance.

MI assumes that behavior change is affected more by motivation than by information and that no lasting change will be achieved unless the patient sees the need to change. MI is person-centered and goal-directed, and it increases the person’s motivation for commitment to behavioral change.
The hallmark of MI is working with and through a person’s ambivalence about making a change and recognizing that it is the patient who decides whether and how to change. The core principles of MI are:

- Expressing empathy
- Supporting the person’s self-efficacy
- “Rolling” with resistance
- Developing discrepancy
  (Castelnuovo et al., 2017; Kelley et al., 2017)

Motivational interviewing has been shown to reduce dropout and increase motivation and cooperation (Ingersoll, 2017; MINT, 2018).

(See also the “Case” on motivational interviewing later in this course.)

TECHNOLOGY AND BEHAVIORAL CHANGE

Technology can also be enlisted to enhance the success of behavioral change efforts. Mobile health (mHealth) is a term describing the medical and public health practice of utilizing mobile devices such as phones, tablets, personal computers, personal digital assistances, biosensors, and others. MHealth has shown positive results in both adult and childhood obesity. Use of this technology provides education, clinical decision support, remote data collection and analysis, health promotion and awareness, remote monitoring, and integrated care and diagnostic support.

For example, smartphones have gained popularity and are being adopted for the prevention and control of obesity because they offer multiple functionalities. Different types of applications (apps) have been developed for use in obesity management, utilizing features such as movement sensors, microphones, and cameras.

Successful Internet-based programs include a structured curriculum providing information and behavioral strategies for losing weight, along with personal feedback from an interventionist delivered via email, text, or phone (Alamuddin et al., 2018).

Overall, the effects of obesity-related apps and the use of the Internet on patient satisfaction and adherence have been positive and cost effective. Costs associated with the purchase and use of obesity-related apps are generally, but not always, relatively low, especially when compared with the costs associated with conventional behavioral weight-loss therapy (Harous et al., 2018; Bennett et al., 2018).

It has been recognized that obesity treatment is less successful for socioeconomically disadvantaged populations, particularly when delivered in primary care. Digital health strategies extend the reach of clinical obesity treatment to many settings serving patients who otherwise would have no access (Bennett et al., 2018).
THE ROLE OF OCCUPATIONAL THERAPY

Occupational therapists treat patients for the prevention and management of obesity, including helping with weight-loss efforts and adaptations for occupational challenges caused by obesity. Occupational therapists assist patients who are obese in making necessary lifestyle changes by focusing on health promotion, disease prevention, remediation, adaptation, and maintenance. Outcomes often include increased participation, increased ease when performing activities of daily living and instrumental activities of daily living that require physical activity and endurance, improved self-esteem, and decreased symptoms of depression and anxiety.

Occupational therapists enhance the person’s functional abilities in the following areas and manner:

- Activities of daily living, including strategies for maintaining good hygiene
- Supporting increased physical endurance
- Offering strategies for safe mobility in the home and in the community
- Teaching ways to conserve energy and to simplify work
- Instructing in the use of proper body mechanics to avoid injury
- Monitoring and maintaining skin integrity
- Recommending and assisting with adaptive equipment and methods to facilitate instrumental activities of daily living
- Home modification to promote participation in activities, improve environmental access, and ensure safety
- Assisting with setting routines for healthy food selection, shopping, and meal preparation
- Assisting with the establishment of sleep routines, relaxation, and positioning to increase comfort and promote adequate rest
- Providing wellness groups for patients and families to facilitate health promotion and social support
- Teaching coping strategies for management of pain, stress, and anxiety
- Addressing sexual health concerns
- Assisting individuals to participate in the community by identifying appropriate businesses and social gatherings
- Assisting the individual in making task and environmental modifications to maintain participation in roles and occupations at current body weight, and to accommodate weight management
  (AOTA, 2015)
Pharmacology

There are only a few drugs available for the treatment of obesity, and their effectiveness is limited to palliation rather than cure. Benefits fade when they are discontinued. All medications carry more risks than diet and physical activity do, and medications are used only in those patients in whom the benefit justifies the risk. They are not used during pregnancy or when breastfeeding.

Weight-loss drugs are considered for patients with a BMI >30 or a BMI >27 with a serious medical condition related to obesity (e.g., diabetes, hypertension).

Weight-loss drugs may not be effective for everyone. When used as part of a diet and exercise plan, typical weight loss is 5% to 10% of body weight over a 12-month period.

Currently, there are three major categories of drugs used to manage obesity:

- **Anorexiants** are drugs that act on the brain to suppress appetite. They have a stimulant effect on the hypothalamic and limbic regions of the brain that control satiety.

- **Stimulants** are drugs that increase dopamine, which accelerates the autonomic nervous system and results in an increased energy expenditure.

- **Lipase inhibitors** impair the gastrointestinal absorption of ingested fat, which is then excreted in the stool.

### DRUGS APPROVED FOR WEIGHT LOSS

<table>
<thead>
<tr>
<th>Drug</th>
<th>Category</th>
<th>Common Side Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phentermine (Adipex-P, Suprenza)</td>
<td>Anorexiant and stimulant</td>
<td>Increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal with long-term use</td>
</tr>
<tr>
<td>Phendimetrazine (Bontril PDM, Bontril SR)</td>
<td>Anorexiant and stimulant</td>
<td>Same as above</td>
</tr>
<tr>
<td>Benzphetamine (Didrex, Regimex)</td>
<td>Anorexiant and stimulant</td>
<td>Same as above</td>
</tr>
<tr>
<td>Methamphetamine (Desoxyn)</td>
<td>Anorexiant and stimulant</td>
<td>High abuse potential</td>
</tr>
<tr>
<td>Diethylpropion</td>
<td>Anorexiant and stimulant</td>
<td>Constipation, restlessness, dry mouth</td>
</tr>
<tr>
<td>Lorcaserin (Belviq, Belviq XR)*</td>
<td>Anorexiant</td>
<td>Headache, nausea, dizziness, fatigue, dry mouth, constipation; euphoria/dissociation with higher doses</td>
</tr>
</tbody>
</table>
Phentermine and topiramate ER (Qsymia)*
- Anorexiant; action of topiramate on weight loss is not known
- Constipation, restlessness, dry mouth, increased blood pressure and heart rate, insomnia, nervousness, restlessness, dependence, abuse or withdrawal with long-term use

Liraglutide subcutaneous injection (Saxenda)*
- Anorexiant
- Nausea/vomiting, diarrhea, constipation, headache, heartburn, fatigue, dizziness, stomach pain, gas, dry mouth, low blood sugar in type 2 diabetes, increased lipase

Buproprion and naltrexone (Contrave)*
- Anorexiant
- Nausea, vomiting, headache, fatigue, constipation, dizziness, insomnia, dry mouth, diarrhea, increased blood pressure, anxiety, tremor, hot flush, unusual taste

Orlistat (Alli OTC, Xenical)*
- Lipase inhibitor
- Oily spotting, flatulence, fecal urgency, soft stools, fecal incontinence; vitamin A, D, E, and K deficiency

*Approved for long-term use.

Sources: Perreault, 2018f; Hamdy et al., 2018; Mayo Clinic 2018; Anderson, 2018.

Weight Loss Surgical Procedures

Surgical procedures for obesity are major, life-changing events. An individual who is considering bariatric surgery must undergo an evaluation to determine if health benefits of surgery outweigh the potentially serious risks, and if the person is medically and psychologically able to undergo such procedures.

Candidates for bariatric surgery must meet at least one of the following criteria:

- BMI ≥40 or ≥100 pounds overweight
- BMI ≥35 and at least one obesity-related comorbidity (type 2 diabetes, hypertension, sleep apnea, other respiratory disorder, nonalcoholic fatty liver disease, osteoarthritis, lipid abnormality, gastrointestinal disorder, heart disease)
- Inability to achieve a healthy weight loss sustained for a period of time with prior weight loss efforts

It is recommended that surgery be performed by a board-certified surgeon with specialized experience/training in bariatric and metabolic surgery and at a center that has a multidisciplinary team of experts for follow-up care (ASMBS, 2019a).

TYPES OF BARIATRIC SURGERY

Bariatric surgical procedures cause weight loss by restricting the volume of food the stomach can hold, causing malabsorption of nutrients, or a combination of the two. Evidence is growing that
these procedures may also have neurohormonal effects on the regulation of energy balance and hunger control. Studies suggest that different types of bariatric surgery may interact with particular gene variants and may take effect by different pathways, determining the outcomes of obesity treatment. This trait may help in choosing the most suitable type of surgery for an individual patient (Sun et al., 2017).

The most commonly performed procedure in the United States is the gastric sleeve, which appears to be the safer procedure. The American Society for Metabolic and Bariatric Surgery reports that in 2017, 59.4% of bariatric procedures were sleeve gastrectomies, followed by gastric bypass (17.8%), gastric band (2.8%), and biliopancreatic diversion (0.7%) (Cleveland Clinic, 2018; ASMBS, 2018).

Studies have found that more than 90% of bariatric surgery patients are able to maintain a long-term weight loss of 50% of excess body weight or more, and among those who are super-obese (BMI $\geq 50$), more than 80% are able to maintain more than 50% excess body weight loss. Bariatric surgery is associated with massive weight loss and improves, or even cures, obesity-related comorbidities for the majority of patients (ASMBS, 2019b).

**Gastric Bypass (Roux-en-Y)**

The gastric bypass combines both restrictive and malabsorption approaches. The operation involves sealing off the upper section of the stomach from the lower section and then connecting the upper stomach directly to the bottom end of the small intestine. The procedure is completed by connecting the top portion of the divided small intestine to the small intestine further down so the stomach acids and enzymes from the passed stomach and first portion of the small intestine will eventually mix with the food.

With this procedure, weight loss is fast and dramatic, and about 50% of it happens in the first six months, continuing for up to two years following surgery. Gastric bypass also has good long-term results, with studies showing many people keep most of the weight off.
for 10 years or longer. Gastric bypass is considered irreversible but has been reversed in rare cases.

A significant risk for this procedure is dumping syndrome, which involves food emptying too rapidly from the stomach into the intestines before it is properly digested. Approximately 85% of people who have this procedure develop some dumping. Symptoms include nausea, bloating, pain, sweating, weakness, and diarrhea, and are often triggered by sugary or high-carbohydrate foods.

Other risks include gallstones due to rapid weight loss, hernias that require surgical correction, and failure to get adequate nutrients. The loss of calcium and iron may lead to osteoporosis and anemia, and supplements must be taken for the remainder of the person’s life (NIH, 2018; Saber, 2018).

**Laparoscopic Adjustable Gastric Band**

This is a restrictive procedure that involves the placement of an adjustable silicone band with an inner inflatable balloon around the top of the stomach, creating a small pouch that allows for a full feeling after eating a small amount of food (approximately one ounce). The balloon is filled with sterile saline solution, and the size of the opening from the pouch to the rest of the stomach can be adjusted as needed to reduce side effects and improve weight loss by injecting or removing the saline through a plastic tube that runs from the balloon to a small port placed under the skin.

Advantages of this procedure are that it is done laparoscopically, does not require cutting the stomach or moving the intestines, and therefore has fewer complications. In addition, the band can be adjusted or removed later. A disadvantage is the risk that the band may slip or become worn, requiring another surgery to repair it.

Gastric banding results in a loss of approximately 35% to 45% of excess weight, but results vary widely. In time, the stomach returns to its normal size.
The most common problems after gastric banding surgery include nausea and vomiting, issues with the adjustment device, surgical wound infections, or minor bleeding, all of which occur less than 10% of the time (NIH, 2018; Saber, 2018).

**Gastric Sleeve**

Gastric sleeve, also known as *vertical sleeve gastrectomy*, involves removal of 75% of the stomach, leaving a narrow tube or sleeve, which is then connected to the intestines. This restricts the amount of food that can fit in the stomach, creating a feeling of fullness. Removal of part of the stomach also affects gut hormones and other factors such as gut bacteria that may affect both appetite and metabolism. This surgical procedure is not reversible.

![Gastric sleeve](Source: National Institutes of Health.)

With this procedure there is a greater weight loss than with gastric banding. There are no changes to the intestines, and no foreign objects are placed in the body. The procedure causes favorable changes in gut hormones that suppress hunger, reduce appetite, and improve satiety. Gastric sleeve requires a short hospital stay of approximately 2 days. With this procedure there is a risk of long-term vitamin deficiencies, a chance of acid reflux, and a higher risk of surgery-related problems than with gastric banding (NIH, 2018; Saber, 2018).

**Biliopancreatic Diversion with Duodenal Switch**

This is a malabsorption procedure with two components: 1) a surgery similar to the gastric sleeve creates a small tubular stomach pouch, and 2) the duodenum is divided just past the outlet of the stomach. A segment of the distal small intestine is then brought up and connected to the outlet of the newly created stomach pouch, so that when the person eats, food passes through the tube and empties directly into the last segment of the small intestine. This second surgery redirects food to bypass roughly three quarters of the small intestine. The bypassed section is then reattached to the first part of the small intestine, allowing bile and pancreatic enzymes necessary for the breakdown and absorption of protein and fat to mix with food.
Biliopancreatic diversion with duodenal switch. (Source: National Institutes of Health.)

This procedure is more involved than a gastric bypass but can result in even greater and more rapid weight loss. Much of the stomach is removed. However, what remains is larger than the pouches formed during gastric bypass or banding, and larger meals may be eaten with this surgery.

Biliopancreatic diversion increases the risk of failure to get enough nutrients and has many of the same risks as gastric bypass. With the addition of the duodenal switch, however, these risks may be lower. There is a fairly high risk of hernias requiring surgical repair, but the risk is lower if the procedure is done laparoscopically (NIH, 2018; Saber, 2018).

OTHER SURGICAL INTERVENTIONS

*Electrical Stimulation System (Vagal Blockade, or VBLOC)*

This is a laparoscopically implanted pulse generator that delivers low-energy, high-frequency, intermittent electrical pulses to the intra-abdominal vagal trunk for a predetermined number of hours that signal to the brain that the stomach is full.

The internal components include a rechargeable pulse generator (also called a *neuroregulatory disc*) that delivers electrical signals to nerve electrodes. The electrodes are placed on the trunks of the vagus nerve in the abdomen, and two electrical leads connect the leads to the pulse generator. The external components include a transmit coil and a mobile charger, allowing the patient to charge the device and healthcare professionals to adjust settings. The process of electric stimulation is understood, but the exact reasons for its weight-loss benefit are as yet unknown.
Implantation of this device takes about an hour and a half under general anesthesia, and side effects may include nausea, vomiting, heartburn, problems swallowing, belching, mild nausea, and chest pain. The procedure has a low rate of serious complications, and the device can be removed or deactivated at any time.

FDA approval is limited to people with a BMI between 40 and 45, or patients with a BMI of 35 to 39.9 who also have an obesity-related condition. In addition, patients must have demonstrated a history of supervised, traditional weight-loss efforts without success (FDA, 2018).

Results from a study of the Maestro Rechargeable System have shown the device to result in less weight loss than reported with conventional surgical procedures. However, the weight loss led to improvements in comorbidities, qualify of life, and control over hunger with fewer risks than conventional procedures (Apovian et al., 2017).

**Gastric Balloon**

These temporary devices are gas- or saline-filled silicone balloons that limit how much the stomach can hold, making the person feel fuller faster. They can be placed via a swallowable capsule attached to a thin catheter or via an endoscope. The balloon is placed temporarily and should be removed after six months (FDA, 2018).

An intragastric balloon may be an option for a person who:

- Has a BMI between 30 and 40
- Is willing to commit to healthy lifestyle changes and regular medical follow-up, as well as participation in behavioral therapy
- Has not had any previous stomach or esophageal surgery

Side effects, including pain and nausea soon after insertion of the balloon, usually last only a few days and can be treated with oral medications. There is a risk that the balloon...
could deflate and move through the digestive system, causing blockage requiring a further procedure. Other risks include ulcers or perforation of the stomach or esophagus. Of serious concern is the fact that five deaths were reported in 2017 that may have been due to the balloons as a result of perforation of the stomach or esophagus or intestinal obstruction (FDA, 2018; Mayo Clinic, 2019; Kumar et al., 2017).

The FDA has indicated **serious risks** with these balloons, including:

- Sudden inflammation of the pancreas (acute pancreatitis) caused by the balloon’s pressure on surrounding organs
- Balloons filling with air (spontaneous overinflation) and causing discomfort and death

Because of these reports, the FDA is currently monitoring the problems and advising healthcare providers to closely monitor patients for complications. The FDA is also advising providers to explain symptoms that could be signs of serious or even life-threatening problems and what to do if these symptoms occur (FDA, 2018).

**Gastric Emptying System (AspireAssist)**

The AspireAssist, approved in 2016, is a device intended to assist weight loss in persons age 22 and older who are obese with a body mass index of 35 to 55 and who have failed to achieve and maintain weight loss through nonsurgical weight-loss therapy. It is not approved for use in certain patients, including those who have eating disorders such as bulimia.

The AspireAssist includes a tube placed in the stomach via an endoscope connected to a disc-shaped port valve that lies outside the body, flush against the skin of the abdomen. The valve is used to drain a portion of the stomach contents into a receptacle 20 to 30 minutes after a meal. Once opened, it takes approximately 5 to 10 minutes to drain food matter through the tube and into the container. The device removes approximately 30% of the calories consumed. Patients require frequent monitoring by a healthcare provider to shorten the tube as they lose weight and abdominal girth so that the disc remains flush against the skin. Patients must thoroughly chew all food, among other lifestyle changes, and may have the device removed when they reach their target weight.

The device has a safety feature that keeps track of the number of times the drain tube is connected to the port and automatically stops working after 115 cycles (about five to six weeks). Patients must then return for a replacement part for the device in order to continue therapy.

Study results show an average loss of 12.1% of total body weight after one year compared with 3.6% for control patients who receive only lifestyle therapy.

Side effects include occasional indigestion, nausea, vomiting, constipation, and diarrhea. Other side effects may be due to the use of an endoscope, including sore throat, pain,
unintended puncture of the stomach intestinal wall, and death. Risks related to the abdominal opening for the port value can include pain, irritation, inflammation of the skin, leakage, bleeding, and/or infection, as well as migration of the port valve into the stomach wall. Following removal of the device, there is a risk of a persistent fistula between the stomach and the abdominal wall (FDA, 2018; Kumar et al., 2017).

BARRIERS TO BARIATRIC SURGERY

Bariatric surgery is expensive. Even though patients may spend only two days in the hospital, these operations require the use of expensive, high-technology equipment as well as advanced nursing and surgical training. The decision to pursue a surgical solution for treatment of obesity is often one taken by middle- to upper-income patients, since most low-income people cannot pay the cost for these procedures.

<table>
<thead>
<tr>
<th>Type of Procedure</th>
<th>Price Range</th>
<th>Average Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gastric bypass</td>
<td>$15,000 to $35,000</td>
<td>$25,571</td>
</tr>
<tr>
<td>Laparoscopic adjustable gastric band</td>
<td>$8,700 to $29,000</td>
<td>$14,532</td>
</tr>
<tr>
<td>Gastric sleeve</td>
<td>$9,600 to $26,000</td>
<td>$16,800</td>
</tr>
<tr>
<td>Biliopancreatic diversion with duodenal switch</td>
<td>$22,000 to $42,000</td>
<td>$25,000</td>
</tr>
</tbody>
</table>

Historically, these surgeries were considered experimental and were not covered by healthcare insurers, in part due to bias against morbidly obese people. Some argue that adding a bariatric benefit is “enabling” people who are obese or providing coverage for a cosmetic procedure. However, more and more insurance companies are beginning to cover these procedures. Most carriers offer some sort of weight-loss surgery coverage, and Medicaid typically covers these procedures with certain stipulations. Certain states have laws that require insurance companies to cover weight-loss surgery if the patient meets the NIH health criteria.

However, because of an increase in the number of these procedures, many carriers add qualifiers to the NIH guidelines. Some require people considering bariatric surgery to stop smoking, while others may require candidates to lose weight before they qualify, which is a difficult feat for those who have not been able to do so through lifestyle and behavioral modification. Other insurance plans require a candidate to be successful at losing weight when following 6 to 12 months of a continuous medically supervised diet, while others require the opposite (failure). One insurance company requires that candidates do not gain any weight during the three-month preoperative phase in order to provide evidence that they will be able to follow the postoperative plan of care.

In part, due to these hurdles, only a small number (1% to 2%) who qualify as a candidate for bariatric surgery actually get the operation (Obesitycoverage, 2018; PMPH, 2019).
THE ROLES OF OCCUPATIONAL AND PHYSICAL THERAPY

**Occupational therapists** provide lifestyle modification interventions to reduce weight before surgery and improve postsurgical outcomes. Occupational therapists also assist patients with occupational changes following surgery, including new habits and routines required when eating much smaller quantities of food, taking supplements, building and maintaining strength through physical activity, and social eating. Occupational therapy lifestyle interventions are also beneficial for patients who experience weight gain after the initial loss (Dieterle, 2018).

**Physical therapists** assist in the management of patients who are candidates for bariatric surgery. Therapists help prepare patients for the surgery and recovery by developing and instructing them in individualized preoperative and postoperative programs. Preoperatively, therapy may involve strength training and aerobic conditioning, and postoperative programs often begin with deep breathing and lower-extremity exercises to gently increase strength and aerobic conditioning (APTA, 2019).

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**CASE**

**Eric, Age 63**

Eric is a 63-year-old man with type 2 diabetes who is referred by his primary care physician to the Kensington Bariatric Center for evaluation for bariatric surgery. The bariatric center is staffed by a team of obesity specialists that includes internists, registered dietitians, nurses, and a psychologist, all of whom are involved in a comprehensive evaluation of the patient.

Eric’s medical history indicates that his current medications include 30 units of NPH and 70 units of NPH insulin before breakfast and 70 units before dinner, Metformin 850 mg twice a day, atorvastatin, nifedipine, aspirin, and allopurinol. He has sleep apnea but is not currently using his continuous positive airway pressure (CPAP) machine. His reported morning glucose levels are between 100 and 130 mg/dl, hemoglobin A1C level is 6.1% (within normal limits), and his triglyceride level is 201 mg/dl. He weighs 342 pounds, is 5 feet 6 inches tall, and has a BMI of 55.2.

Eric reports that he became obese as a child and that he has gained weight every decade since. He is currently at his highest adult weight and there are no indications that medications or medical complications contribute to his obesity. His family history reveals that his father, two of his sisters, and one of his daughters are also obese.

Eric describes that his weight-loss efforts in the past have included both commercial and supervised medical weight-loss programs. He has been unable to sustain any weight he lost on these programs after a few months of discontinuing them. He has been to weight-loss sessions with a registered dietitian and has also taken part in a hospital-based, dietitian-led, group weight-loss program where he lost weight. But again, he regained it all. He has been on many self-directed diets throughout the years but has never lost any significant weight while on them, and whatever weight he did lose, he once again regained.
A food intake history reveals that Eric eats three meals a day, with dinner being the largest. He sometimes eats between meals, especially if there is food available at his workplace. He eats a snack before bedtime to avoid hypoglycemia. He eats in restaurants once or twice each week but does not frequent any fast-food places. He does not drink alcohol. He admits to binge eating on occasion, even when not hungry, and attributes this to stress.

Eric is a widower who recently began a new relationship. He and his girlfriend have known each other for many years, and she does not have a problem with weight. He reports that both he and his girlfriend are concerned about his weight and his diabetes, and he is now willing to consider weight-loss surgery.

Following his evaluation, it is determined that Eric meets the criteria according to current clinical guidelines because he has clinical severe obesity (BMI ≥40 with comorbid conditions), has failed with less invasive methods of weight loss, and is at high risk for obesity-associated morbidity/mortality. He is found to have no contraindications for surgery.

Eric attends an orientation session where he learns about his surgical options, is given a description of the procedures, including their risks and possible complications, and is encouraged to ask questions. He is referred to the surgeon for evaluation, and it is decided that he will pursue the Roux-en-Y gastric bypass. He is set up for a surgical date and also encouraged to lose weight before the surgery.

Eric does well after surgery, eats without difficulty, and reports feeling no hunger. At two months post surgery, his fasting and pre-dinner blood glucose levels have been consistently less than 120 mg/dl, with no other diabetes medications required.

One year following surgery, Eric’s weight is 254 pounds, a loss of 88 pounds, and he continues to lose weight at approximately 1 to 2 pounds each month. His diabetes, sleep apnea, and hypercholesterolemia are resolved, and his blood pressure is controlled.

MANAGEMENT AND TREATMENT OF OBESITY IN CHILDREN AND ADOLESCENTS

Management of obesity in children and adolescents requires family-centered communication and family-based interventions rather than those focused on the patient (child or adolescent) alone. Targeting a parent as an important agent of behavior change, either with or without the child, is more effective for long-term weight management than targeting only the child without parental participation. Any therapeutic intervention without the understanding, approval, and active participation of family members is unlikely to succeed (Skelton, 2018; Schwarz, 2018b).

Effective approaches should be collaborative rather than prescriptive, with the clinician engaging the family in selecting specific behaviors to change. The child should be directly involved in decision-making as appropriate for his or her age (Schwarz, 2018b).
Programs in which parents are active participants in the intervention result in superior outcomes for the child compared with interventions in which the parent is not encouraged to make their own behavioral changes. Parental weight loss is a robust predictor of the success of weight loss in the child, with evidence suggesting that parental influences on the child’s weight-loss success occur through parental modeling of healthy behaviors and changes to the home environment. Furthermore, family-based intervention is cost effective in comparison to treating children with obesity and parents with obesity separately (Kumar & Kelly, 2017).

A team approach to management includes nurse educators, nutritionists, exercise physiologists, and counselors, as well consultations with pulmonary medicine specialists, orthopedists, and/or gastroenterologists as appropriate. In addition, any acute or chronic complications of obesity are managed and psychiatric assistance obtained for eating disorders or severe depression (Schwarz, 2018a).

The Staged Approach

The staged approach to address obesity is determined by multiple factors, including age, BMI, and previous weight-management history. Management to address overweight or obesity is divided into stages that represent degrees of supervision, counseling, and intervention. The American Academy of Pediatrics recommends a four-stage approach to treatment of childhood obesity:

1. **Stage I (Prevention-Plus Protocol)** can be implemented in primary care with recommendations for improving the diet, increasing physical activity, modifying family behaviors or environments, monthly follow-ups, and advancement to stage II if BMI does not improve in 3 to 6 months.

2. **Stage II (Structured Weight Management Protocol)** consists of more structure and supervision in a primary care office with help from allied professionals (e.g., dietitian, physical therapist, mental health counselor) and includes stage I guidelines plus increased structure and education, follow-up as often as needed, and advancement to stage III if BMI does not improve in 3 to 6 months.

3. **Stage III (Comprehensive Multidisciplinary Intervention)** for children with severe obesity can be implemented in a primary care office and includes stage II guidelines, increased structured dietary program, plus a multidisciplinary team and outside facilities, such as a pediatric obesity treatment clinic for structured physical activity.

4. **Stage IV (Tertiary Care Intervention)** is implemented in a pediatric weight management center with a multidisciplinary team with expertise in pediatric obesity, and includes stage III recommendations, medications, extremely structured dietary regimens, or bariatric surgery.

(Skelton, 2018; AAP, 2017b; Kumar & Kelly, 2017)
Lifestyle Interventions for Children and Adolescents

Research has indicated that lifestyle interventions incorporating a dietary component along with an exercise and/or behavioral therapy component are effective in treating childhood and adolescent obesity.

However, before initiating therapy, it is important to determine the family’s motivation and readiness to make change, willingness to change, and actions for change (see also “Behavioral Therapy” further below). Providers must assess parental perceptions about the child’s weight, and ask specific questions to measure the parent’s knowledge and determine barriers to change. A family readiness questionnaire may be utilized to assist in this assessment, and motivational interviewing or other techniques may be utilizing to help improve attitudes and encourage change.

Studies have shown that a parent’s ability to lose weight and make nutritional changes is highly correlated with a child’s ability to make similar changes. Furthermore, parent readiness to change has been associated with successful BMI changes in teens (Rhee et al., 2015).

WEIGHT-LOSS GOALS

Weight-loss goals are based on the child’s age and degree of overweight or obesity. For children and adolescents who are overweight or mildly obese, the goal of maintaining current body weight is appropriate, as this will lead to a decrease in BMI as the child grows taller. If the child is in a phase of rapid linear growth, simply slowing weight gain is more realistic and often improves weight status. At high degrees of obesity, however, gradual weight loss is safe and appropriate depending on the child’s age and degree of obesity.

For children between 2 and 11 years with obesity as well as comorbidities, a weight loss of one pound per month is safe and of benefit. For obese adolescents with comorbidities, it is considered safe to lose up to two pounds per week, although a weight loss of one to two pounds per month is usually a more realistic goal. It should be noted, however, that there is little or no evidence to support these specific recommendations; rather, they represent expert opinion. Because is it difficult to achieve and sustain a dramatic reduction in BMI, realistic goals should emphasize gradual weight loss and maintenance rather than a rapid fall to an ideal body weight (Schwarz, 2018b).

DIET

There is limited evaluation and clinical evidence to support structured dietary interventions for children with obesity. Rather than focusing on a specific structured diet, goals are more apt to be achieved if eating behaviors are the focus. Programs that modify family patterns of eating are most likely to be successful.

A semi-structured dietary approach aimed at encouraging children and families to select food groups of lower energy-density and decreasing portion size are best used for weight loss in children.
Such an approach may include:

- Intake of five or more servings of fruits and vegetables daily
- Decreased intake of calorie-dense foods such as saturated fats, salty snacks, and high-glycemic foods such as candy
- Minimized intake of sugar-containing beverages
- Minimized eating outside the home and eating fast food in particular
- Family meals at least five times a week
- Self-regulation of food
- Eating breakfast daily
- Discouraging dieting
- Avoiding skipping meals
  (Mayo Clinic, 2019; Kumar & Kelly, 2017)

It is important to note that the long-term effects of a very controlled-energy diet on adolescent growth and development and subsequent reproductive function, musculoskeletal development, and intermediary metabolism remain poorly understood. In light of these factors and problems inherent in adhering to and maintaining severe caloric restriction, very controlled-energy diets are not recommended for the great majority of children and adolescents with obesity.

In circumstances where rapid weight loss is recommended, a protein-sparing modified fast can achieve rapid weight loss in an inpatient or outpatient setting and has been successfully used in children and adolescents with obesity. A high-protein diet, however, does not reduce obese children’s desire to eat, and ratings of desire to eat significantly increase over the duration of the intervention (Schwarz, 2018a; Kumar & Kelly, 2017).

Weight loss tools—such as ChooseMyPlate and MyPlate—use effective visual cues to teach healthy dietary patterns, including major food groups, portion sizes, and the goal of including more fruits and vegetables.

Healthy food selection and relative portion amounts recommendations for avoiding obesity. (Source: USDA, 2012.)
<table>
<thead>
<tr>
<th>Food Group</th>
<th>Age Group</th>
<th>What Counts as . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>2 years: 1 cup</td>
<td>1/2 cup of fruit?</td>
</tr>
<tr>
<td></td>
<td>3 years: 1 to 1-1/2 cups</td>
<td>• 1/2 cup mashed, sliced, or chopped fruit</td>
</tr>
<tr>
<td></td>
<td>4–5 years: 1 to 1-1/2 cups</td>
<td>• 1/2 cup 100% fruit juice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1/2 medium banana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 4–5 large strawberries</td>
</tr>
<tr>
<td></td>
<td>2 years: 1 cup</td>
<td>1/2 cup veggies?</td>
</tr>
<tr>
<td></td>
<td>3 years: 1-1/2 cups</td>
<td>• 1/2 cup mashed, sliced, or chopped vegetables</td>
</tr>
<tr>
<td></td>
<td>4–5 years: 1-1/2 to 2 cups</td>
<td>• 1 cup raw leafy greens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1/2 cup vegetable juice</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 small ear of corn</td>
</tr>
<tr>
<td>Grains</td>
<td>2 years: 3 ounces</td>
<td>1 ounce of grains?</td>
</tr>
<tr>
<td></td>
<td>3 years: 4–5 ounces</td>
<td>• 1 slice bread</td>
</tr>
<tr>
<td></td>
<td>4–5 years: 4–5 ounces</td>
<td>• 1 cup ready-to-eat cereal flakes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1/2 cup cooked rice or pasta</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 tortilla (6” across)</td>
</tr>
<tr>
<td></td>
<td>2 years: 2 ounces</td>
<td>1 ounce of protein foods?</td>
</tr>
<tr>
<td></td>
<td>3 years: 3–4 ounces</td>
<td>• 1 ounce cooked meat, poultry, or seafood</td>
</tr>
<tr>
<td></td>
<td>4–5 years: 3–5 ounces</td>
<td>• 1 egg</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1 tablespoon peanut butter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 1/4 cup cooked beans or peas (kidney, pinto, lentils)</td>
</tr>
<tr>
<td>Dairy</td>
<td>2 years: 2 cups</td>
<td>1/2 cup of dairy?</td>
</tr>
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<td></td>
<td>3 years: 2 cups</td>
<td>• 1/2 cup milk</td>
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<tr>
<td></td>
<td>4–5 years: 2-1/2 cups</td>
<td>• 4 ounces yogurt</td>
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<td></td>
<td></td>
<td>• 3/4 ounce cheese</td>
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<td></td>
<td></td>
<td>• 1 string cheese</td>
</tr>
<tr>
<td></td>
<td>2 years: 2 cups</td>
<td>Source: USDA, 2012.</td>
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<td></td>
<td>4–5 years: 2-1/2 cups</td>
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PHYSICAL ACTIVITY

Increasing child and family levels of physical activity is a key focus in obesity treatment. It has been demonstrated that lifestyle exercise programs, in connection with dietary restrictions, provide long-term weight control in children and adolescents. It is recommended that children and adolescents participate in 60 minutes or more of physical activity each day (Schwarz, 2018b; Kumar & Kelly, 2017).

Providers can recommend a variety of options for consideration. Structured physical activity (such as sports or performance arts) may be team-based or individual, competitive or noncompetitive. Noncompetitive activities may be more appealing to some children, particularly those with more severe obesity. Less-structured activities can include recreational sports with peers or family or self-directed physical training.

For preschool-aged children, physical activity for the most part will be unstructured, and outdoor play is particularly helpful. Providers can encourage physical activity in this age group by prescribing playground time and providing a list of local resources (such as playground locations) in addition to discouraging sedentary time. Parents can be encouraged to consider physical activity levels when making choices for daycare and after-school programs.

For older children, structured physical activity is encouraged whenever possible, such as team or individual sports, or supervised exercise sessions. Children are more likely to participate consistently in such activities since they are accountable to a coach or a leader.

Directly engaging adolescents in choosing activities to replace sedentary time is helpful, as some will enjoy engaging in sports or fitness centers, while others may not (Schwarz, 2018b; Kumar & Kelly, 2017).

The following are recommendations for physical activity in the management of obesity and overweight in children and adolescents:

- Decrease sedentary behavior such as watching television, surfing the Internet, and playing video games to less than two hours per day for children older than 2 years.
- Obtain one hour of physical activity daily.
- Do not allow children younger than 2 years to watch television.
- No television in a child’s bedroom.
- Engage in fun and age-specific activity or exercise that is appropriate to the individual’s abilities.
- Emphasize activity, not exercise—the object is to get the child moving.
- Increase intensity, frequency, and duration of activity or exercise gradually as tolerated. (Mayo Clinic, 2019)
DOG OWNERSHIP AND PHYSICAL ACTIVITY

Owning and caring for a dog has shown promise in increasing children’s outdoor physical activity. This is a unique tool in treating childhood obesity, particularly for children living in urban areas who lack safety and space for play. Dogs provide safety, companionship, support, motivation, and the necessity for walking. When children play with dogs, “they may run, dance, and mirror an animal’s natural energy, enthusiasm, and exuberance for life” (Boisvert & Harrell, 2015).

THE ROLE OF PHYSICAL THERAPY

The American Physical Therapy Association (2016) recommends that primary care providers involve physical therapists in the management of childhood and adolescent obesity. Physical therapists can assess a child’s risk factors for injury during exercise and evaluate and monitor a child’s increasing level of activity. Recommendations include:

- Do not rely on BMI alone. Use BMI charts that reflect demographics and tools for measuring whole-body fat mass such as waist circumference or skin-fold thickness before beginning treatment. Ideally, it is recommended that body composition be analyzed by cross-sectional imaging.

- Be aware that a child with type 2 diabetes who is receiving insulin treatment can experience hypoglycemia during exercise.

- Evaluate the child’s psychosocial barriers, which may include low self-esteem, anxiety, negative body image, or other psychological issues that can influence how a child will adhere to the plan of care.

- Measure exercise endurance capacity and muscle strength. This can be accomplished by using the 20-meter shuttle run test for endurance and the handgrip strength test and standing broad jump test for muscle strength.

- Promote weight loss by encouraging endurance exercises, whole-body exercises being the best option.

- For children over the age of 5 years, to avoid injury when there is muscle weakness, strength training is recommended under the supervision of a physical therapist to ensure the proper execution of the exercises.

Physical therapists can be very important in helping a child develop a sense of self-efficacy that can motivate them to continue exercising.
CASE

Jaime, Age 9

Jaime is a 9-year-old boy who was referred to physical therapy for help in establishing a personal fitness plan after being identified as obese during a routine BMI screening at his school. Jaime is a pleasant child who enjoys reading and playing video games during his free time. His dad drives him to and from school, and Jaime spends most of the day in the classroom. At recess, he likes to read on a bench while the other kids play. He attends gym class one day a week.

The physical therapist, Monica, conducted an initial evaluation that included Jaime’s overall health status, history of his current presenting complaint, and screening for medical red flags, as well as evaluation of pain, joint range-of-motion, manual muscle testing, bony and soft-tissue palpation, orthopedic special tests, sensation testing, postural evaluation, gait biomechanics, and static and dynamic balance testing.

Monica next met with Jaime and his parents about an appropriate long-term fitness routine, to include cardiovascular exercise, strength training, flexibility, and functionality work. Jamie looked worried at the mention of exercise. “You won’t make me play basketball, will you?” he whispered. She assured Jaime that there are plenty of exercises he can do that don’t require throwing or catching. Monica helped Jamie and his family plan an activity program designed to gradually increase his activity level to at least 60 min/day. His father purchased a stationary bike and a set of free weights for them to use together. Monica reviewed safe weight-lifting technique and set parameters for the appropriate amount of weight for Jaime to be lifting.

Two weeks later, Jaime reported logging 60 minutes of activity on 3 of 7 days and at least 30 minutes on 3 of the remaining days. His parents also bought him new sneakers and started a daily “family workout night” after dinner, beginning with specific stretches and core strengthening exercises learned at physical therapy, followed by riding the stationary bike or swimming at the community pool. Jaime’s dad started walking to school with him instead of driving. They now log each day’s activities in order to track their progress.

After six weeks, Jaime has made the following progress toward his long-term physical fitness goals:

- A reduced BMI and an absence of weight gain since program initiation
- Reading for half of recess and playing actively with his peers during the other half
- 60 minutes of physical activity attained on 85% of days since the start of the program

Due to the consistent support of Jaime’s parents and his rapid progress toward his physical therapy goals, it is decided that Jaime need not follow up with physical therapy until one month later, at which time he may be discharged to an independent home fitness program.
Behavioral Therapy

Systematic training and parental adoption of various behavioral skills for helping change children’s dietary and physical activity behaviors are core components of pediatric obesity treatment. Behavioral strategies are basically the same as those for adults, including self-monitoring of foods eaten and/or activity performed, stimulus control, goal-setting (e.g., contracting), and positive reinforcement of target behaviors. Behavioral interventions are delivered most commonly in a group setting (Schwarz, 2018a; Skelton, 2018; Altman & Wilfley, 2015).

Well-established behavioral therapy modes include:

- Family-based behavioral treatment (FBT)
- Parent-only behavioral treatment for children
- Parent-only behavioral treatment for adolescents
- FBT-guided self-help for children
- Behavioral weight-loss treatment with family involvement for toddlers, children and adolescents
- Intensive group therapy for adolescents
  (Altman & Wilfley, 2015: Schwarz, 2018b)

Evidence from studies with school-age children support superior short- and long-term outcomes for family-based programs that include a high level of parental involvement. Several studies indicate that treatments involving only parents are as effective, or more effective, than those that include the parent and child and more efficacious compared to those that target the child alone.

Behavioral interventions for weight management in young children and adolescents have shown mixed results. Younger children show a greater weight loss effect than older children and adolescents. Treatment has been found to be more effective for younger moderately obese children than for older children. Severely obese adolescents show no change.

An alternative for engaging adolescents is enhancement of the role of peers. Adolescent weight control interventions that focus on peer support in a group have shown positive outcomes, and intensive group therapy is superior to standard family-based therapy in achieving lifestyle changes and reducing BMI of overweight adolescents (Schwarz, 2018; Jelalian & Evans, 2017).

CASE: Motivational Interviewing

Cynthia, Age 15

Cynthia is a 15-year-old African American girl who is 5 feet 3 inches tall and weighs 180 pounds, with a BMI of 31.9. She has been referred to the local health clinic by the school nurse at Winston Senior High School because of recent weight gain. The clinic’s nurse practitioner
employs motivational interviewing to assist adolescent patients and their families in weight-loss efforts. During the first session with the family, the nurse found both parents to be very supportive and eager to help Cynthia meet the goals agreed on with the clinic’s weight loss team.

Today is Cynthia and her parents’ second visit to the clinic, and the nurse practitioner utilizes MI in her meeting with the family.

Nurse: “Hello, Cynthia. Hello, Mr. and Mrs. Rockland. It’s good to see you all again. Tell me, how have things been going for you this past week?” (Asking an open-ended question)

Cynthia: “Oh, so, so. Mom and Dad have been after me to follow the plan, and I’m trying, but not very well, I’m afraid.” (Responding with elaboration)

Nurse: “You haven’t been completely successful sticking with the plan.” (Rephrasing)

Mom: “She’s trying, but not has hard as we think she could.”

Nurse: “You think she is not trying hard enough.” (Restating)

Mom: “Well…”

Cynthia (interrupting): “I really am trying hard, but there’s so many things that happen and get in the way!” (Emotional elaboration)

Nurse: “You sound a bit upset!” (Mirroring)

Cynthia: “I am! It’s really hard when you sit in the cafeteria and everyone else is eating the good stuff, and your lunch is a salad with a dinky piece of chicken in it!” (Elaboration)

Nurse: “It sounds like it’s hard to sit and watch others enjoying the foods you like but aren’t supposed to eat.” (Reflecting)

Dad: “I know just how she feels. I’ve been heavy all my life, and it’s very hard to give up those things you’ve always enjoyed.” (Empathizing)

Nurse: “I can certainly understand how you both feel.” (Empathizing)

Cynthia: “You know, it’s really hard. I didn’t gain any weight last summer but started gaining again when I went back to school this fall.” (Elaborating)

Nurse: “It sounds like you were successful in sticking to your diet last summer.” (Affirming)

Cynthia: “Yes, but when I went back to school, everyone around me was eating all the good things I like and can’t have.” (Elaborating)
Nurse: “You want to stick to your diet and lose weight, but you still want to enjoy the foods you like. That sounds like a dilemma to me.” (Summarizing)

Cynthia: “Yeah, that’s exactly it! But I really do want to be thinner like the other girls. I don’t want to be a fatty! I know I can do it, but sometimes it’s just so hard.” (Using “change talk”)

Nurse: “Well, let’s see. You say you want to be thin like the other girls, and at the same time, you’re saying that eating the foods you shouldn’t eat is very important to you.” (Developing and examining discrepancy)

Cynthia: “Yes, I don’t like to look the way I do, and I really want to try harder. I wish I could do it.” (Using change talk)

Nurse: “You really are strongly motivated to change and believe you can do it.” (Supporting self-efficacy)

Cynthia: “Yes, and I know Mom and Dad are really trying to help me.” (Using change talk)

Nurse: “I see. So, tell me what the three of you might do to make this wish happen.” (Finding out what the patient and family already knows)

Cynthia: “I don’t know what else I can do. I miss Taco Bell!”

Dad: “You and me both.”

Mom: “Well, I think I have a suggestion. Maybe we could try to be more creative with the meals we make. Maybe we could explore some new recipes so your lunch is more exciting. We could start to cook together. How does that sound?” (Collaborating)

Dad: “That’s sounds like fun to me. When do you two start?” (Encouraging)

Cynthia: “That does sound like fun. We’ve never cooked anything together before. Could we really do that?” (Collaborating and negotiating)

Nurse: “Would you be interested in meeting with the dietitian again to get some ideas about the foods you could make and some basic recipes?” (Asking permission, collaborating, negotiating a plan, empowering)

Cynthia: “Shall we do that, Mom? Yeah, let’s do that!” (Collaborative response)

Mom: “I would love to spend time with you in the kitchen.” (Agreeing on action plan)

**Pharmacology**

The role of pharmacological therapy in the treatment of obesity in children and adolescents is limited. Although there have been some positive findings, anorectic drugs should never routinely
be used for the prevention or treatment of obesity in childhood or adolescence. These agents must not be prescribed for prepubertal children until clinical studies have been performed to assess safety and efficacy.

Medication might be prescribed for some adolescents, but only after the patient has failed to respond to vigorous attempts to modify behavior as part of an overall weight-loss plan. However, the risks of taking prescription medications over the long term are unknown, and the medication effects on weight loss and weight maintenance for adolescents are also unknown.

Orlistat is the only medication currently approved by the Food and Drug Administration for the treatment of obesity in adolescents (age ≥12 years). All adolescents who are prescribed anorectic agents should receive concurrent nutritional and family counseling and should implement a plan of regular exercise and physical activity (Mayo Clinic, 2019; Schwarz, 2018b).

**Surgical Procedures for Adolescents**

Weight-loss surgery might be an option for severely obese adolescents (but not younger children) who have been unable to lose weight through lifestyle changes. However, as with any type of surgery, there are potential risks and long-term complications (Mayo Clinic, 2019).

The following **criteria** have been recommended by the American Society for Metabolic and Bariatric Surgery in the selection of adolescents for weight-loss surgery:

- BMI ≥35 and a severe comorbidity, or BMI ≥40 with more minor comorbidities
- Physical maturity, defined as completing 95% of predicted adult stature based on bone age (based on theoretical concerns that rapid weight loss might inhibit structural growth if an adolescent has not reached near adult height)
- History of efforts to lose weight through changes in diet and physical activity
- Ability and motivation of patient and family to adhere to recommended treatments pre- and postoperatively, including vitamin and mineral supplementation
- Appropriate understanding of the risks and benefits of surgery on behalf of the adolescent
- Supportive but not coercive family

**Contraindications** include:

- Medically correctable cause of obesity
- An ongoing substance abuse problem (within the preceding year)
- Medical, psychiatric, psychosocial, or cognitive condition that prevents adherence to postoperative dietary and medication regimens or impairs decision-making capacity
- Current or planned pregnancy within 12 to 18 months of the surgery
• Inability on the part of the patient or parent to comprehend risk and benefits (Kumar & Kelly, 2017)

The Roux-en-Y gastric bypass and sleeve gastrectomy are the most widely used procedures for pediatric obesity. Laparoscopic adjustable gastric banding has not been approved by the FDA for use in adolescents and is considered investigational (Schwarz, 2018b).

Preoperative evaluation of adolescents prior to bariatric surgery are performed by a multidisciplinary team that includes a pediatric obesity specialist, experienced bariatric surgeon, nurse, dietitian, and pediatric psychologist or psychiatrist (Kumar & Kelly, 2017).

CARING FOR THE BARIATRIC PATIENT

Healthcare providers face a number of challenges when working with the growing number of obese patients being admitted to hospitals and other healthcare facilities. It is essential that providers understand the physiologic and mobility concerns that may hinder the patient’s capacity to adapt to the stressors of an illness as well as the safety issues for both patients and healthcare workers regarding mobilization.

Respiratory Concerns

Changes in breathing due to obesity include increased respiratory rates, increased oxygen consumption and metabolic requirements, increased work of breathing, and decreased tidal volume. Obesity has a profound effect on the physiology of breathing, leading to pulmonary compromise in a number of ways:

• Decreases in respiratory compliance due to mechanical factors such as increased weight in the thoracic cage and abdomen
• Changes in lung compliance related to the increased pulmonary blood volume
• Disproportionately high percentage of total oxygen consumption for respiratory work, even during quiet breathing, in severely obese patients
• Changes in the airway associated with obstructive sleep apnea, obesity hypoventilation syndrome, and respiratory failure
• Rapid patient oxygen desaturation (hypoxia) due to the decrease in residual volume

Both acute hypoxemia and hypercapnic respiratory failure are more common among obese patients. Early diagnosis and application of noninvasive ventilation can improve survival.

Assessment issues and intervention measures for patients who are obese include:

• Breath sounds are commonly distant or difficult to auscultate.
• Cyanosis is best assessed by examining the inside of the patient’s eyelids or lips.

• Pulse oximetry readings may be difficult to obtain due to thick, dense fingers. Alternate placement of the probe can be the smallest available finger, the earlobe, or the lip.

• Patients who are obese do better when placed in semi-Fowler’s position to decrease intrathoracic pressure and reduce atelectasis, ventilation-perfusion mismatch, and hypoxemia.

• Patients may use a continuous positive airway pressure (CPAP) machine at home and require its use when in a healthcare facility.

• If resuscitation measures become necessary and CPR is required, use of a Doppler may be needed to hear blood flow through the carotid artery to determine the effectiveness of compressions.

(Foroozesh et al., 2017; Dambaugh & Ecklund, 2016; Nagel, 2017; Berrios, 2016; Queensland Government, 2016)

Circulation Concerns

Notable changes in the circulatory system of the obese patient include:

• Increased blood volume to meet the perfusion needs of increased adipose tissue

• Increased blood viscosity and fibrinogen, factor VII, factor VIII, and plasminogen activator inhibitors

• Decreased levels of antithrombin III and circulating fibrinolytic activity

These changes increase the risk for deep vein thrombosis and pulmonary emboli. Anticlotting medications in combination with sequential compression devices should be considered unless contraindicated. Because of increased blood volume, preload, afterload, and myocardial work, obese patients also have a high incidence of heart failure, ventricular hypertrophy, and dysrhythmias.

Access to veins may be difficult in an obese patient, and as a result, many of these individuals require a central venous catheter. CVC placement may be difficult due to problems locating anatomical structures, and ultrasound technology may be required to accurately locate veins. Obese patients may be at a higher risk for catheter-associated bloodstream infections partly due to immune dysfunction associated with severe obesity.

Patients with circulation alterations require frequent assessment of heart rate and blood pressure. Appropriate-sized blood pressure cuffs must be available to provide accurate information (Berrios, 2016; Queensland Government, 2016; Dambaugh & Ecklund 2016).
Skin Integrity

Because of excess body weight, obese patients are predisposed to impairment of skin integrity.

Due to increased adipose tissue, there is increased pressure on dependent tissues and decreased blood and oxygen supply, which increases the risk of decubitus ulcers. Pressure ulcers (wounds) in obese patients may occur in uncommon areas, including skin folds, under the breasts, beneath the abdomen, in perineal and gluteal folds, the posterior of the neck, and the lumbar and midback areas. The key to prevention is pressure redistribution involving the use of pressure-relieving devices, bariatric beds, frequent repositioning, and the avoidance of shearing through use of friction-reducing devices.

Deep skin folds must be closely monitored, dried thoroughly, and kept open to air as much as possible. Soft, moisture-wicking cloths (such as moisture-wicking textile with antimicrobial silver) between skin folds and antimicrobial and fungus-inhibiting powders are also recommended. The use of cornstarch is not recommended, as is often used in home remedies, since it is a substrate for the growth of yeasts.

Wound healing may be slower in the obese patient if the patient lacks adequate protein, vitamin, or mineral stores and has a wound within a skinfold where moisture can accumulate and allow bacteria and fungi to flourish. A dietitian may provide guidance to assist the patient in meeting nutritional goals (Dambaugh & Ecklund, 2016; Berrios, 2016).

General Hygiene and Toileting

Bariatric patients often require access to walk-in bathing facilities, hand-held showerheads, and appropriate-sized shower chairs. Long-handled, soft-bristled shower brushes allow the patient to reach all body areas. Inspection of the skin is done during bathing to determine care needs and interventions.

Both men and women are challenged in maintaining genital or perineal care, particularly women who are menstruating. Men are at risk for Fournier’s gangrene, a polymicrobial necrotizing fasciitis of the perineal, perianal, or genital area associated with a high mortality rate (Pais, 2018).

Toileting concerns for the bariatric patient include access to adequate facilities, limited reach for cleansing, and urgency and incontinence due to tissue compression causing sphincter dysfunction.

Appropriate facilities include a toilet riser with handrails for support or a bariatric commode. Rather than using regular toilet tissue, washcloths or premoistened wipes may be employed. Occupational therapy may be consulted for assistance in obtaining an appropriate tool to assist in reaching areas requiring cleansing (Blacket et al., 2011).
Medications

Standard medication dosing is based on data for ideal-weight persons. Due to pharmacokinetic and pharmacodynamic variations associated with obesity, a clinical pharmacist is an essential member of the care team in order to determine correct dosages for the bariatric patient. Differences in the proportion of adipose and lean muscle mass and fluid status can affect absorption, distribution, metabolism, and excretion of drugs.

When administering medications, the following are taken into consideration regarding absorption:

- Increased rate of absorption of oral medications can occur due to increased gastric emptying.
- Intravenous access can be difficult.
- Decreased subcutaneous absorption can occur due to poor subcutaneous blood supply.
- Intramuscular administration may fail if needles are too short.

When monitoring medications being taken by obese patients, caregivers must also recognize certain differences in patients who are obese.

Distribution is affected by:

- Ratio of adipose tissue to lean body mass, if lipid-soluble
- Accumulation of lipophilic drugs in fat stores, requiring increased dose to gain effect
- Total body water, which may be increased by resuscitation volume
- Altered protein binding
- Reduced peak serum concentration

Metabolism is affected by:

- Critical illness with increase for drug interactions
- Reduced hepatic blood flow

Elimination is affected by:

- Increased half-life of lipid-soluble drugs due to accumulation
- Increased glomerular filtration rates
- Coexisting disease related to diabetes and hypertension
• Calculated and measured creatinine clearance, which correlate poorly in obesity and critical illness
  (Berrios, 2016; Smit et al., 2018)

**Mobility and Safety**

Maintaining an obese patient’s mobility and safe patient handling pose unique challenges. Patient care areas require equipment designed for obese patients. This includes adequate weight-bearing beds, toilets, specialized chairs, and wheelchairs. Obese patients may require assistance to transfer out of bed and with ambulation. Care may require additional personnel, proper lifting equipment (such as a ceiling-mounted or portable lift to help reduce the risk of injury to staff), and a standard protocol on the methods of care and use of the equipment.

Lack of appropriate equipment, lack of staff knowledge, and shortage of adequate numbers of caregivers may all be barriers to patient mobility, which increases the complications related to immobility. Some healthcare personnel may avoid caring for obese patients because they do not want to jeopardize their own health (Foroozesh et al., 2017). Overexertion injuries in healthcare workers is the most common risk factor associated with manual patient handling (moving, lifting, or repositioning).

It is important for healthcare personnel to become familiar with the weight and size restrictions of commonly used equipment such as beds, bedside commodes, toilets, showers, doorways, hallways, elevators, and emergency transport equipment, and to become proactive in establishing protocols, developing safe lifting policies, using proper assistive equipment, and insisting on multidisciplinary teamwork and effective communications (Dambaugh & Ecklund, 2016; Berrios, 2016; Foroozesh et al., 2017; Ferguson, 2016). Most obese patients are at high risk for the additional hazards of immobility, which include cardiac deconditioning, skin breakdown, deep vein thrombosis, atelectasis, pneumonia, muscle atrophy, urinary stasis, constipation, pain management problems, and depression.

**GENERAL STRATEGIES FOR OVERWEIGHT AND OBESITY PREVENTION AND ADVOCACY**

Every healthcare professional has the opportunity to guide their patients toward making healthy lifestyle choices. Healthcare providers can be role models and bring their knowledge and standing to advocate for healthy changes that connect with people well beyond the healthcare facility they are working in. Every healthcare professional must have the skills to counsel patients about obesity prevention.

Recommendations are provided below for healthcare professionals working with various patient populations in various specialties.
Primary Care Practices

The following recommendations have been made for adults in primary care:

- Measure BMI in all adult patients.
- Order appropriate follow-up laboratory tests for patients who are overweight and obese.
- Prescribe a long-term treatment strategy that may include:
  - Counseling, coaching, or behavioral interventions on diet and lifestyle change
  - Weight-loss medication for appropriate patients who have been unable to lose weight using conventional therapy and who have no contraindications
  - Bariatric surgery for those individuals with severe obesity unable to lose weight through conventional therapy and who have no contraindications
- Design offices to avoid stigmatizing overweight or obese individuals, such as providing private weighing areas and using scales that can measure weights greater than 300 pounds.
  (Harvard T.H. Chan, 2019b)

Pediatric Care Practices

The newest research in children indicates that healthcare interventions in a clinic or office setting in the absence of broader community strategies to prevent obesity may lead to behavior change but may not be adequate to result in sizable improvements in weight. It is therefore recommended that clinic efforts be combined with communitywide changes such as the “Collaborate for Healthy Weight” initiative. For all children seen in pediatric offices, recommendations include:

- Measure BMI-percentile-for-age at every well-child visit for children ages 2 and older; measure weight-for-length percentile for children under 2 years.
- Counsel all patients and families on healthy eating, physical activity, and healthy growth, regardless of current weight status.
- Counsel all patients and families to limit television time to no more than two hours per day and to remove televisions from children’s bedrooms.
- Counsel all patients and families to limit consumption of sugar-sweetened beverages.
- Counsel all patients and families to help children achieve 60 minutes of moderate to vigorous physical activity per day.
- Establish procedures for follow-up assessment (including laboratory tests), counseling, and treatment plans for children who are overweight or obese.
Establish policies to avoid weight bias in pediatric clinics, which may include requiring all employees to be trained on weight-bias prevention. (USPSTF, 2017; Skelton, 2018; Harvard T.H. Chan, 2019b)

Obstetrical Care Practices

There are many factors before and during pregnancy that can affect a child’s obesity risk later in life. The following recommendations pertain to obstetrical care practices:

- Counsel patients on the importance of having a healthy weight before pregnancy and gaining weight at a healthy rate during pregnancy.
- Recommend that mothers breastfeed their babies and provide support and training for breastfeeding.
- Counsel patients on the importance of discontinuing smoking during pregnancy.
- Screen pregnant women for gestational diabetes. (Harvard T.H. Chan, 2019b)

Hospital and Clinic Efforts

The following are recommendations for helping in the prevention of obesity in hospital settings:

- Encourage healthcare providers to model healthy eating.
- Offer healthy foods and beverages to employees and patients.
- Ban the sale and marketing of unhealthy foods and beverages on clinic and hospital premises.
- Promote breastfeeding among new mothers who give birth in the hospital or clinic, as well as for hospital and clinic employees who are nursing. (Harvard T.H. Chan, 2019b)

Health Insurance Providers

Recommendations put forth to insurance providers include advocating for the following:

- Cover obesity-related services that include assessment, prevention, evaluation, treatment, and follow-up.
- Provide subscribers with incentives for maintaining healthy body weight or adopting healthy behaviors.
- Measure and track progress in BMI screening through Healthcare Effectiveness Data and Information Set (HEDIS) data collection.
• Fund obesity prevention efforts in the community and/or participate in community obesity prevention coalitions.  
  (Harvard T.H. Chan, 2019b)

**Individual Healthcare Professionals**

Each healthcare professional can serve as a leader and role model—both within one’s area of practice and in the community—to encourage healthy behaviors and to make changes in the built environment. Professionals can advocate at professional organizations, local, state, and federal levels for policy and built environment changes promoting healthy eating and physical activity in healthcare settings, schools, after-school programs, and communities. Healthcare professionals can encourage parents to advocate for changes in the environment that promote physical activity in their children’s’ schools and communities (Harvard T.H. Chan, 2019b).

**Barriers to the Provision of Weight Management in Primary Care Clinics**

Recent studies have been done to determine why there is a low rate of weight management success in primary care settings. Primary care practitioners often report they lack the confidence in their ability to counsel and treat obesity and that they have low proficiency in behavioral management skills and parent counseling techniques. They say that improving their knowledge and skills is important in order to provide effective counseling during a busy outpatient clinic visit.

However, the most significant issue among providers is the lack of available resources, specifically, time, staff support, BMI calculation tools, and community resources.

The U.S. Preventive Services Task Force has noted that delivery of moderate-intensity counseling by primary care providers may not be possible within the confines and structure of the current well-child visit, and that children who are overweight or obese should be referred to intensive counseling or behavioral programs to assist with weight loss. Such programs, unfortunately, often are available only in tertiary care academic settings, making access difficult for families due to long waiting lists or long travel distances.

Many primary care providers have expressed interest in learning more about what strategies they might use in the office setting to encourage weight-loss efforts, such as motivational interviewing techniques. However, they report that lack of time limits their ability to engage in such discussions. Many providers also express uncertainty regarding available community resources, existing treatment options, and where to refer their patients.

Some providers report that lack of parental motivation and readiness to address obesity in their children is a common barrier to weight-loss success. Motivating parents to engage in treatment has been found to be difficult, particularly if parents do not recognize their child is overweight (Rhee et al., 2018).
CONCLUSION

Obesity around the world and in the United States continues to be a major problem. Researchers have learned a great deal over the past several years about the pathogenesis and contributing factors involved in the development of obesity, and as a result, have a much better understanding of this chronic disease. However, despite these efforts, the problem persists and continues to grow.

Of great concern is the need for healthcare providers to become aware of their own biases and the socially accepted stigma surrounding overweight and obesity, much as those efforts were and are continuing to be made regarding issues of mental health. Overweight and obesity requires healthcare professionals to take an active role in the prevention of obesity and treatment for those who live with this disease, and to learn that compassion, empathy, and patience are necessary to become a positive force against this modern public health concern.

RESOURCES

Adult obesity facts (CDC)
https://www.cdc.gov/obesity/data/adult.html

BMI calculator (U.S. DHHS)
http://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm

Childhood obesity facts (CDC)
http://www.cdc.gov/obesity/data/childhood.html

Growth charts
http://www.cdc.gov/growthcharts

Institute for Healthy Childhood Weight (American Academy of Pediatrics)
https://ihcw.aap.org

State of Obesity
https://www.stateofobesity.org
REFERENCES


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TEST

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1. Which is a true statement about the prevalence of obesity worldwide?
   a. Obesity has been growing especially in rural areas compared to urban areas.
   b. The number of overweight and obese people has been dropping in lower-income countries.
   c. There are more people who are obese than underweight.
   d. Obesity is declining in urban areas.

2. Which is a correct statement regarding obesity among U.S. racial and ethnic groups?
   a. Black and Hispanic populations have higher rates of obesity compared to white and Asian populations.
   b. Men have a higher prevalence of obesity than women among non-Hispanic black, non-Hispanic Asian, and Hispanic adults.
   c. Prevalence of overweight and obesity has decreased in some groups and increased in others.
   d. White and Asian youth populations have higher rates of obesity than black and Hispanic youth populations.

3. The region of the United States with the highest prevalence of obesity is the:
   a. Northwest.
   b. Southwest.
   c. South.
   d. Northeast.

4. Which traits related to obesity have been shown to be inherited to a certain degree?
   a. Number of fat cells in the body and appetite
   b. Number of fat cells in the body and physical activity
   c. Metabolic rate and thermic response to food
   d. Physical activity and hypophagia

5. Which rare disorder is the most common genetic cause of morbid obesity in children?
   a. Cohen syndrome
   b. Bardet-Biedl syndrome
   c. Alström syndrome
   d. Prader-Willi syndrome
6. Obesogens are believed to contribute to obesity by:
   a. Altering how fat cells develop.
   b. Decreasing the effects of high-fat and high-sugar diets.
   c. Decreasing fat cell storage of fat.
   d. Decreasing appetite.

7. Which factor may contribute to obesity by stimulating production of biochemical hormones and peptides involved in regulating food intake?
   a. Damage to the hypothalamus
   b. Stress
   c. Inflammation
   d. Infection

8. Which is a correct statement about gut microbiota?
   a. Most inhabit the small intestine.
   b. They are important for body homeostasis.
   c. They are not affected by dietary habits.
   d. They play only a protective role in obesity progression.

9. A major prenatal determinant of increased risk for obesity in offspring in later life is maternal:
   a. Gut microbiota.
   b. Stress.
   c. Obesity.
   d. Alcohol use.

10. Which is a correct statement about early childhood feeding and overweight and obesity?
    a. Breastfeeding initiation and duration may influence obesity in later life.
    b. Bottle feeding can reduce overweight and obesity in early childhood.
    c. Duration of breastfeeding does not influence obesity.
    d. Breastfeeding has been shown to prevent obesity.

11. Research indicates that the most important link between obesity and ultra-processed foods is that they:
    a. Contain no real food substances.
    b. Contain mostly minimally processed ingredients.
    c. Are made up of many more ingredients than unprocessed foods.
    d. Produce effects that lead to inflammation.
12. Through consumption of plant-based vegetable oils, the human body manufactures endocannabinoids, which play a role in triggering:
   a. Termination of eating.
   b. Increased appetite.
   c. Suppression of hunger hormone.
   d. Hair and skin problems.

13. Which is a correct statement about high-fructose corn syrup’s (HFCS) role in obesity?
   a. HFCS decreases appetite.
   b. Fructose triggers satiating hormones.
   c. Fructose stimulates insulin secretion.
   d. HFCS alters the brain’s neurochemistry.

14. Which is a correct statement regarding the connection between physical activity and obesity?
   a. The more sedentary an individual is, the more weight they will gain over time.
   b. Only planned and structured exercise leads to healthy weight maintenance.
   c. Globally, people are becoming more active in order to lose weight.
   d. Building muscle mass has no effect on energy burned at rest.

15. Research has shown that children in kindergarten and first grade are more likely to become overweight or obese if they:
   a. Watch at least 3 hours of TV per day.
   b. Use the computer at home or at school.
   c. Play video games every day.
   d. Watch as little as one hour per day of TV.

16. Which factor has been linked to increased risk of obesity in schoolchildren?
   a. Fast food restaurants located near schools
   b. Eating meals together as a family
   c. Higher income and education of parents
   d. Absence of a stay-at-home parent

17. Parents’ ethnicity and cultural beliefs and practices:
   b. Have no influence on food choices for their child.
   c. Contribute to lower physical fitness and calorie expenditure.
   d. Do not influence a child’s food preferences.
18. Which style of parenting has been suggested to be protective against the risk of childhood obesity?
   a. Neglectful
   b. Permissive
   c. Authoritarian
   d. Authoritative

19. What is a true statement about the link between the working environment and obesity?
   a. Working less than 40 hours per week is associated with obesity.
   b. The risk for obesity/overweight decreases for permanent night shift workers.
   c. Risks for obesity increases with increased duration of rotating shift work.
   d. Working in food preparation does not facilitate increased consumption.

20. Which is not a correct statement regarding the link between sleep/circadian alignment and overweight/obesity?
   a. People who are awake longer have more opportunities to eat and take in excess calories.
   b. Misalignment of circadian rhythm can result in alterations in overeating and obesity.
   c. Too little sleep increases appetite due to changes to the levels of leptin and ghrelin.
   d. Those who get too much sleep tend to weigh more than those who get too little sleep.

21. Which is a correct statement concerning obesity and cognitive function in adults?
   a. Midlife obesity is related to slower cognitive aging.
   b. Midlife obesity is not related to the pace of deterioration in executive functions.
   c. Increased waist-to-hip ratio is not associated with total brain volume.
   d. High BMI in midlife results in lower global cognition.

22. Gynecomastia in males who are obese is related to:
   a. Early onset of sexual maturation due to increased testosterone.
   b. Stimulating effects of fat on estrogen production.
   c. Endothelial dysfunction of the blood vessels related to fat intake.
   d. Effects due to metabolic syndrome.
23. The most significant health consequences of childhood overweight and obesity that become apparent in adulthood are:
   a. Obstructive sleep apnea and obesity hypoventilation syndrome.
   b. Nonalcoholic fatty liver disease and cholelithiasis.
   c. Heart disease and stroke.
   d. Idiopathic intracranial hypertension and multiple sclerosis.

24. Bullying has been found to have which effect on girls 6 years and older with a high BMI?
   a. Losing weight due to feelings of shame
   b. Bullying other children who are obese
   c. Developing anorexia nervosa
   d. Gaining more weight over time

25. According to research, what percentage of healthcare providers were found to believe that obesity is always the result of poor lifestyle choices?
   a. 12%
   b. 33%
   c. 52%
   d. 80%

26. Which is a not a true statement regarding effects on the provision of medical care due to stigmas against obese patients?
   a. Quality of care is equal for patients who are obese and patients of normal weight.
   b. Studies have found long-term ill effects on patients who are obese because of stigma in healthcare.
   c. Obese patients may delay or avoid seeking medical care because of stigma.
   d. Healthcare professionals overwhelmingly feel discomfort in discussing weight-related issues.

27. Which is a correct statement concerning assessment of body mass index (BMI) in children and adolescents?
   a. BMI for children and adolescents remains constant unless a lot of weight is gained or lost.
   b. Patterns of growth are the same for male and female children and adolescents.
   c. BMI for children and adolescents takes into account age and sex.
   d. Severe obesity is having a BMI greater than or equal to the 85th percentile.
28. Which is a new and improved alternative to BMI for determining body fatness based on height and waist circumference?
   a. Relative fat mass index (RFM)
   b. Whole-body plethysmography
   c. Hydrodensitometry
   d. Bioelectrical impedance analysis

29. Which pattern of fat distribution significantly increases the risk for comorbidities?
   a. Excess fat around the hips or gluteal region
   b. Excess fat in the intrascapular area
   c. Excess fat in the lower extremities
   d. Excess fat in the central abdomen

30. Which is not a standard laboratory study for all adult patients with obesity?
   a. 24-hour urinary free-cortisol test
   b. Fasting lipid panel
   c. Liver function studies
   d. Thyroid function tests

31. Based on the fact that body weight and body fat are steadfastly regulated, the current weight loss recommendations are to:
   a. Lose a massive amount of weight as quickly as possible to eliminate comorbidities.
   b. Lose at least 25% of body weight as quickly as possible to reduce comorbidities.
   c. Reduce weight to eliminate or reduce obesity-related comorbidities.
   d. Lose at least 3 to 5 pounds weekly to reduce or eliminate comorbidities.

32. Which is correct statement regarding very low-calorie diets (VLCDs)?
   a. They are the diets weight-management professionals most commonly recommend.
   b. The Mediterranean diet is one type of VLCD.
   c. VLCDs allow everyday foods, including alcohol, in reduced portions.
   d. VLCDs are best used in an established, comprehensive program.

33. Which is an example of a low-fat diet?
   a. Dietary Approaches to Stop Hypertension (DASH)
   b. Ornish diet
   c. Mediterranean diet
   d. Warrior diet
34. According to the Transtheoretical Model, a person who underestimates the pros and places more emphasis on the cons involved in making change is in which stage of readiness to change?
   a. Contemplation
   b. Preparation
   c. Precontemplation
   d. Action

35. Motivational interviewing is a behavioral modification process that recognizes that:
   a. It is the patient who decides whether and how to change.
   b. Patients respond most to clinician advice, solutions, and suggestions.
   c. Resistance breaks down communication between patient and clinician.
   d. It is best to avoid pointing out discrepancies between present behavior and values.

36. The lipase inhibitor approved for long-term use in obesity management is:
   a. Suprenza (phentermine)
   b. Xenical (orlistat)
   c. Contrave (bupropion and naltrexone)
   d. Saxenda (liraglutide subcutaneous injection)

37. Which weight loss surgical procedure combines both restrictive and malabsorption components?
   a. Laparoscopic adjustable gastric band
   b. Gastric bypass (Roux-en-Y)
   c. Biliopancreatic diversion with duodenal switch
   d. Gastric sleeve

38. A medical device used in bariatric surgery that limits how much the stomach can hold is:
   a. Gastric emptying system.
   b. Electrical stimulation system.
   c. Gastric balloon.
   d. Vagal blockade (vBloc).

39. Management of obesity in children and adolescents requires:
   a. Child- or adolescent-focused communication and interventions.
   b. A prescriptive approach by the clinician.
   c. Targeting only the child without parental participation.
   d. Family-centered communication and family-based interventions.
40. Stage III of the staged approach to management of obesity in children and adolescents involves which protocol?
   a. Tertiary care intervention
   b. Comprehensive multidisciplinary intervention
   c. Prevention-plus
   d. Structured weight management

41. For children and adolescents who are overweight or mildly obese, the weight-management goal should be:
   a. Losing 2 to 4 pounds per month.
   c. Losing 1 pound per month.
   d. A rapid fall to ideal body weight.

42. Which dietary approach is recommended for children with obesity?
   a. A highly structured dietary approach
   b. Severe calorie restriction
   c. Skipping meals and encouraging dieting
   d. A semi-structured dietary approach

43. Physical therapy is recommended in the management of childhood and adolescent obesity in order to:
   a. Assess a child for risk of injury during exercise.
   b. Ensure adherence to lifestyle modification recommendations.
   c. Manage dietary intake.
   d. Instruct parents in weight-loss management.

44. Which is a true statement regarding behavioral therapy interventions for youth who are overweight or obese?
   a. Behavioral therapies for obesity are typically more successful with adolescents than younger children.
   b. Group therapy involving peers is superior to family-based therapy among adolescents.
   c. Treatments involving only the parents are not as effective as those that target the child alone.
   d. Behavioral strategies for children and adolescents are different than those used with adults.
45. Which is a correct statement regarding the use of medications and bariatric surgery in the treatment of obesity in children and adolescents?
   a. Orlistat is the only medication approved for treatment of obesity in adolescents.
   b. Anorectic drugs can be used in prepubertal children for prevention or treatment of obesity.
   c. Roux-en-Y surgery is FDA-approved for children age 9 and older.
   d. Laparoscopic adjustable gastric banding is FDA-approved for use in adolescents.

46. To ensure adequate oxygenation when addressing respiratory issues, the obese patient is placed in which position?
   a. Left-side lying
   b. Supine
   c. Semi-Fowler’s
   d. Prone

47. Maintaining skin integrity between skinfolds in the obese patient can include:
   a. Soft, moist cloths.
   b. Cornstarch.
   c. Massaging to improve circulation.
   d. Fungus-inhibiting powders.

48. Which is a concern to a clinician when administering or monitoring a medication in a patient who is obese?
   a. Elimination is affected by decreased glomerular filtration rates.
   b. Metabolism is affected by increased hepatic blood flow.
   c. Intramuscular administration because the needle is too short.
   d. Decreased rate of absorption of oral medications can occur due to increased gastric emptying.

49. The most significant barriers to provision of weight management in primary care clinics are:
   a. Lack of awareness of available community resources and where to refer patients.
   b. Lack of parental motivation and readiness to engage in treatment of obese children.
   c. Lack of ability to counsel and treat obesity and lack of parent counseling techniques.
   d. Lack of available time, staff support, BMI calculation tools, and community resources.