Obesity in Children

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EDUCATION GAP AND PRACTICE GAPS

The prevalence of childhood obesity and its associated comorbidities is worsening, but specialized care for patients has limited availability. Primary care clinicians should be aware of current guidelines for performing the screening, evaluation, and treatment of children and adolescents with obesity. Primary care clinicians should be familiar with the nuances in care and be comfortable with deciding when patients need referrals.

OBJECTIVES *After completing this article, readers should be able to:*

1. Provide definitions and describe the epidemiologic landscape of childhood obesity.
2. Describe and identify multifactorial causes of obesity.
3. Describe new knowledge on neuroendocrine and genetic causes of obesity.
4. Describe evaluation and treatment in the primary care and specialty care settings.
5. Describe initiatives focusing on childhood obesity prevention.

ABSTRACT

Child obesity is widely prevalent, and general pediatricians play an important role in identifying and caring for patients with obesity. Appropriate evaluation and treatment require an understanding of the complex etiology of child obesity, its intergenerational transmission, and its epidemiologic trends, including racial/ethnic and socioeconomic disparities. The American Academy of Pediatrics has published screening, evaluation, and treatment guidelines based on the best available evidence. However, gaps in evidence remain, and implementation of evidence-based recommendations can be challenging. It is important to review optimal care in both the primary care and multidisciplinary weight management settings. This allows for timely evaluation and appropriate referrals, with the pediatrician playing a key role in advocating for patients at higher risk. There is also a role for larger-scale prevention and policy measures that would not only aid pediatricians in managing obesity but greatly benefit child health on a population scale.

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ABBREVIATIONS

AAP	American Academy of Pediatrics
ALT	alanine transaminase
AST	aspartate aminotransferase
BP	blood pressure
CDC	Centers for Disease Control and Prevention
FDA	Food and Drug Administration
HbA1c	hemoglobin A1c
LAGB	laparoscopic adjustable gastric band
NAFLD	nonalcoholic fatty liver disease
PCOS	polycystic ovary syndrome
RYGB	Roux-en-Y gastric bypass
VSG	vertical sleeve gastrectomy

INTRODUCTION

Child obesity is a public health crisis, given the dramatic increases in the past 3 decades. (1)(2)(3)(4) For many children, the onset of obesity occurs in early childhood. (2)(5) Infant rapid growth and overweight status are especially consequential because they strongly predict later obesity (6)(7)(8)(9)(10)(11)(12) and comorbidities (eg, diabetes, cardiovascular disease). (13)(14)(15)(16) Obesity during adolescence is associated with greater likelihood of comorbidities and adult obesity. (17) Significant disparities in obesity rates exist in the United States, with higher prevalence in children from lower-income and racial/ethnic minority families. (1)(18)(19)(20)(21)(22) These disparities, often with onset during infancy, (23) have implications for long-term obesity and cardiovascular and metabolic health. (18)(24)(25)

Given the high prevalence, disparities, and long-term consequences of child obesity, it is critical for pediatricians to be knowledgeable about 1) obesity definitions, 2) multifactorial causes, 3) associated comorbidities and screening recommendations, and 4) prevention and treatment.

DEFINITIONS AND CLASSIFICATIONS

Assessment of healthy growth is a key component of pediatric primary care. Weight and height (recumbent length for infants) should be measured at health supervision visits from birth through adolescence. Unlike in adults, the definition of obesity in children depends on weight, height, age, and sex (Table 1). The 2000 Centers for Disease Control and Prevention (CDC) growth charts are recommended for children aged 2 to 19 years, (26) with weight status defined using either BMI (calculated as weight in kilograms divided by height in meters squared), percentiles, (27)(28) or BMI cutoff values. (29) Severe obesity, which is associated with greater cardiometabolic risk, (30) can be defined as a proportion of the 95th percentile (Table 1). The extended BMI growth curves to classify and monitor children with severe obesity are available in electronic medical records or can be charted manually. (31) Adaptation of clinical tools to use *z* scores in addition to percentiles may be beneficial.

From birth through 23 months, the CDC and the American Academy of Pediatrics (AAP) recommend using weight, recumbent length, and sex to determine weight-for-length percentile based on the World Health Organization growth charts (Table 1). Overweight is defined as weight-for-length of at least the 97.7th percentile, which is at or above 2 SD above the median for sex. Rapid infant weight gain, defined as an upward change in weight-for-length or weight-for-age *z* score greater than 0.67 (equivalent to crossing 2 percentile

Table 1. Definitions and Classifications of Weight Status

AGE AND WEIGHT CATEGORY	WEIGHT STATUS DEFINITION AND CLASSIFICATION
Adults	
Weight category	BMI
Underweight	<18
Healthy weight	18 to <25
Overweight	25 to <30
Obesity	≥30
Class I	30 to <35
Severe class II	35 to <40
Severe class III	≥40
Children 2–19 years old (based on CDC 2000 growth charts)	
Weight category	BMI percentile
Underweight	<5th percentile
Healthy weight	5th to <85th percentile
Overweight	85th to <95th percentile or BMI ≥25[a]
Obesity	≥95th percentile or BMI ≥30[a]
Class I	≥95th to 120th percentile of the 95th percentile
Severe class II	≥120th to 140th percentile of the 95th percentile or BMI 35 to <40[a]
Severe class III	≥140th percentile of the 95th percentile or BMI ≥40[a]
Children <2 years old (based on WHO growth charts)	
Weight category	WFL percentile
Underweight	<2.3rd percentile[b]
Healthy weight	>2.3rd to <97.7th percentile
Overweight	≥97.7th percentile

CDC=Centers for Disease Control and Prevention, WFL=weight-for-length, WHO=World Health Organization.
[a]Overweight and obese status categories for children are defined using either BMI percentiles or BMI cutoff values depending on which value is lower.
[b]Using WHO Anthro Survey Analyser Quick Guide.

lines) over a 6-month period, is highly predictive of later obesity. (6)(13)

EPIDEMIOLOGY

Based on 2017–2018 National Survey of Children's Health (National Health and Nutrition Examination Survey) data, obesity affects 13.7% of preschool-age (2–5 years), 19.3% of school-age (6–11 years), and 20.9% of adolescent (12–18 years) children in the United States. Overweight status affects 9.2% of children younger than 2 years. Although the prevalence of obesity has stabilized for young children, it has increased from rates in 1999 that were 15.8% and 16.0%, respectively, among school-age children and adolescents. (32) Racial and ethnic disparities can begin in infancy, especially if living below the poverty line, as seen with higher rates for Black, Latino, and American Indian/Alaskan native children; (32)(33) prevalence was 28.7% among 10- to 17-year-old American Indian/Alaskan natives. (34) Although obesity prevalence among Asian youth is lower (8.7%) than that of other racial/ethnic groups, cardiometabolic complications tend to occur at a lower BMI and younger age among South Asian children. (35)

Disparities based on income are similarly large, with a 21.5% prevalence of obesity among youth in households earning less than the federal poverty level compared with 8.8% prevalence of obesity among youth in families earning at least 400% of the federal poverty level. (36)

ETIOLOGY

Pediatric obesity is a complex, multifactorial disease caused by interaction between genetics and environmental exposures. (37)(38)(49)(40) Ultimately, excess energy intake relative to expenditure leads to excess weight gain and adiposity (41)(42)(43)(44) and represents the final pathway to obesity. (45)(46) Contextual factors before conception, and continuing through pregnancy, infancy, childhood, and adolescence, (47)(48)(49) create an intergenerational cycle of obesity risk (Fig). Adverse social determinants of health, defined as economic and social conditions that affect health, contribute to disparities and this intergenerational transmission.

Before conception, parental obesity and comorbidities are risk factors for the next generation. (50)(51)(52) Preconception is also a time when adults establish their own attitudes, beliefs, and lifestyle behaviors (eg, smoking, diet, exercise) that affect their energy balance and will shape the attitudes, beliefs, and lifestyle behaviors of their children. During pregnancy, women with overweight/obesity at conception are more likely to have excess gestational weight gain, to develop gestational diabetes mellitus and hypertensive disorders of pregnancy, to have an operative delivery, and to deliver an infant with large- or small-for-

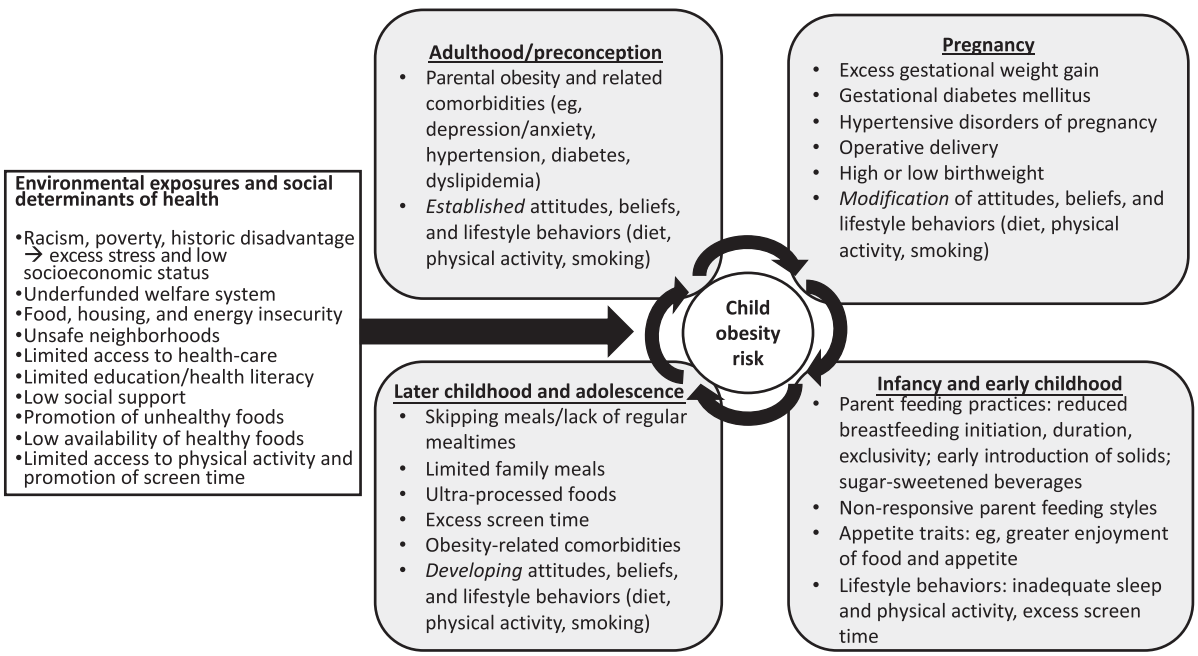

Figure. A life course perspective of child obesity etiology.

gestational-age birthweight. All of these factors predispose the child to excess weight gain and obesity, (45)(46) whereas modification of lifestyle behaviors during pregnancy can reduce this risk. (19)(53)(54)(55) During infancy and early childhood, a variety of parent feeding practices are associated with the risk of child obesity, including formula feeding (56)(57) and combination feeding versus exclusive breastfeeding, (58)(59)(60)(61)(62)(63) consumption of sugar-sweetened beverages (64)(65)(66) and high–energy-dense foods, (67)(68) early introduction of solids, (69)(70)(71)(72)(73) and consumption of limited fruits and vegetables. (74) In addition, maternal obesity is associated with reduced initiation, establishment, and maintenance of breastfeeding. (75)(76) Less responsive parent-child feeding styles, which include pressuring or restricting feeding, not following infant cues, indulgent feeding without appropriate limit setting, or uninvolved/inattentive feeding, (77)(78) are also associated with child obesity (79)(80)(81)(82)(83)(84)(85)(86) and can potentially disrupt infant self-regulatory capacity around eating and energy intake. (45)(77)(78)(87)(88)(89)(90)(91)(92)(93) In addition, infant and child appetite traits develop during this time, influencing parent feeding styles and practices, as well as child weight gain and obesity risk. (94)(95)(96)(97)(98)(99) During later childhood and adolescence, a child's own attitudes, beliefs, and lifestyle behaviors affecting energy balance develop. Lifestyle patterns of low physical activity, high screen time, and inadequate sleep are also associated with obesity across the life cycle. Decreased sleep has been linked to obesity, abnormal glucose regulation, and increased hunger/appetite. (100)

Most cases of child obesity are due to interrelated individual and environmental factors, and affected children commonly have typical cognitive and pubertal development, normal or tall stature, and a lack of dysmorphic features. However, in rare circumstances, obesity is secondary to identifiable conditions, such as endocrine, genetic, or central nervous system disorders. Genome-wide association studies have identified mutations in genes associated with neuroendocrine feedback loops (eg, leptin and ghrelin pathways) that regulate energy intake and appetite, as well as energy expenditure, although to a lesser degree (Table 2). (101) A secondary cause should be considered for an infant, child, or adolescent with obesity and developmental delay, short stature, delayed puberty, early-onset obesity, or hyperphagia, warranting referrals for endocrine, developmental, and genetic evaluations. Genetic analysis from saliva can be used for DNA collection and epigenetic analysis to help identify underlying causes of obesity. (102)

EVALUATION OF CHILD OVERWEIGHT AND OBESITY IN THE PRIMARY CARE SETTING

Multiple expert panels recommend a careful history and physical examination and a thorough evaluation for comorbidities and secondary conditions for children with overweight and obesity at every health supervision visit. (37)(103)(104)(105) Recommended laboratory screening includes fasting analyses for glucose, lipids, and liver function tests (alanine transaminase [ALT], aspartate aminotransferase [AST]), although many providers perform nonfasting laboratory tests for convenience. Children with overweight status should have these screening laboratory tests obtained if they have an elevated risk of comorbidities. Evaluation for endocrine, neurologic, or genetic syndromes is indicated only if signs and symptoms are found. Additional laboratory screening for diabetes suggested by the Pediatric Endocrine Society and the American Diabetes Association includes an oral glucose tolerance test and hemoglobin A1c (HbA1c) (Table 3). Some weight management clinics obtain vitamin D levels because the prevalence of vitamin D deficiency is higher among children with overweight and obesity. (106) Routine screening for other micronutrient deficiencies is not recommended. The timing of testing depends on the level of risk, based on history, physical examination, previous laboratory tests, and clinical judgment, and testing may begin as early as age 2 years. If results of nonfasting studies are abnormal, fasting studies should be obtained. There are limited recommendations for how often to repeat normal laboratory tests. In our practice, this is determined by level of risk from history, physical examination, weight status, signs, and symptoms. Generally, laboratory tests are repeated annually for children with a BMI that remains greater than or equal to the 95th percentile.

SCREENING FOR COMMON COMORBIDITIES

Weight-related comorbidities can affect every organ system. It is helpful to consider a systems-based approach for screening and diagnosis (Table 3).

Cardiovascular

Dyslipidemia. Disordered lipid metabolism is an early marker of cardiovascular risk and is found in approximately 40% of children with obesity. (107) Combined dyslipidemia, with elevated triglyceride levels, low high-density lipoprotein cholesterol levels, and normal or moderately elevated total cholesterol levels, is the most common pattern and is related to insulin resistance. (108)(109) Children with dyslipidemia should have fasting tests repeated within 1 to 3 months and if still abnormal should receive targeted nutritional counseling and weight management. Guidance should focus on reducing

Table 2. Syndromic and Monogenic Obesity

CAUSE[a]	LOCUS	GENE	OBESITY ONSET (TYPE)	CLINICAL FEATURES
Syndromic				
Albright hereditary osteodystrophy (pseudohypoparathyroidism type 1a)	20q13.2	*GNAS1*	Early (generalized)	Short stature, short metacarpals and metatarsals, round facies, delayed dentition, hypocalcemia, subcutaneous calcium or bone deposition, precocious puberty, mild cognitive deficit
Alström	2p13	*ALMS1*	Age 2–5 y (central)	Blindness, deafness, acanthosis nigricans, chronic nephropathy, T2DM, cirrhosis, hypogonadism in males, normal cognition
Bardet-Biedl	11q13	*BBS1,* multiple others	Age 1–2 y (central)	Intellectual disability, hypotonia, retinitis pigmentosa, polydactyly, hypogonadism, +/– glucose intolerance, deafness, renal disease
Beckwith-Wiedemann	11p15.5	Multiple	Infancy	Hyperinsulinemia, hypoglycemia, hemihypertrophy, intolerance of fasting
Carpenter	6p11	*RAB23*	Mid-childhood (central)	Intellectual disability, short stature, brachycephaly, polydactyly, syndactyly of feet, cryptorchidism, umbilical hernia, high-arched palate, hypogonadism
Cohen	8q22	*COH1*	Mid-childhood (central)	Intellectual disability, microcephaly, small hands and feet, cryptorchidism, hypotonia, failure to thrive in infancy, prominent central incisors, long and thin fingers and toes
Prader-Willi	15q	*NDN, SNRPN*	Age 1–3 y (generalized)	Intellectual disability, microcephaly, short stature, hypotonia, almond-shaped eyes, high-arched palate, small hands and feet, late puberty, early failure to thrive then later hyperphagia
Monogenic obesity[a]				
Leptin deficiency	7q32.1	*LEP*	Infancy–3 y	Extreme hyperphagia, frequent infections, hypogonadotropic hypogonadism, mild hypothyroidism
Leptin receptor deficiency	1p31.3	*LEPR*	Infancy	Extreme hyperphagia, frequent infections, hypogonadotropic hypogonadism, mild hypothyroidism
POMC deficiency	2p23.3	*POMC*	Infancy	Hyperphagia, cholestatic jaundice or adrenal crisis due to ACTH deficiency, pale skin, and red hair (depending on racial/ethnic background)
PCSK1 deficiency	5q15	*PCSK1*	Data unknown (varies)	Small bowel enteropathy, hypoglycemia, hypothyroidism, ACTH deficiency, diabetes insipidus
MC4R deficiency	18q21.32	*MC4R*	Infancy–3 y	Rapid weight gain, food-seeking behavior, tall stature/increased growth velocity

ACTH=adrenocorticotropic hormone, *ALMS1*=Alström syndrome protein 1, *BBS1*=Bardet-Biedl syndrome 1, *COH1*=*VPS13B* gene, *GNAS1*=guanine nucleotide binding protein alpha stimulating activating polypeptide, LEP=leptin, LEPR=leptin receptor, *MC4R*=melanocortin 4 receptor, NDN=necdin, *PCSK1*=proprotein convertase subtilisin/kexin type 1, POMC=proopiomelanocortin, *RAB23*=ras-associated binding protein 23, SNRPN=small nuclear ribonucleoprotein polypeptide N, T2DM=type 2 diabetes mellitus.
[a]This list is not comprehensive. There are additional causes of syndromic and monogenic obesity.

intake of refined carbohydrates and saturated fats and increasing exercise and intake of vegetables, fruits, and healthy fats. One should consider familial hypercholesterolemia and referral to a lipid specialist for low-density lipoprotein cholesterol levels greater than 190 mg/dL (>4.92 mmol/L) and triglyceride levels greater than 600 mg/dL (>6.78 mmol/L).

Hypertension. Nearly 10% of children with obesity have hypertension. Stage 1 hypertension is an average systolic or diastolic blood pressure (BP) greater than or equal to the 95th percentile or greater than or equal to 130/80 mm Hg measured on at least 3 separate occasions confirmed by manual BP measurement using an appropriately sized cuff and

Table 3. Recommended Laboratory Screening for Children with Overweight and Obesity

GUIDELINES	BMI ≥95%[a]	NORMAL/DIAGNOSTIC VALUES		NEXT STEPS FOR LABORATORY ABNORMALITIES[b]
AAP Institute for Healthy Child Weight (obtain fasting laboratory tests)[c]	Glucose Lipid panel ALT, AST	Glucose (fasting) Normal, <100 mg/dL (<5.55 mmol/L) Prediabetes, 100–125 mg/dL (5.55–6.94 mmol/L) Diabetes, ≥126 mg/dL (≥6.99 mmol/L) Nonfasting glucose ≥200 mg/dL (≥11.10 mmol/L) is diagnostic for diabetes Lipid panel (fasting) LDL-C <110 mg/dL (<2.85 mmol/L) Triglycerides <75–90 mg/dL (<0.85–1.02 mmol/L) ALT <22 U/L (<0.37 μkat/L) (girls) ALT <26 U/L (<0.43 μkat/L) (boys)		Glucose Prediabetes: repeat in 1–2 mo, consider HbA1c, 2-h OGTT Diabetes: refer to endocrine Lipids LDL-C >190 mg/dL (>4.92 mmol/L) Triglycerides > 600 mg/dL (>6.78 mmol/L) Consider familial hypercholesterolemia Refer to a lipid specialist ALT >22–26 U/L (>0.37–0.43 μkat/L): repeat in 1–3 mo ALT 60–100 U/L (1–1.67 μkat/L): refer to gastroenterology
ADA, PES		Prediabetes	Diabetes	
	HbA1c[d]	5.7%–6.4%	≥6.5%	
	2-hour OGTT[d]	140–199 mg/dL (7.77–11.04 mmol/L)	200 mg/dL (11.10 mmol/L)	

AAP=American Academy of Pediatrics, ADA=American Diabetes Association, ALT=alanine transaminase, AST=aspartate aminotransferase, HbA1c=hemoglobin A1c, LDL-C=low-density lipoprotein cholesterol, OGTT=oral glucose tolerance test, PES=Pediatric Endocrine Society.

[a]Laboratory tests should also be performed for the 85th percentile or greater if risk factors are present.

[b]Normal laboratory tests can be repeated yearly for patients with persistent/worsening obesity.

[c]Can be performed nonfasting for patient convenience.

[d]Can additionally be considered depending on patient risk of diabetes.

proper placement. Stage 2 hypertension is an average systolic or diastolic BP greater than or equal to the 95th percentile + 12 mm Hg or greater than or equal to 140/90 mm Hg. Many electronic medical record systems calculate BP percentiles. Clinicians without access to these systems may use standardized tables (110) or smartphone applications. Additional evaluation for children with hypertension includes serum electrolyte levels, blood urea nitrogen/creatinine level, urinalysis, and urine microalbumin to creatinine ratio. Treatment includes weight management and salt reduction. One should consider referral to nephrology or cardiology for children with persistent stage 1 hypertension for more than 6 months, stage 2 hypertension, or risk factors (renal anomalies, prematurity, cardiac or rheumatologic disease) for evaluation of secondary causes, end organ damage, and the need for pharmacotherapy.

Endocrine

Prediabetes and Type 2 Diabetes Mellitus. Up to 15% of adolescents with obesity have prediabetes or type 2 diabetes mellitus. (111) The 2015 Institute for Healthy Child Weight guidelines recommend obtaining fasting glucose levels for children with overweight/obesity. Guidelines from the American Diabetes Association and the Pediatric Endocrine Society recommend obtaining HbA1c levels, although they acknowledge its poor predictive value. (112)(113)(114) A 2-hour oral glucose tolerance test should be considered in children with abnormal screening laboratory tests, a strong family history, or other risks, such as acanthosis nigricans. Children with diabetes should be referred to endocrinology. Children with prediabetes should be referred to endocrinology or a comprehensive weight management clinic, obtain targeted nutritional counseling to reduce refined carbohydrate intake, and potentially receive medication management. HbA1c in the prediabetic range should be repeated in 1 to 3 months, and a 2-hour oral glucose tolerance test should be considered if the HbA1c concentration worsens or shows no improvement.

Menstrual Irregularities and Polycystic Ovary Syndrome. Up to 5% to 10% of women of childbearing age have polycystic ovary syndrome (PCOS). Insulin resistance associated with obesity is one of the most common etiologies. Although oligomenorrhea and anovulatory cycles are common during the first 2 years after menarche, evaluation for PCOS should be considered in adolescents with BMI greater than or equal to the 85th percentile and irregular menses and/or signs of hyperandrogenism (eg, hirsutism, acne). The Endocrine Society recommends using the Rotterdam criteria: PCOS is diagnosed when 2 of 3 criteria are present: 1) anovulation/oligomenorrhea, 2) clinical/biochemical signs of hyperandrogenism, and 3) polycystic ovaries. (115) This evaluation may be performed in primary care settings or in adolescent, endocrine, or comprehensive weight management clinics. Laboratory tests include first-morning 17-OH-progesterone, dehydroepiandrosterone sulfate, androstenedione, total and free testosterone, sex hormone binding globulin, β-human chorionic gonadotropin, luteinizing hormone, follicle-stimulating hormone, estradiol, prolactin, thyroxine, thyroid-stimulating hormone, and insulin. Patients with normal laboratory test results and persistent menstrual irregularity should undergo pelvic sonography to assess for polycystic ovaries. Similar to all obesity-related comorbidities, first-line treatment is weight loss. Initial pharmacologic treatment should include oral contraceptive pills, and for patients with significant insulin resistance or continued symptoms despite weight loss, metformin can be added. Metformin can be used as monotherapy if there are other contraindications to hormonal treatment.

Gastrointestinal

Up to 29% to 38% of children with obesity have nonalcoholic fatty liver disease (NAFLD), with an increased prevalence among Hispanic adolescents. NAFLD can progressively range from fibrosis to end-stage liver disease. (116) NAFLD is typically asymptomatic. (107) Although hepatic magnetic resonance imaging or biopsy can detect NAFLD even when liver function test results are normal, screening with ALT is recommended for all patients with overweight/obesity. Patients with elevated ALT levels should have repeated laboratory tests in 1 to 3 months. One should consider referral to gastroenterology and/or a weight management clinic for patients with ALT levels twice the upper limit of normal (~60 U/L [~1.0 μkat/L]) or persistently elevated for 3 months to evaluate for other causes (eg, infectious, metabolic, inflammatory, genetic) using hepatic ultrasonography and additional laboratory analyses. Lifestyle modifications to improve diet and physical activity are the first-line treatment for NAFLD, with emphasis on avoidance of sugar-sweetened beverages. (107)

Pulmonary

Obesity is related to an increased risk of obstructive sleep apnea, (117) occurring in 13% to 59% of children with severe obesity. (117)(118) Screening should assess snoring, respiratory pauses, and daytime sleepiness. There is limited evidence for validated screening tools, but some use the Pediatric Sleep Questionnaire. (117)(119)(120) Examination should evaluate degree of tonsillar hypertrophy and nasal obstruction due to allergies or other causes. Treatment for allergic rhinitis with nasal corticosteroids and/or antihistamines

may relieve symptoms. One should also consider referrals to otolaryngology and/or pulmonology for polysomnography, initiation of continuous positive airway pressure treatment, and tonsillectomy and adenoidectomy.

Musculoskeletal

Children with obesity should be screened for extremity and gait abnormalities. Obesity increases the risk of Blount disease, which presents as genu varum or bowed legs and has juvenile- and adolescent-onset peaks (4–10 years or >10 years). (121) School-age and adolescent children with severe obesity have a lifetime risk of 1:450 for slipped capital femoral epiphysis, (122) which should be considered for a child with obesity and hip or knee pain and an abnormal gait/limp. Blount disease and slipped capital femoral epiphysis require urgent referral to orthopedic surgery. Flat feet (pes planus) can be referred to physical therapy, podiatric medicine, and/or orthopedic surgery if associated with pain.

Neurologic

The prevalence of pseudotumor cerebri (idiopathic intracranial hypertension) in children with obesity and severe obesity is approximately 26 and 65 per 100,000, respectively. (123) Patients with signs of increased intracranial pressure, eg, headache or papilledema, should be referred for emergency evaluation.

Psychosocial

The most common comorbidities of obesity are mental health issues, including depression, anxiety, low self-esteem, and poor body image. Recent systematic reviews estimate that rates of depression and anxiety are approximately 1.5- to 2-fold higher in children with obesity than in those with weight in the healthy range. (124) Disordered eating also occurs, including binge eating, bulimia nervosa, anorexia nervosa, and night eating syndrome, which occurs with insomnia and eating during the night. Weight stigmatization, such as teasing, bullying, and social exclusion, (125)(126) contributes to mental health issues. Baseline screening for disordered eating, depression, and anxiety should be completed for all patients, and if identified, patients should be referred to adolescent medicine, psychology, or psychiatry for therapy and/or pharmacologic management.

Due to the heterogeneity of comorbidity risk within BMI categories, there are other approaches for categorizing obesity. The Edmonton Obesity Staging System for Pediatrics defines 4 stages for children 2 years and older based on severity and functioning within 4 domains: metabolic, mechanical, mental health, and psychosocial. (127) Using this framework may help prioritize referrals to weight management programs with limited availability, create individualized care plans, and decrease stigma.

TREATMENT

Overall Approach

Behavioral interventions, composed of lifestyle modification counseling (eg, changes in diet, physical and sedentary activities, and sleep habits), remain the core treatment for obesity at all ages and degrees of severity, with pharmacotherapy and bariatric surgery as additional options for select patients. The AAP recommends a staged approach (Table 4) that increases in frequency and intensity.

Stage 1: prevention plus includes lifestyle modification counseling that benefits most patients in the primary care setting. Stage 2: structured weight management includes more structured lifestyle modification counseling in the primary care setting with additional support from a dietitian, social worker, health educator, or physical therapist. For children with class II and III obesity who are not achieving weight loss goals and for those with weight-related comorbidities, referral to a comprehensive multidisciplinary treatment program should be considered. Stage 3: comprehensive multidisciplinary intervention occurs in a pediatric weight management specialty clinic and includes increased intensity in lifestyle modification counseling, including input from a dietitian,

Table 4. AAP Management and Treatment Stages for Patients with Overweight or Obesity

STAGE	SETTING	COMPONENTS
1: Prevention plus	Primary care	Positive behavior change; "5-2-1-0" messaging
2: Structured weight management	Primary care with appropriate training + nutrition	Positive behavior change with goal of weight maintenance or decrease in BMI velocity; self-monitoring; medical screening
3: Comprehensive multidisciplinary intervention	Pediatric weight management clinic	Increased intensity of behavior change; increase visit frequency
4: Tertiary care intervention	Pediatric weight management clinic	Intensive diet and activity counseling; meal replacements; medications; surgery

AAP=American Academy of Pediatrics.

psychologist, or social worker, and management of mental health concerns and weight-related comorbidities. Participation in a behavioral treatment program, if available, should be considered. Behavioral treatment programs are a component of many comprehensive weight management clinics and are also offered in multiple settings, including school and community centers and many larger group and university-affiliated pediatric practices. Behavioral treatment programs are family-centered, multicomponent programs that offer intensive, multiphasic, lifestyle modification counseling and generally include weekly visits in the treatment phase and monthly maintenance visits. Stage 4: tertiary care intervention occurs in a pediatric weight management specialty clinic setting and adds intensive dietary management, pharmacologic therapy, and bariatric surgery to the stage 3 interventions.

In accordance with evidence that at least 26 contact hours of behavioral treatment over 2 to 12 months is necessary to achieve desired outcomes, (128) the AAP recommends follow-up visits every month in stage 1, every 2 to 4 weeks in stages 2 and 3, and tailored frequency depending on patient motivation and medical status in stage 4. Interventions with at least 52 contact hours had greater improvements, regardless of the variations in content of the interventions. (128) Because this frequency of visits is not achievable or feasible for many families or practices, (129) we recommend targeted visits at least every 3 months, including telemedicine to minimize travel and school absences. Behavioral treatment programs with weekly visits, including telehealth sessions, can also help meet US Preventive Services Task Force recommendations. Evidence from multiple systematic reviews has shown that behavioral treatment programs can lead to modest short-term reductions in BMI, in the range of BMI *z* score reductions of –0.06 units for 6- to 11-year-old children and –0.3 units for 0- to 6-year-old children, with minimal risk of adverse events. (128)(130)(131)(132)(133)

Lifestyle Modification Counseling Techniques. Lifestyle modification counseling is the foundation and initial treatment for all children with obesity in all stages of treatment. The most effective method is motivational interviewing, which is a patient-centered communication style involving reflective listening, support of autonomy, shared decision-making, and eliciting change-talk. (134) The stages of change used in motivational interviewing include precontemplation, contemplation, preparation, action, maintenance, and relapse (Table 5). Keeping these stages in mind supports "meeting the patient where they are."

Lifestyle modification counseling aims to increase goal setting, self-monitoring, problem-solving, contingent reward systems, and stimulus control to support behavior change. Goal setting can promote behavior change in children (135) and is a key component of the contemplation, preparation, and action phases. SMART goals are defined as Specific, Measurable, Achievable, Realistic, and Time-based. Allowing the patient to select the frequency and timeframe of the goal fosters autonomy. (135) Once goals are set, follow-up should review progress, provide support, and troubleshoot barriers.

Self-monitoring of diet, exercise, and weight is associated with weight loss (136) and should be used to track progress and increase awareness of behaviors. Phone apps can help monitor diet and physical activity. Contingent reward systems provide rewards for meeting goals. For stimulus control, patients/families focus on changing environmental factors that affect nutrition (eg, decreasing available snacks) and physical activity (eg, having clothing for varied weather, removing screens from bedrooms).

Although the pediatric primary care office is a key setting for providing lifestyle modification counseling, numerous barriers exist, including time for providers and patients, reimbursement, provider training, and limited availability of specialty weight management clinics and behavioral

Table 5. Stages of Change

STAGE OF CHANGE	DEFINITION	PATIENT STATEMENT	PLAN
Precontemplation	Patient/family does not see weight as a problem	"I don't want to talk about my weight today."	Acknowledge wishes and revisit at next appointment
Contemplation	Patient/family interested in behavior change	"I would like to decrease my risk of diabetes."	Discuss SMART goals
Preparation	Patient/family planning to address the problem	"I think I could drink less soda."	Eliminate soda and drink more water
Action	Patient/family actively carrying out behavior change	"I bought a water bottle and stopped buying soda."	Congratulate patient on positive behavior change
Maintenance	Patient/family sustaining behavior change by establishing habits and modifying the environment	"I always drink water now."	Focus on new SMART goal
Relapse	Return to earlier stages/ behaviors	"I was stressed with school and started craving soda."	Normalize relapse and work on "resetting"

SMART=Specific, Measurable, Achievable, Realistic, and Time-based.

treatment programs for children. Potential strategies to address barriers include 1) telehealth visits for primary and specialty care; 2) inclusion of nurses, dietitians, and health educators to participate in lifestyle modification; 3) increased reimbursement for treatment with chronic disease care models; and 4) more providers receiving training in obesity treatment and prevention strategies. Advocacy is needed for policy changes to increase availability and reimbursement for these important services.

Lifestyle Modification Counseling Content. Counseling should promote healthy changes in diet, physical activity, screen time, and sleep, depending on patient needs. The AAP "5-2-1-0" message recommends 5 or more servings of fruits and vegetables, less than 2 hours of screen time, 1 hour or more of physical activity, and 0 sugary drinks. (137)

Diet

Common obesogenic dietary patterns are identified to guide practical goals, including decreasing portion sizes; increasing fruit, vegetable, and whole grain intake; decreasing processed sugar and carbohydrate consumption; and increasing water intake. (132) Some popular ways to conceptualize diet include 1) MyPlate, which focuses on a balanced plate with half fruits and vegetables, one-quarter whole grains, and one-quarter lean protein (https://www.myplate.gov), (138) and 2) the Traffic Light Diet, (139)(140) which organizes food into categories using the colors of a traffic light, with green for anytime foods, yellow for sometimes foods, and red for foods to eat rarely.

Plant-based and vegetarian diets have become more common, as evidence in adults shows that such diets may lower cardiovascular risk through lowering BMI, total cholesterol level, blood pressure, fasting plasma glucose levels, and HbA1c concentration. (141) Carefully planned vegetarian diets can provide adequate nutrition during childhood and adolescence with appropriate knowledge, counseling, and surveillance. (142) Depending on the content of the diet, special attention should be given to the amounts of protein, essential fatty acids, vitamin B_{12}, calcium, vitamin D, iron, and zinc consumed. (143)

Many patients and their families find information about intensive nutrition and diet plans using the Internet, social media, and word of mouth. Many of these diets have no benefit, and some may be harmful. Some intensive nutrition plans may have benefit for carefully evaluated adolescent patients. Intensive nutrition plans should be offered only in weight management clinic settings with close physician and registered dietitian monitoring. Examples of intensive nutrition and diet plans that may benefit some patients include 1) intermittent fasting (time-restricted feeding), which has shown benefits on overall health, disease, and aging in adults (144) and can lead to weight loss in selected patients; it is less effective if the 6-hour eating period occurs at the end of the day and is followed by sleep or sedentary time (145); 2) ketogenic diets are very-low-carbohydrate, high-fat, and high-protein diets, with evidence of efficacy and safety (146); and 3) low- and very-low-calorie diets, 1,000 to 1,500 and 800 cal per day, respectively, which can be facilitated by meal replacement plans. All intensive nutrition and diet plans should be performed only with the guidance of a physician and registered dietitian.

Physical Activity

Although increasing physical activity without altering dietary intake is generally not sufficient to attain healthy weight loss, the quantity of daily activity for most children falls well below current guidelines. Physical activity recommendations vary by age. For infants (birth–12 months), interactive floor-based play and at least 30 minutes of tummy time spread throughout the day while awake is recommended. For toddlers (12–36 months) and young children (3–5 years), at least 180 minutes daily, of which at least 60 minutes are moderate to vigorous intensity, is recommended. For 6- to 12-year-old children, 60 minutes of moderate to vigorous activity is recommended. (104)(147)(148) For adolescents, 60 to 90 minutes of physical activity is recommended. To improve compliance and sustainability, one should select activities that the child enjoys. Older children with poor exercise tolerance can start with walking goals, aiming for a particular number of steps or minutes per day, and use phone apps for self-monitoring.

Screen Time

The AAP recommends zero screen time for children younger than 2 years, less than 1 hour daily for 2- to 4-year-olds, (149) and less than 2 hours daily for school-age children and adolescents. (150) Screen time for family communication or education is not included in these totals.

Sleep

The American Academy of Sleep Medicine and the AAP recommend optimal sleep duration of 12 to 16 hours for infants, 11 to 14 hours for 1- to 2-year-olds, 10 to 13 hours for 3- to 5-year-olds (including naps), 9 to 12 hours for 6- to 12-year-olds, and 8 to 10 hours for adolescents. (151)(152)

Pharmacologic Management

Pharmacotherapy can be used as an adjunct to lifestyle changes in a multidisciplinary weight management program for class I obesity with a comorbidity or class II or III obesity; all medications require close follow-up and dose titration (Table 6). (153) There are currently 3 US Food and Drug Administration (FDA)–approved medications for weight loss in children and adolescents. Additional medications with other primary indications that have weight loss as a side effect are used off-label in the pediatric weight management setting. Generally, medications are considered effective if there is at least 5% BMI reduction or slowed weight gain within 12 weeks of reaching optimal dose, and they are generally discontinued if no improvement occurs. The average range of weight loss for each medication is listed in Table 6. Weight regain is common when medications are stopped. In general, the cost of these medications for children, other than metformin and phentermine, is not covered by insurance, especially if used off-label. Some plans may cover liraglutide.

Bariatric Surgery

The AAP recommends bariatric surgery as a treatment to consider for youth with class III obesity or class II obesity with severe comorbidities when the response to behavioral and/or medical interventions is limited. (154)(155) The 3 most common types of bariatric surgery procedures, all performed laparoscopically, are 1) Roux-en-Y gastric bypass (RYGB), which creates a small stomach pouch and attaches a section of the small intestine directly to the pouch, allowing "bypass" of the upper portion of the intestines; 2) vertical sleeve gastrectomy (VSG), which removes a large portion of the stomach, creating a small, tube-shaped stomach; and 3) laparoscopic adjustable gastric band (LAGB), which places an inflatable, adjustable silicone band around the top portion of the stomach, creating a small pouch that slows the passage of food to the lower portion. These procedures restrict food intake, reduce appetite, and increase satiety through similar mechanisms (including impacting the ghrelin and leptin pathways). RYGB also has a malabsorption component from the bypassed small intestine. Currently, VSG is the most commonly performed procedure. Complications, both surgical (staple-line leak, stricture formation, and bleeding) and nutritional (eg, iron and vitamin B_{12} deficiency), are less common after VSG than after RYGB. LAGB is now less often used due to higher complication rates. (156) Bariatric surgery produces greater sustained weight loss, improved quality of life, (157)(156)(158)(159) and resolution of comorbidities in adolescents compared with behavioral and pharmacologic interventions. (157) Meta-analysis of weight loss outcomes after bariatric surgery report mean BMI reductions at 6 and 36 months, respectively, of 5.4% and 10.3% for LAGB, 11.5% and 18% for VSG, and 13% and 15% for RYGB. (156) The Teen Longitudinal Assessment of Bariatric Surgery cohort, the largest multicenter case series, reported major perioperative (within 30 days of surgery) complications in 8% of patients, (118) minor complications (eg, nausea and dehydration) in 15%, and no deaths. Micronutrient deficiencies are the most common long-term complications. Due to increased postoperative fertility, an increased risk of unintended pregnancy in adolescents has been well documented. (160) We recommend discussing this risk and providing contraception. Ultimately, the choice to have surgery should be guided by the patient's age, sex, severity of obesity, comorbidities, psychosocial factors, pubertal status, and patient/family preferences within a comprehensive pediatric weight management clinic. Both private and public medical insurance plans cover the cost of bariatric surgery for adolescents who meet the criteria. Most patients who receive bariatric surgery are 16 years and older and complete VSG after 6 months of intensive lifestyle counseling and evaluation by the pediatric weight management, surgery, nutrition, and psychology teams.

Prevention

The mainstay of prevention is promoting healthy behaviors throughout childhood, regardless of weight status. Despite standard counseling in primary care, the progression of obesity is common, highlighting the need for additional preventive strategies. Several evidence-based obesity prevention programs exist for preschool- and school-age children, based in child care and school settings. The Nutrition and Physical Activity Self-Assessment for Child Care Program uses public health professionals to focus on physical activity, nutrition, policy, and physical environments in child care facilities. (161) Planet Health is a school-based program focused on decreasing television viewing and fast food intake and increasing fruit/vegetable intake and physical activity. (162) Team Kid Power is an academic-community partnership with face-to-face contact between health mentors and elementary school students to improve nutrition and activity. (163)

Recent clinical trials of obesity prevention interventions during pregnancy and/or infancy have demonstrated promising effects on obesity-related feeding practices and child weight during the first 2 years after birth. The Starting Early Program, (164) is a strengths-based intervention in

Table 6. Pharmacologic Treatment Options for Weight Loss

MEDICATION (ROUTE)	MECHANISM OF ACTION	CONSIDER USE	CONTRAINDICATIONS/ CAUTION	RISKS/SIDE EFFECTS	MEAN WEIGHT LOSS	AGE, y	COST PER MONTH, mo
FDA-Approved Use							
Orlistat (oral)	Inhibits dietary fat absorption by ∼30%	Healthy patient who wants option of OTC or not systemically absorbed	Renal impairment, liver impairment. use of levothyroxine, cyclosporine, seizure medications. chronic malabsorption, cholestasis	Gastrointestinal symptoms (oily stool, gas, rectal discharge), hepatic dysfunction, nephrolithiasis nephropathy, cholelithiasis	−2.6 kg[a]	≥12	800
Liraglutide (daily injection)	Appetite suppressant, increases satiety, regulates insulin and blood glucose levels	Medication-induced weight gain, PCOS, insulin resistance, diabetes	Family or personal history of medullary thyroid cancer or MEN type 2,[b] history of pancreatitis, fear of needles	Nausea, reflux, changes in bowel movements, pancreatitis	BMI reduction −4.29%[c]	≥12	1,100
Phentermine[d] (oral)	Appetite suppressant, stimulates metabolism	Healthy patient without cardiac issues	Hypertension, palpitations, arrythmias,[b] heart disease,[b] anxiety	Increased heart rate, increased blood pressure, palpitations, anxiety, insomnia	BMI reduction −4.1%[a]	≥16	35
Off-Label Use							
Metformin (oral)	Increases insulin sensitivity	Atypical antipsychotics,[e] PCOS, insulin resistance, diabetes	Impaired renal function, liver disease	Nausea, looser stool (temporary)	BMI reduction −0.86[a]	≥10	4–100
Lisdexamfetamine (oral)	Decreases thoughts around food and compulsive eating	Binge-eating disorder or behavior	Hypertension, palpitations, arrythmias,[b] heart disease,[b] anxiety	Palpitations, increased heart rate, increased blood pressure, anxiety, jitters, constipation, insomnia, dry mouth	Reduction −1.1 to 2 kg[a]	≥6	380
Topiramate (oral)	Increased satiety	Migraines, seizures	Glaucoma,[b] metabolic acidosis, academic difficulties, suicidal ideation, teratogenic[b]	Impaired cognition, difficulty concentrating, paresthesia	BMI reduction −4.9%[a]	≥16	50
Phentermine/topiramate (oral)	Appetite suppressant, stimulates metabolism, increased satiety	Healthy patient without cardiac issues, migraines	Hypertension, palpitations, arrythmias,[b] heart disease, anxiety, glaucoma[b]	Increased heart rate, increased blood pressure, palpitations, anxiety, cognitive slowing, decreased efficacy of birth control	% weight change: low dose: −4.78%; high dose: −6.02%[f]	≥16	230
Semaglutide (weekly injection or oral)	Appetite suppressant, increases satiety, regulates insulin and blood glucose levels	Medication-induced weight gain, PCOS, insulin resistance, diabetes	Family or personal history of medullary thyroid cancer or MEN type 2,[b] history of pancreatitis	Nausea, reflux, changes in bowel movement, pancreatitis	Weight reduction −14.9%[g]	≥12	1,400

Continued

Table 6. Pharmacologic Treatment Options for Weight Loss (Continued)

MEDICATION (ROUTE)	MECHANISM OF ACTION	CONSIDER USE	CONTRAINDICATIONS/ CAUTION	RISKS/SIDE EFFECTS	MEAN WEIGHT LOSS	AGE, y	COST PER MONTH, mo
Setmelanotide[h] (daily injection)	Works on melanocortin-4 receptor (regulation of hunger, satiety, energy expenditure)	POMC deficiency, PCSK1 deficiency, LEPR deficiency	Severe depression	Increased skin pigmentation, nausea, headache, depression	Mean weight change baseline −25%[i]	≥6	20,000

FDA=Food and Drug Administration, LEPR=leptin receptor, MEN=multiple endocrine neoplasia, OTC=over the counter, PCOS=polycystic ovary syndrome, PCSK1=proprotein convertase subtilisin/kexin type 1, POMC=proopiomelanocortin.

[a]Per Srivastava G, Fox CK, Kelly AS, et al. Clinical considerations regarding the use of obesity pharmacotherapy in adolescents with obesity. *Obesity (Silver Spring)*. 2019;27(2):190–204.

[b]Absolute contraindications.

[c]Per Kelly AS, Auerbach P, Barrientos-Perez M, et al. A randomized, controlled trial of liraglutide for adolescents with obesity. *N Engl J Med*. 2020;382(22):2117–2128.

[d]FDA-approved for use in individuals 16 years and older for BMI ≥27 and at least 1 comorbidity. Phentermine is a class IV controlled substance. Phentermine is generally recommended for short-term treatment (12 weeks). In some states, it is considered a controlled substance and has strict guidelines for the prescriber to review before initiation.

[e]Metformin can be initiated concurrently with atypical antipsychotic agents.

[f]Per Hsia DS, Gosselin NH, Williams J, et al. A randomized, double-blind, placebo-controlled, pharmacokinetic and pharmacodynamic study of a fixed-dose combination of phentermine/topiramate in adolescents with obesity. *Diabetes Obes Metab*. 2020;22:480–491.

[g]Per adult data from Wilding JPH, Batterham RL, Calanna S, et al. Once-weekly semaglutide in adults with overweight or obesity. *N Engl J Med*. 2021;384(11):989.

[h]Studies completed for children 6 years and older.

[i]Per Clément K, van den Akker E, Argente J, et al. Efficacy and safety of setmelanotide, an MC4R agonist, in individuals with severe obesity due to LEPR or POMC deficiency: single-arm, open-label, multicentre, phase 3 trials. *Lancet Diabetes Endocrinol*. 2020;8(12):960–970.

which registered dietitians support responsive parenting and active practicing of skills using prenatal and postpartum nutrition counseling and parenting support groups coordinated with health supervision visits. (165) Greenlight (166) is a health literacy–informed intervention with training in communication strategies, plain-language booklets, and tangible tools to reinforce healthy behaviors, delivered by providers at health supervision visits. (167)(168) The Intervention Nurses Start Infants Growing on Healthy Trajectories (169) intervention uses a home visiting model, with nurses providing counseling on positive parenting in feeding, sleep, and emotional regulation. (170) Participation in these interventions is associated with a 0.2 reduction in BMI *z* score compared with children in standard care control groups.

A recent systematic review found that obesity preventive interventions targeting diet and physical activity for children from infancy through adolescence can lead to reductions in mean BMI *z* score from 0.07 to 0.05 and do not have adverse effects. (171) Despite the small effect size, the multifactorial environmental influences leading to child obesity support the need for prevention across the lifespan.

Weight Stigma

Weight bias or stigma is defined as negative attitudes, beliefs, judgments, stereotypes, or discriminatory acts toward individuals because of their weight. (172) Data show that peers, family, health-care professionals, teachers, and media contribute to cultural norms that fail to acknowledge obesity as a complex, multifactorial chronic disease. (125) Bias occurs as early as preschool, with young children placing negative stereotypes onto peers with larger body sizes. Bias causes adverse physical and psychological outcomes and promotes social norms that marginalize people.

These effects can be minimized with people-first language, careful word choices to describe weight, and a welcoming setting. People-first language can enhance weight-related communication between parents, providers, and children to focus on building healthy habits rather than on weight. (173) Discussing “a child with obesity” rather than “an obese child” recognizes that the child has the medical problem, rather than equating the child with the problem. People-first language has not been adopted consistently for obesity. (174)

Using appropriate language and word choice for describing obesity decreases stigmatization. (126) Some terms that clinicians use enhance stigma, including “fat,” “obese,” and “extremely” or “morbidly obese,” whereas terms such as

"high weight" and "unhealthy weight" are considered motivating. Stigmatizing language could cause families to switch doctors or avoid medical appointments. (126) Finally, having appropriately sized chairs, BP cuffs, scales, and examination gowns readily available can help increase patient comfort in the clinical setting.

Policy

Policy strategies are needed to address changes at a population level and have focused on 1) supporting evidence-based interventions and implementing effective programs at wider community levels, (171)(175) 2) revising existing nutrition support programs, 3) taxing sugar-sweetened beverages, and 4) adding calorie labels and nutrient warnings to menus and food products.

Revisions to the Special Supplemental Nutrition Program for Women, Infants, and Children package reduced juice and increased fruit, vegetable, and whole grain allowances and led to changes in consumption of the targeted items and a reversal of the increasing obesity prevalence among program participants. (176)(177)(178) In addition, the Healthy, Hunger-Free Kids Act of 2010, which strengthened nutrition standards for meals and beverages provided through the National School Lunch, School Breakfast, and Smart Snacks in School programs, found a significant decline in obesity for children in poverty after its implementation. (179)

Several systematic reviews of taxation on sugar-sweetened beverages show that taxes can decrease their purchase and consumption. (180) Calorie labeling, which requires restaurants with multiple locations to post the caloric content of regular menu items, did not change the level of calories purchased in fast food restaurants, (181) although some reduction in other settings was found. (182) Studies of health warning labels, a type of food label that requires products with excessive levels of unhealthy nutrients to display front-of-package warning labels (eg, "WARNING: High in added sugar"), demonstrate decreased purchase of labeled products. (183)(184)(185)

Expert panels from the Institute of Medicine and the World Health Organization have emphasized that obesity on a population scale is fostered and sustained by socioenvironmental contextual factors that include overconsumption of palatable, high-calorie processed foods, sedentary work, learning and leisure environments, and financial incentives that perpetuate these circumstances in both the general and highest-risk populations. (186)(187) These panels have suggested that in addition to implementing policies such as those listed previously herein, systems-level transformation considering the synergy (or syndemic) of epidemic obesity, undernutrition, and climate change will be required, and that reducing obesity disparities will require improving underlying societal structures that lead to all health disparities.

Summary

- According to Level D evidence, BMI percentiles and extended BMI charts can help better classify obesity severity. (26)(27)(28)(29)(30)(31)
- According to Level D evidence, contextual factors affect child obesity risk beginning before conception and through pregnancy, infancy, childhood, and adolescence, creating an intergenerational cycle of obesity risk. (37)(38)(39)(40)(41)(42)(43)(44)(45)(46)(47)(48)(49)
- According to Level D evidence, children with developmental delay, short stature, delayed puberty, early-onset obesity, or hyperphagia warrant referrals for endocrine, developmental, and genetic evaluations to rule out secondary causes.
- According to Level D evidence, for children with obesity, recommended screening includes fasting laboratory analyses for glucose, lipids, and liver function testing (alanine transaminase and aspartate transaminase). (37)(103)(104)(105)(106)
- According to Level A evidence, the American Academy of Pediatrics (AAP) recommends a staged approach that begins with behavioral interventions in primary care (stage 1), increases in frequency and intensity if the patient does not respond favorably (stage 2), progresses to behavioral management in a comprehensive, multidisciplinary program (stage 3), and is finally complemented by the addition of pharmacologic and surgical treatment options available in a tertiary referral center (stage 4).
- According to Level B evidence, motivational interviewing is a patient-centered communication style that involves reflective listening, support of autonomy, shared decision-making, and eliciting change-talk. (134)
- According to Level D evidence, the AAP recommends taking the patient's physical, psychological, developmental, psychosocial, and mental health into account when deciding when to initiate medications. (153)

- According to Level C evidence, the AAP recommends bariatric surgery as a treatment to consider for youth with class II obesity with comorbidities or youth with class III obesity. (154)(155)
- According to Level A evidence, bariatric surgery demonstrates both short-and long-term weight loss, a greater amount of weight loss compared with behavioral and pharmacologic interventions, and resolution of comorbidities. (156)(157)(158)(159)
- According to Level D evidence, use of people-first language can enhance weight-related communication between parents, providers, and children to focus on building healthy habits rather than on weight. (173)(174)

References and teaching slides for this article can be found at https://doi.org/10.1542/pir.2021-005095.

PIR QUIZ

1. A 10-year-old boy with obesity is brought to the clinic by his parents for an initial visit. Both parents and his 6-year-old sister have obesity. In the discussion of causes of obesity by the clinician, the most likely cause in their child includes which of the following?

   A. A single autosomal dominant gene.
   B. Can only be determined with 100% certainty with obesity genetic testing panel.
   C. Interaction between genetic factors and the environment in most cases.
   D. Maternal factors.
   E. Prader-Willi syndrome.

2. An 8-year-old boy with obesity has a blood pressure (BP) of 135/85 mm Hg on 2 separate pediatric visits taken with an appropriately sized BP cuff. Which of the following would be the most appropriate next step in management?

   A. Obtain serum electrolytes.
   B. Obtain urine analysis.
   C. Perform renal ultrasonography to assess for a renal malformation.
   D. Refer to pediatric nephrology.
   E. Repeat BP measurement at the next clinic visit.

3. An 11-year-old girl with obesity is found to have a normal fasting blood glucose level and a hemoglobin A1c (HbA1C) level in the prediabetic range. A repeat HbA1C 2 months later is unchanged. Which of the following is the most appropriate next step in management of this patient?

   A. Consider ordering an oral glucose tolerance test (OGTT).
   B. Medication management only.
   C. Repeat hemoglobin A1C in 2 months.
   D. Refer to a pediatric endocrinology clinic, provide nutritional counseling, and consider medical management.
   E. Repeat laboratory studies in 1 year and refer to endocrinology and nutrition if her repeated laboratory values are in the diabetic range.

4. A 15-year-old girl with class III obesity has been followed by her primary care provider for the past year using a combination of prevention and lifestyle modification strategies. She has acanthosis nigricans and an elevated hemoglobin A1c level. Which of the following is the most appropriate next step in management?

   A. A more intense regimen of increased physical activity.
   B. Bariatric surgery.
   C. In-office implementation of SMART (Specific, Measurable, Achievable, Realistic, and Time-based) goals using motivational interviewing to help obtain behavior change.
   D. Pharmacologic treatment.
   E. Referral to a comprehensive multidisciplinary weight management program.

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5. The family of a 16-year-old girl with obesity is interested in pursuing bariatric surgical options after a suboptimal response to behavioral and pharmacologic interventions. The patient meets the criteria and her insurance covers the procedure. The family asks about the various procedures available and the safety and complication rates of each of them. Which of the following is the most appropriate bariatric procedure to perform in this patient?

   A. The laparoscopic adjustable gastric band (LAGB) because of lowest nutritional complications.
   B. The LAGB because of highest mean BMI reductions.
   C. The Roux–en-Y gastric bypass because of lowest risk of unintended pregnancy due to increased fertility.
   D. The vertical sleeve gastrectomy because of lowest risk of unintended pregnancy due to increased fertility.
   E. The vertical sleeve gastrectomy because of lowest surgical complications.