



Nutrition Issues and Concerns



Breastfeeding

Health professionals are uniquely positioned to influence women in their decision about whether to breastfeed. Discussing the benefits of breastfeeding during prenatal care enables parents to make an informed choice about whether and for how long to breastfeed their infant. Breastfeeding success is in large part dependent on a health professional's supportive attitudes, a hospital climate that is conducive to the initiation and maintenance of breastfeeding, family support, and health professionals' awareness of the need for breastfeeding instruction and support.

BREASTFEEDING RATES

The *Healthy People 2010* objectives for breastfeeding are that 75% of mothers will breastfeed in the early postpartum period, and 50% will still be breastfeeding when their infant is 6 months old.¹ In 2004, 73% of mothers breastfed their infants in the early postpartum period, and 41% continued to breastfeed through age 6 months.² The *Healthy People 2010 Midcourse Review* objectives for breastfeeding are that 60% of mothers will breastfeed exclusively for 3 months, and at least 25% will breastfeed exclusively for 6 months.³ In 2004, 30% of mothers exclusively breastfed their infants for 3 months, and 11% exclusively breastfed their infants for 6 months.² To promote optimal nutritional status for infants, it is essential that health professionals and parents recognize the enormous benefits of breastfeeding and breast milk, understand how to effectively manage lactation, and learn the importance of breastfeeding exclusively during the first 6 months of life.

Most infants born in the United States in the 20th century were not breastfed. Cow's milk preparations and other infant formulas were usually the major source of nutrition during the first year of life. However, research conducted over the past 30 years has repeatedly demonstrated the importance of breast milk for infants.⁴ This recognition of the health, nutritional, immunologic, psychological, and societal advantages of breast milk over all substitutes has led to a gradual increase in breastfeeding, especially during the first 2 to 4 months of life. Additional health benefits from breastfeeding for mothers—as well as economic and environmental advantages—have been identified.⁴⁻⁸

BREASTFEEDING BENEFITS

Breastfeeding provides infants with significant protection against a variety of infectious diseases, particularly in areas with poor sanitation and contaminated water and food supplies. Epidemiological studies have shown that, compared with formula-fed infants, breastfed infants may have fewer and less severe bacterial and viral diseases, including meningitis, gastroenteritis, otitis media, pneumonia, botulism, and urinary tract infections.⁴⁻⁶

Epidemiological data suggest that children who were breastfed as infants experience certain chronic disorders at a lower rate than their counterparts who were not breastfed. Breastfeeding may confer a protective effect against some chronic disorders, such as Crohn's disease,⁹ celiac disease,¹⁰ lymphoma and leukemia,^{11–13} type 1 diabetes mellitus,¹⁴ and certain allergic conditions.¹⁵ Some of the preventive effects of breastfeeding (including the preventive effects against otitis media and asthma) continue well beyond the period of breastfeeding, suggesting that breastfeeding enhances long-term immunologic response.⁴ Moreover, growth patterns observed in the first year of life suggest that breastfeeding may help prevent obesity.⁵ Multiple studies have demonstrated an association between breastfeeding and improved cognitive behavior, including higher IQs and improved school performance through adolescence.⁷

In the days after delivery, the mother's lactation reduces postpartum bleeding and the size of the uterus (an effect of oxytocin). The absence of menstruation during lactation reduces iron loss and delays the resumption of ovulation.¹⁶ Consequently, the time between pregnancies is increased, the risk of prematurity in later pregnancies is reduced, and adverse outcomes for the pregnancy or the infant are reduced. In proportion to the total duration of lactation, women who breastfeed have lower rates of ovarian cancer, premenopausal breast cancer, hip fractures, and osteoporosis.^{5,6}

Hospitalizations, medical office visits, and pharmaceutical use are significantly reduced for breastfed infants, cutting health care costs by an average of \$200 per breastfed infant compared with formula-fed infants.⁸ Improved infant health reduces loss of income due to parents' absence from work to care for the infant. Breastfeeding also eliminates or reduces the need to purchase infant formula, the cost of which has been estimated to range from \$750 to \$1,500 for the first year of life. Breast pump rental or purchase and lactation consultation services may counteract some of these savings, but the net economic benefit remains significant.¹⁶

BREAST MILK COMPOSITION

Human milk is radically different from cow's milk and even from prepared infant formula, despite attempts to modify formulas to make them similar to breast milk. Breast milk is low in protein (about 0.9 g/100 mL) compared with raw cow's milk, which has nearly 4 times the concentration of protein.¹⁶ Infant formulas are diluted to provide a low protein concentration that is similar to the concentration in human milk, but the protein structure (which is more difficult for the young infant to absorb) remains the same as that of cow's milk. In some formulas, the ratio of whey to casein is altered in an attempt to mimic the amino acid concentrations in breast milk, in which whey is dominant. Human milk proteins contain antibodies (known as secretory IgA) that are structured specifically to resist digestion.

Breast milk also contains hundreds of micronutrients, including free amino acids, essential fatty acids, minerals, growth factors, cytokines, and other chemical agents that contribute to infant growth and development. Many of these components serve as both nutrients and bioactive agents to enhance the infant's development.

Breast milk's composition varies during the course of breastfeeding. Colostrum, the initial milk, is higher in protein and lower in fat and lactose concentrations than mature milk.¹⁶ Throughout the course of lactation, secretory IgA concentration gradually declines, allowing the infant's immune system to develop and lose its dependency on the mother's sources. Because the mother and infant share the same environment, the mother develops and secretes antibodies specific to the viruses and bacteria to which the infant is exposed. This response is rapid, requiring only a few days. These dynamic changes in the composition of breast milk show how well it adapts to meet the infant's needs.

INITIATING BREASTFEEDING

Breastfeeding is established most successfully when it is begun during the first hour after birth. The infant and mother should remain together throughout the recovery and postpartum period, with no interruptions in the rooming-in. The mother should be encouraged to put her infant to the breast at the earliest signs of hunger (eg,

mouthings motions, hand-to-mouth movements, wide-eyed eagerness, cooing).¹⁶ Crying is a late sign of hunger that often interferes with good breastfeeding; the crying infant usually requires calming before breastfeeding can begin. Positioning and latching-on require some initial experimentation. A good let-down or milk-ejection reflex (tingling sensation and a strong surge of milk) in the breast, accompanied by brief cramping pain in the uterus (from the release of oxytocin by the pituitary gland), are signs of a good latch-on in the first few days' postpartum. Although only small amounts of colostrum are produced at each feeding for the first day or so, this initial milk is vital for nutrition and immune protection. No supplemental feeding is necessary in most cases, and families should be counseled that weight loss in the first few days of life is expected and normal. The volume of breast milk will increase over the next few days. Counseling by a lactation consultant can often identify problems in positioning and latching-on that can be easily corrected before unnecessary pain and nipple injury occur.¹⁷

Mothers should breastfeed at least 8 to 12 times every 24 hours during the early weeks of lactation, and the infant should empty the first breast before being put to the second breast. Frequent breastfeeding and complete emptying of both breasts will help prevent engorgement and stimulate breast milk production. The hind milk—the portion that comes out toward the end of emptying a breast—contains much more fat, which provides essential calories and signals the infant to end feeding on that breast.¹⁶ Water and formula supplementation are not needed and should be discouraged, because they may interfere with the development of good breastfeeding patterns. Water supplementation also increases the likelihood that the infant will consume fewer calories and subsequently develop jaundice and severe hyperbilirubinemia. When the infant does not get sufficient calories and produce enough stools, bilirubin is not excreted, and the infant can become jaundiced. The use of pacifiers should also be discouraged during the early weeks of life, until breastfeeding is well established, as pacifier use may complicate breastfeeding initiation and cause premature weaning.⁵

The mother and health professionals can evaluate the adequacy of the infant's milk intake by observing whether the infant has 5 or more wet diapers and 3 or 4 stools per day by age 5 to 7 days. A trained observer should evaluate the breastfeeding position, latch-on, and sucking and swallowing during the first few days. Within 3 to 5 days after birth and within 48 to 72 hours after discharge from the hospital, the mother and infant should be seen by a physician or other health professional trained in lactation management to evaluate breastfeeding.¹⁷ If the infant is being monitored for hyperbilirubinemia, follow-up may occur even sooner, within 24 to 72 hours of discharge. At this time, infants should be weighed; if they have lost more than 7% of their birth weight, the mother's breastfeeding practices should be evaluated and, if necessary, corrected to increase milk production and frequency and duration of feeding. Nipple pain and cracking, breast engorgement, and all other problems should also be addressed to ensure that breastfeeding is successful. If problems are not evaluated and corrected at this point, breastfeeding may be stopped too early.¹⁷

Mothers should be able to obtain counseling from a lactation consultant by phone and in person when needed. Home or office visits with licensed, certified lactation consultants, nurses, nutritionists, or physicians trained in breastfeeding can be helpful in evaluating and correcting breastfeeding problems. Peer support groups (eg, La Leche League International) are also helpful throughout infancy, especially when the mother is initiating breastfeeding and adapting to her new infant. If the mother has breastfeeding issues or concerns, she should contact her infant's pediatrician.

THE MOTHER'S DIET

During the early weeks of breastfeeding, the mother does not need to eat more food than she would have eaten before pregnancy. Fat stores provide adequate energy sources for milk production. Encourage the mother to drink extra fluids (especially milk, juice, and water) to keep from getting thirsty. Breastfeeding accelerates the mother's return to her pre-pregnancy weight. However, after about 6 weeks, breastfeeding mothers need to eat more to satisfy their energy needs. Increasing calories by 400 or less per day

and drinking enough water to satisfy thirst is usually sufficient.¹⁸ A well-balanced diet is adequate, and no special foods or nutrient groups are required.

While most foods (including spicy and exotic ones) eaten by the mother are well tolerated by breastfeeding infants, occasionally the infant may have symptoms that suggest allergy or intolerance. For example, cow's milk protein enters breast milk and has been shown to result in sensitization and allergic symptoms in about 8% of breastfed infants. In these cases, the mother may need to eliminate known or suspected allergenic foods (especially dairy products) from her diet. The mother's caffeine intake should be eliminated or reduced, because caffeine in breast milk may lead to prolonged waking periods or agitation in the infant. Alcohol intake during lactation should be an occasional single drink, because alcohol is readily transferred to breast milk. The Institute of Medicine reports that 8 oz wine, 12 oz beer, or 2 oz hard liquor is safe if breastfeeding is then delayed for 2 hours.¹⁹ Breastfeeding mothers should be discouraged from smoking, especially while breastfeeding.

CONTINUING BREASTFEEDING

For healthy, full-term infants, breast milk from a well-nourished mother offers enough vitamins and minerals, with the exception of vitamin D and possibly iron, during the first 6 months. Because maternal stores of vitamin D are low, it is recommended that all breastfed infants receive 400 IU of vitamin D per day beginning shortly after birth and continuing throughout breastfeeding²⁰ and an iron supplement (1 mg/kg/day) beginning at age 4 months.⁵ Ideally, mothers should exclusively breastfeed for a minimum of 4, but preferably 6, months.

Healthy infants usually require little or no supplemental water. Water is not needed during the first 6 months and should be offered thereafter only when the infant has lost an excessive amount of water. Breastfeeding can continue for 12 months or as long as the mother and infant wish.⁵ The benefits of breastfeeding for both the mother and the infant or child continue for as long as breastfeeding is practiced.

Some mothers may wish to breastfeed and formula-feed their infants, perhaps because they have returned to work or school outside the home. Mixed feeding should be discouraged during the early weeks of breastfeeding because it often interferes with the establishment of a good breast milk supply and may lead to premature weaning from the breast.¹⁷ Some mothers may be able to adapt their breastfeeding schedules after a few months so that they can go without feeding or pumping for 6 to 8 hours during the day and then breastfeed the infant frequently in the evening and at night.

For mothers returning to work or school, breastfeeding can be effectively maintained by pumping and storing the expressed breast milk in a cooled container (eg, an insulated bag with ice packs, in a prefrozen insulated vacuum bottle) for 24 hours. Breast milk can be stored in the refrigerator for 5 days, in the freezer compartment of a refrigerator for 2 weeks, in a freezer compartment of the refrigerator with separate doors for 3–6 months, and in a chest or upright deep freezer for 6 to 12 months.²¹ Breast milk should never be stored in the door of a freezer because of the freezing-thawing effect of continually opening and closing the door. Similarly, milk stored in the refrigerator should not be stored in the door because of the cooling-warming effect. Sterile or well-cleaned hard plastic or glass containers are suitable for storing breast milk. Frozen breast milk should be thawed slowly either at room temperature, in the refrigerator, or in a warm-water bath. Breast milk should never be warmed in a microwave oven since it can easily overheat or may heat unevenly (because of hotspots caused by microwaving), burning the infant and destroying the milk's beneficial qualities.

Mothers who plan to go back to work or school should talk with their employer or with school personnel about the need for a private place to pump and about ensuring that they have time to pump. Some employers purchase high-grade electric breast pumps for employees' use and allow sufficient time to use them. These arrangements benefit an organization financially because employees' absences to care for sick infants, as well as health insurance costs, may be reduced, and employee satisfaction (and thereby retention)

improves.^{22–24} However, women who have hourly jobs in non-office or retail settings may find it more challenging to make these arrangements.

Weaning should occur naturally and gradually when the mother and infant are ready, although preferably not before the infant's first birthday.^{5,17} The most comfortable way to wean is for mothers to gradually reduce the frequency of breastfeeding and replace breast milk with other foods over a period of several weeks. In the first year, only iron-fortified infant formula is appropriate as a substitute for breast milk.⁵

Complementary (solid) foods can be introduced between ages 4 and 6 months when the infant is developmentally ready. After age 6 months, solid foods aid in the development of appropriate feeding and eating skills for all infants and provide additional nutrients to meet the Dietary Reference Intakes for breastfed infants. Instruct parents to offer good sources of iron, such as iron-fortified, single-grain infant cereals (eg, rice cereal) and pureed meats, especially red meats, as the first solid food. They provide ample sources of iron, zinc, and protein, nutrients especially needed by breastfed infants.^{25,26} One ounce (30 g) of infant cereal provides the daily iron requirement, particularly if fed with vitamin C-rich foods, such as baby fruits, which enhances iron absorption from the cereal.

CONTRAINDICATIONS TO BREASTFEEDING

While breast milk is the best food for almost every infant, breastfeeding and breast milk in some cases may be contraindicated, either temporarily or permanently.^{5,6}

The strongest contraindication is when the infant has an inherited metabolic disorder, such as galactosemia, in which he is unable to metabolize the lactose portion of milk sugar, called galactose. Lactose elimination for the infant must then be implemented, and the infant should not be breastfed. Infants with phenylketonuria may continue to receive breast milk (because of its low phenylalanine concentration) if they are monitored carefully for blood phenylalanine levels. There are other inherited disorders that contraindicate or require modification of breastfeeding, but they are rare.

Although HIV and untreated active pulmonary tuberculosis are contraindications to breastfeeding in the United States, most maternal infections do not contraindicate breastfeeding.^{5,6} Maternal hepatitis A, B, and C are usually not transmitted through breastfeeding. The infant must be immunized against hepatitis B. Cytomegalovirus through breastfeeding may be a risk to premature infants, but it is not a risk to full-term infants. A mother who develops a fever or other signs of a mild, non-life-threatening infection while breastfeeding (whether from a viral or a bacterial infection) has already exposed her infant to the infection and should be encouraged to continue breastfeeding the infant or to express breast milk; the breast milk will provide specific antibodies and other nonspecific anti-infectious agents to protect the infant. In fact, discontinuing breastfeeding may increase the infant's risk of developing the infection. Mastitis does not harm the infant, and the continuation of breastfeeding is essential to hasten the mother's recovery. Breastfeeding may even be continued with breast abscesses, as long as the incision and surgical drainage tube are far enough away from the areola that they are not involved in feeding.

Breastfeeding mothers can take most drugs, whether prescription or over the counter. Radioactive isotopes, certain antimetabolites (eg, chemotherapeutic agents), and a few antibiotics and antipsychotic drugs are contraindicated during breastfeeding. Every effort should be made to substitute safe drugs or maintain lactation by pumping while the drugs are being administered. Excellent references are available to identify which drugs are safe and which are not.^{1,27–29} Oral contraceptives of low-dose progesterone are safe and compatible with breastfeeding, but estrogen-containing agents should be avoided because they may inhibit milk production. Herbals are not recommended because they contain many active ingredients and are not controlled or regulated. Health professionals should include a discussion of all medication or herbal use with breastfeeding mothers as part of routine follow-up.

SUMMARY

Breast milk is a valuable, readily available resource with extensive short- and long-term benefits for both mothers and infants. It is essential that health professionals understand the benefits and management of breastfeeding and that this topic be included in their education and training. Health professionals can thus help ensure the improved health and development of almost all infants, children, and adolescents.

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Supporting an Adolescent Mother's Decision to Breastfeed

Denise Booker, a 17-year-old high school junior who is unmarried and pregnant, can't decide how to feed her baby. She is enrolled in WIC (Special Supplemental Nutrition Program for Women, Infants and Children) and has attended prenatal classes. All the health professionals have emphasized the benefits of breastfeeding, pointing out the complete nutrient content of breast milk, the lower risk of infection for babies, and the convenience of not having to sterilize bottles and prepare infant formula. Denise has also learned that she could complete her senior year at a high school that provides child care and would allow her to breastfeed her baby during school hours. She has become convinced that breastfeeding offers many advantages to her and her baby.

Denise's mother and the baby's father are trying to discourage Denise from breastfeeding. Both believe that breastfeeding will interfere with their ability to care for the baby. Denise's mother bottle-fed all of her children, and she thinks it is unnecessary to have to pump breast milk when infant formula is widely available. She has also expressed uneasiness about handling expressed breast milk when she is caring for her grandchild.

Denise discusses her dilemma with the WIC nutritionist, Mariana Rivera. They set up a meeting at which Denise, her boyfriend, and her mother talk openly about the issue of breastfeeding versus bottle-feeding.



After the baby is born, a lactation consultant visits

Denise in the hospital.



The nutritionist plays a videotape that demonstrates the techniques for breastfeeding and for feeding expressed breast milk. After a thorough discussion, they all agree to support Denise's desire to breastfeed her baby.

After the baby is born, a lactation consultant visits Denise in the hospital. She helps Denise position the baby for breastfeeding and explains the baby's natural reflex to search for the nipple and begin suckling. The consultant shows Denise how to tell if the baby is properly latched on to the breast and swallowing milk. Before Denise and her baby leave the hospital, the lactation consultant gives Denise some pamphlets and other educational materials on breastfeeding as well as a list of local resources. The consultant tells Denise that she will call in a few days to find out how things are going and to answer any questions. Denise is also scheduled to bring the baby into the clinic when the baby is between 3 and 5 days old so that the baby can be weighed and evaluated.



Children and Adolescents With Special Health Care Needs

The Maternal and Child Health Bureau has defined children and adolescents with special health care needs as those “who have or are at increased risk for chronic physical, developmental, behavioral, or emotional conditions and who require health and related services of a type or amount beyond that required by children generally.”¹

SIGNIFICANCE

According to the National Survey of Children with Special Health Care Needs, approximately 13.9% of children and adolescents in the United States have a special health care need.² These children and adolescents are at increased risk for nutrition-related health problems because of (1) physical disabilities that may affect their ability to consume, digest, or absorb nutrients; (2) biochemical imbalances caused by long-term medications or metabolic disturbances; (3) psychological stress from a chronic condition or physical disorder that may affect appetite and food intake; and/or (4) environmental factors, often controlled by parents or caregivers, which may influence access to and acceptance of food. Young children with special health care needs have been found to be particularly vulnerable to nutrition problems. A screening project of infants and young children with developmental delays in the Massachusetts Early Head Start Program found that 92% of the infants and children had at least one nutrition risk factor, and 67% met more than one of the criteria for referral to nutrition services.³ Nutrition reports of children with special health care needs estimate that 40% to 50% have nutrition risk factors that warrant a referral to a registered dietitian.^{4,5}

Common nutrition problems in children and adolescents with special health care needs include the following^{5,6}:

- Altered energy and nutrient needs
- Delayed growth
- Oral-motor dysfunction; feeding, swallowing, or digestive disorders

- Regurgitation and gastroesophageal reflux disease
- Elimination problems
- Drug/nutrient interactions
- Appetite disturbances
- Unusual food habits (eg, pica, restrictive food choices, rumination)
- Early childhood caries, gum disease

SCREENING

As with any type of health or medical concern, early identification and treatment are important to correct, control, or prevent additional harm from a nutrition problem. Table 1 outlines basic nutrition screening parameters and criteria for referral for children and adolescents with special health care needs.

TABLE 1. NUTRITION SCREENING PARAMETERS AND CRITERIA FOR REFERRAL FOR CHILDREN AND ADOLESCENTS WITH SPECIAL HEALTH CARE NEEDS^a

Screening Data	Criteria for Referral to a Registered Dietitian
Anthropometric^b	
Birth weight (for infants and children <18 months) Weight/[length or height]	Birth weight ≤1,500 g Weight/[length or height] ≤5th percentile Weight/[length or height] ≥95th percentile
Height/length	Inappropriate growth or weight change [Length or height]/age ≤5th percentile
Body mass index (BMI) (age >2)	BMI <5th percentile, or >85th percentile
Biochemical^c	
Hemoglobin Hematocrit	Hemoglobin ≤11 gm/dL Hematocrit ≤34%
Clinical/Medical	
Medical condition known to affect nutrition (eg, vomiting, reflux), elimination problems, medications, and appetite or dental problems	Diagnosis of heart disease, cancer, diabetes mellitus, HIV/AIDS, cerebral palsy, inborn error of metabolism, cleft lip and palate, malabsorption syndrome, cystic fibrosis, renal disease, spina bifida, and other conditions Recurring vomiting or reflux, chronic diarrhea or constipation, severe dental caries, early childhood caries (baby bottle tooth decay), long-term use of medications that could affect nutrition, megavitamin use, or prolonged decrease in appetite with weight loss or growth failure
Diet/Feeding	
Feeding method (eg, mouth, tube, parenteral) Therapeutic diet Feeding delays or problems Significant food aversions or allergies	Tube feeding or parenteral nutrition Therapeutic diet Inability to self-feed by age 2 Limited diet because of food aversions, allergies, or socioeconomic constraints
Other	
Parental or professional concern	Unresolved concerns regarding diet, nutrition, or growth

^aSources: Lucas et al⁵; Campbell and Kelsey⁷; Baer and Harris⁸; and Nardella et al.⁹

^bGrowth data should be recorded and plotted on a standard growth chart. Growth charts are also available for specific conditions. Specialized growth charts have some limitations and should be use in addition to Centers for Disease Control and Prevention growth charts.

^cSet lab levels according to your program standards.

NUTRITIONAL ADEQUACY

The energy and nutrient requirements of children and adolescents with special health care needs vary according to their individual metabolic rate, activity level, and medical status. Specific energy calculations for certain metabolic conditions have been reported in the scientific literature. Some of these energy calculations, which may be used as guidelines, are listed in Table 2. Once a desired energy level has been established and achieved, the child or adolescent should be routinely monitored to (1) ensure adequate nutrition for growth, development, and health and (2) make adjustments for periods of stress and illness.

ANTICIPATORY GUIDANCE

The goal of nutrition counseling for children and adolescents with special health care needs is to enable them to achieve optimal nutrition to support growth, development, health, and the highest possible level of functioning. Because of the complex nature of childhood neurodevelopmental and related disabilities, an interdisciplinary team approach to counseling and services is frequently needed to address multifaceted nutrition and feeding problems.^{5,9} In addition to registered dietitians, other health professionals (eg, primary care practitioners; physicians; physician assistants; nurses and nurse practitioners; dentists;

TABLE 2. SELECTED ENERGY CALCULATIONS FOR CHILDREN AND ADOLESCENTS WITH SPECIAL HEALTH CARE NEEDS, BY DIAGNOSIS^a

Medical Diagnosis	Energy Calculation
Down syndrome ¹⁰	For children with Down syndrome, ages 5–11 Girls: 14.3 kcal/cm (36.3 kcal/inch) Boys: 16.1 kcal/cm (40.9 kcal/inch)
Spina bifida ^{11–13}	For children with spina bifida >6 years: As a general recommendation, provide approximately 50% of the Dietary Reference Intake (DRI) for a child of the same age To maintain weight: 9 kcal/cm (22.9 kcal/inch) To promote weight loss: 7 kcal/cm (17.8 kcal/inch)
Prader-Willi syndrome ¹⁴	For children and adolescents with Prader-Willi syndrome To maintain growth within a growth channel: 10–11 kcal/cm To create a slow rate of weight loss and support linear growth: 8.5 kcal/cm
Cystic fibrosis ¹⁵	For children and adolescents with cystic fibrosis and pulmonary involvement To improve weight status, increase intake from 1.1 to 2.0 times the energy needs for healthy peers of the same age, gender, and size. Monitor for age-appropriate weight gain and adjust accordingly. Oral and enteral nutritional supplements may be required.
Pediatric HIV infection or AIDS ^{16,17}	For children and adolescents with HIV infection Monitor closely for growth, caloric intake, and clinical symptoms. Adjust energy requirements accordingly. For children and adolescents with mild or no symptoms related to HIV infection, adjust calories to 1.5 to 2 times the DRI if growth velocity is inappropriate for age. For children and adolescents with moderate or severe symptoms, increase calories beyond those required for children and adolescents with mild or no symptoms, particularly in response to weight loss, wasting, or fever.

^aSources: Culley et al,¹⁰ Ekvall and Cerniglia,¹¹ Grogan and Ekvall,¹² Dustrude and Prince,¹³ Pipes and Powell,¹⁴ Stallings et al,¹⁵ Rothpletz-Puglia,¹⁶ and Ayoob.¹⁷

psychologists; social workers; occupational, physical, and speech therapists) may contribute to the child's or adolescent's nutrition plan and to the family's nutrition education.

Beyond general pediatric nutrition, the following additional topics should be discussed during nutrition assessments and counseling sessions for families of children and adolescents with special health care needs:

- *Effect of certain conditions on growth parameters.* Appropriate measuring equipment (eg, wheelchair or chair scales, length boards) or alternative measurements (eg, arm span or segmental measurements, arm circumference, skinfold) should be used to accommodate children and adolescents who cannot stand independently or cannot be evaluated with traditional assessment tools. Growth charts for specific conditions and illnesses may be used as an additional reference for assessing growth. (See the list of disorder-specific growth charts at the end of the chapter.)
- *Physical activity and dietary intake.* Certain children and adolescents with special health care needs may have physical limitations that decrease their mobility and increase their risk of obesity. Others may have increased muscle tone or involuntary movements that increase their energy expenditure and therefore increase their caloric requirements.
- *Feeding problems.* Children and adolescents with special health care needs may have developmental delays, structural abnormalities, or neuromuscular problems that affect their eating skills and behaviors. Some may need feeding evaluations and swallowing studies to determine the safest and most efficient method of feeding, some may require special eating equipment or modified textures, and others may need tube feedings to supplement or replace oral feedings.
- *Enteral nutrition.* Those children who require tube feedings and receive a large part of their nutrition in the form of formula deserve special consideration for nutrition support and feeding tolerance. Attention should be given to the characteristics of the formula (eg, calories, nutrient and fiber content, osmolarity, etc), as well as the route of delivery (eg, gastric vs jejunal placement, bolus vs continuous drip, etc)
- *Hydration.* Children and adolescents with certain swallowing and feeding difficulties may have problems consuming adequate fluids to keep them well hydrated. Drooling, vomiting, or diarrhea will cause additional fluid loss. A feeding evaluation or swallowing study may be helpful to determine if a child can safely ingest fluids, correct positioning for swallowing, or the need for tube feedings. Some children may need assistance with special cups, thickened liquids, positioning, or supplemental fluids to ensure adequate hydration. A review of the child's or adolescent's fluid intake should be a part of each dietary assessment.
- *Elimination patterns.* Some children and adolescents with special health care needs have chronic elimination problems requiring medical attention. A number of factors can influence bowel function: diet, hydration, activity level, muscle tone, intestinal dysmotility, recent illness/health status, and use of medications. These elements should be explored when evaluating chronic constipation or diarrhea.
- *Medications and vitamin/mineral supplements.* Many children and adolescents with special health care needs take medications that may alter their appetite, food/fluid intake, digestion, absorption, and elimination patterns. It is important to review each medication and to educate parents about drug/nutrient interactions or side effects that may affect nutrition. In addition, vitamin and mineral supplements should be reviewed for nutritional adequacy, safety, and need. Care should be taken to prevent unnecessary vitamin/mineral use and megadoses of certain nutrients.
- *Nutrition assistance programs and community supports (as needed).* Children and adolescents with special health care needs may require many kinds of services and incur significant medical expenses. To effectively provide family-centered care, nutrition services should be available to families in their communities and should be coordinated with other medical appointments. Before prescribing dietary supplements or formulas for an infant, child, or adolescent, the health professional should make sure that the family has the necessary resources or can get assistance for obtaining these products. Resources for food assistance, special feeding equipment, and supplies

for tube feedings or parenteral feedings will vary from state to state. Selected resources include the following: Title V Maternal and Child Health program and Children with Special Health Care Needs program; Special Supplemental Nutrition Program for Women, Infants and Children (WIC); medical assistance/Medicaid; Special Nutrition Assistance Program (SNAP); and private insurance. (See Tool J: Nutrition Resources.)

REFERRAL

Children and adolescents with special health care needs who have nutrition problems should be referred to a registered dietitian in their community, preferably to one who has experience in pediatric nutrition and disabilities. Pediatric registered dietitians may be found in University Centers for Excellence in Developmental Disabilities (formerly called university affiliated programs), Title V–funded pediatric specialty clinics, pediatric and outpatient departments of local hospitals, child development clinics, WIC clinics, private practice, or the Pediatric Nutrition and the Public Health/Community Nutrition Practice Groups of the American Dietetic Association. Two community-based services for families of children with special health care needs are highlighted below.

EARLY INTERVENTION PROGRAMS

Infants and children with special health care needs who are enrolled in early intervention programs in their communities should have access to registered dietitians, occupational therapists, physical therapists, and speech and language pathologists with expertise in pediatrics who can address nutrition and feeding issues. Early intervention services provide community-based interdisciplinary evaluations and therapy services for infants and children with developmental delays. These programs were established through Part C of the Individuals with Disabilities Education Act, which lists registered dietitians and nutritionists as personnel qualified to provide early intervention services. Nutrition outcomes and objectives should be incorporated into the Individualized Family Service Plan for children with feeding and nutrition issues.¹⁸

SCHOOLS

The school system is an excellent community resource for families of children and adolescents with special health care needs. Through the National School Lunch Program and the National School Breakfast Program, children and adolescents may receive modified meals at school. Child and adult care food programs must provide meals at no extra cost for children and adolescents with special health care needs. Food substitutions and special meals to accommodate medical or special dietary needs are to be provided for children and adolescents identified by the educational system as having a disability. To receive these meal modifications, children and adolescents in special education programs must have a diet prescription on file from a licensed physician. The prescription must identify the disability and its effect on the child's or adolescent's diet and must state the required dietary changes and suggested meal modifications.^{18,19}

To receive modified meals, children and adolescents with special health care needs who are not receiving special education services must have a written order from a recognized medical authority (eg, physician, physician assistant, nurse practitioner, other specialist identified by the state). For children and adolescents who have chronic conditions but are not enrolled in a special education program (eg, children with diabetes mellitus or cystic fibrosis), determinations about providing modified meals are made on a case-by-case basis. To ensure that nutrition issues are addressed in the child's or adolescent's school program, nutrition goals and objectives should be incorporated in the Individualized Education Plan or 504 Accommodation Plan for children and adolescents who have significant dietary or feeding problems.^{18,19}

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Diabetes Mellitus

Diabetes mellitus is a chronic disease in which the body does not produce or properly use insulin. Insulin is a hormone manufactured by the beta cells of the pancreas that the body requires to maximally use glucose from digested food as an energy source. Diabetes mellitus is characterized by elevated glucose in the blood and urine. The goal of treatment is to manage the factors that affect blood glucose levels (eg, insulin, food, physical activity) to promote near-normal levels. Although the exact cause of diabetes mellitus is not known, a genetic component of the disease is recognized; environmental and immunologic factors may also play roles.

There are 2 types of diabetes mellitus. With type 1 diabetes mellitus, the body does not produce any insulin, and daily insulin injections are required. In contrast, with type 2 diabetes mellitus, the body continues to produce insulin but is unable to make enough or properly use what is made.

SIGNIFICANCE

More than 23 million people in the United States have diabetes mellitus. Type 1 typically occurs in children, adolescents, and young adults and accounts for 5% to 10% of all cases of diabetes mellitus. Type 1 affects about 1 in every 400 to 600 children and adolescents.¹

Type 2 has typically been diagnosed after age 40 and accounts for 90% to 95% of all cases of diabetes mellitus; however, because of the increasing prevalence of childhood and adolescent obesity, the number of children and adolescents with type 2 is increasing. Community programs that promote healthy eating behaviors, regular physical activity, and healthy weight management are important for the prevention of type 2. (See the Obesity chapter.)

The quality of care that children and adolescents with diabetes mellitus receive may affect their long-term health. Control of diabetes mellitus aims to prevent acute complications (eg, diabetic ketoacidosis and severe hypoglycemia, which may be life-threatening) and chronic microvascular and macrovascular complications, which can lead to blindness, kidney disease, nerve damage, amputations, heart disease, and stroke.

NUTRITIONAL ADEQUACY

The treatment of type 1 diabetes mellitus involves careful attention to insulin administration, food intake, and physical activity to promote acceptable blood glucose and lipid levels. Children and adolescents are encouraged to include foods from all the major food groups in their meals and snacks. The carbohydrate content of foods is monitored, either by carbohydrate counting, exchanges, or experience-based estimations.²

Many children and adolescents receive multiple injections of rapid-acting insulin before meals and large snacks, and longer-acting insulin once or twice a day. The dose of rapid-acting insulin is determined with an insulin-to-carbohydrate ratio and a correction factor to adjust for the premeal glucose level. Other regimens include (1) a fixed dose of rapid-acting insulin before meals and intermediate- or longer-acting insulin once or twice a day and (2) insulin pump therapy, which delivers a small basal dose of rapid-acting insulin continuously and bolus doses of insulin before meals. Blood glucose monitoring 4 or more times per day is recommended to help identify blood glucose patterns and to adjust insulin and/or food intake.

The treatment of type 2 diabetes mellitus focuses on using the most effective method to lower blood glucose levels, whether it is lifestyle changes (eg, reducing energy intake, increasing physical activity to increase energy expenditure), insulin, glucose-lowering medications, or a combination of these methods. Blood glucose monitoring varies from 2 to 4 times per day depending on the method.

The goals of medical management and nutrition therapy for both types of diabetes mellitus include continued normal growth and development, sexual maturation, reduction of hyperglycemic and hypoglycemic episodes, promotion of healthy eating and physical activity, and improvement of overall health and diabetes mellitus control to reduce the risk or delay the progression of complications.

Specific guidelines for energy intake vary with the age of the child or adolescent and should be individualized on the basis of an in-depth nutrition assessment and nutrition and physical activity history. Energy requirements should initially be based on the child's or adolescent's typical food intake, pattern of growth, level of physical activity, and estimated energy allowance for age and sex.³ A child or adolescent who has lost weight before diagnosis often requires additional energy for catch-up weight gain. An overweight child or adolescent diagnosed with type 2 diabetes mellitus needs guidelines for lower energy intake to promote weight maintenance or healthy weight loss. The distribution of calories should be individualized according to desired glucose, lipid, and weight goals, but it should be similar to the

distribution recommended for all healthy children and adolescents to promote a healthy lifestyle (approximately 45%–65% carbohydrates, 5%–30% protein, and 25%–40% fat).⁴

Sucrose substituted for other carbohydrates does not promote adverse hyperglycemia in persons with diabetes mellitus; therefore, foods containing sucrose are allowed in moderation, and the variety of foods permitted in diabetic meal plans has increased.² The use of the glycemic index, a way to compare how different carbohydrate-containing foods affect blood glucose levels, may provide a modest additional benefit over considering total carbohydrates alone.² Nutrition inadequacies may result from food intolerance, personal food preferences (eg, lactose intolerance, vegetarian eating practices), cystic fibrosis-related diabetes, subsequent diagnosis of celiac disease, or food insecurity. For these circumstances, the registered dietitian needs to provide nutrition guidance about healthy food choices, appropriate alternatives, and community resources.

SCREENING

During the early course of type 1 diabetes mellitus, children and adolescents may present with symptoms of polyuria, polydipsia, polyphagia, and weight loss. At this time, a random blood glucose level over 200 mg/dL (11.1 mmol/L) or a fasting plasma glucose over 126 mg/dL (7.0 mmol/L) is sufficient to make a diagnosis.⁵ An elevated blood glucose value should be confirmed if other hyperglycemic symptoms are not present. Early diagnosis reduces the risk of more dangerous conditions (eg, increased weight loss, dehydration, diabetic ketoacidosis).

According to the American Diabetes Association, children and adolescents should be screened for type 2 diabetes mellitus if they are overweight (ie, body mass index greater than the 85th percentile for age and gender, weight for height greater than the 85th percentile, or weight greater than 120% of ideal for height) and have 2 of the following risk factors⁶:

- Family history of type 2 diabetes mellitus in first- or second-degree relatives
- Belonging to a certain racial or ethnic group (ie, Native American, African American, Latino, Asian American, Pacific Islander)

- Signs of insulin resistance or conditions associated with insulin resistance (eg, acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, or small for gestational age birth weight)
- Maternal history of diabetes or gestational diabetes mellitus

Screening should be done every 3 years starting at age 10 or at the onset of puberty, whichever occurs first.⁶

ANTICIPATORY GUIDANCE

Anticipatory guidance is essential to the effective self-management of both types of diabetes mellitus and should be presented in stages.³ Family members will need to help young children with type 1 diabetes mellitus administer insulin and help young children with type 2 diabetes mellitus administer glucose-lowering medications. In addition, family members will need to help young children monitor their blood glucose levels, food intake, and physical activity. The daily tasks of diabetes mellitus management should be taught gradually, and the responsibility for care should be shared with the maturing older child or adolescent.

Initial anticipatory guidance is provided at diagnosis and prepares the child or adolescent and family for living with diabetes mellitus. During this stage, the family should be taught basic management skills (eg, insulin administration, blood glucose monitoring, meal and snack planning). Anticipatory guidance should focus on eating regular meals and snacks; learning to identify carbohydrate-containing foods and portion sizes; and knowing how to recognize, prevent, and treat low blood glucose levels. Carbohydrate intake is tracked to help adjust rapid-acting insulin doses. Carbohydrate intake may vary from meal to meal, or it may be set at a consistent amount for those on fixed insulin doses or with weight-management goals. Recommended educational materials for the initial and subsequent stages are available from the American Diabetes Association, the American Dietetic Association, and other sources (see Suggested Reading).

Once the child or adolescent and family demonstrate a basic understanding of diabetes mellitus and can follow the day-to-day tasks required for its control, anticipatory guidance should be offered to teach insulin adjustment, expand food choices, and allow flexibility in scheduling meals and physical activity. The registered dietitian can provide anticipatory guidance on eating away from home, buying school lunches, eating at fast-food and other restaurants, converting nutrient information on food labels to carbohydrate equivalents, adjusting food and insulin for increased physical activity, and planning sick-day meals. Attendance at diabetes camps provides another opportunity for children and adolescents to develop skills for daily management of diabetes.

Anticipatory guidance for multiple daily insulin injections and pump therapy should be provided to those who demonstrate competency in daily management and are highly motivated to achieve near-normal blood glucose levels.³ The focus at this stage is blood glucose pattern identification and evaluation and the promotion of increasingly sophisticated decision-making about adjusting insulin, food intake, and physical activity. The registered dietitian can provide more information about the effect of food on blood glucose levels, ways to estimate carbohydrate intake more precisely, and ways to calculate carbohydrate-to-insulin ratios. Because the documented side effects of improved glucose control are an increase in hypoglycemic episodes and unwanted weight gain, intensive nutrition anticipatory guidance should also include guidance on preventing and managing low blood sugar and managing weight.

INFANCY

Infants are dependent on parents to manage their diabetes. Because they cannot communicate when they experience symptoms of hypoglycemia, blood glucose goals are more liberal (100–200 mg/dL). Hypoglycemia should be first treated by giving the infant one-half of a carbohydrate serving (eg, 2 oz apple juice), but more may be given if the infant's blood glucose is still low after 15 minutes.

Breast milk or infant formula is recommended throughout the first year of life, and new supplemental foods and textures should be introduced as developmentally appropriate. Parents should be taught how to read nutrition labels to determine the carbohydrate content of infant formula and baby foods (eg, one carbohydrate serving equals 15 g carbohydrate). Rapid-acting insulin is often given after feeding to offset the infant's food intake.

EARLY CHILDHOOD

Young children may exert their independence by refusing to eat certain foods or meals, and the amount and variety of food eaten may vary considerably depending on food habits, changes in routines, and level of physical activity. Younger children may also have difficulty recognizing and verbally labeling symptoms of hypoglycemia; therefore, blood glucose goals are usually higher for this age group than for older children.

With a focus on carbohydrate intake, the registered dietitian can provide meal patterns that specify the number of carbohydrate servings and ranges for meat and fat servings. Families should be taught that, in terms of the carbohydrate content of food, one bread serving equals one fruit serving equals one milk serving.⁷ This information helps increase food choices and may avert food battles and rejection of food. Families should also be advised that most young children need at least 3 snacks per day and that flexibility in food choices will help ensure the child's cooperation.

MIDDLE CHILDHOOD

Children become more emotionally independent between ages 7 and 12. Motor, reading, math, and reasoning skills increase quickly, as do independence and pride in one's accomplishments. Eating at school needs to be managed carefully to promote the child's sense of well-being. Children want to eat what the other children are eating. The registered dietitian can help plan a meal pattern for lunch that matches the standard lunch served at school. The registered dietitian can also recommend convenient, favorite foods for snacks at school (eg, granola bars, crackers, cookies)

to promote consistency of food intake. On gym days, an extra 15-g carbohydrate snack should be provided before the physical activity to help prevent exercise-induced hypoglycemia. However, this additional carbohydrate may not be necessary if the child's blood glucose level is greater than 100 mg/dL.³ It is often helpful for the registered dietitian to collaborate with school personnel (eg, teachers, food service workers) to explain the dietary management goals for the child.

Children with type 2 diabetes mellitus need continuous support and encouragement from the family to promote healthy behaviors that include a moderate carbohydrate and fat intake, regular physical activity, and decreased sedentary activities.

ADOLESCENCE

Adolescence is a time for further developing one's sense of identity and increasing autonomy and independence. More time is spent with friends, and the family's influence is diminished. Because social activities often revolve around food, adolescents with type 1 diabetes mellitus respond better to a flexible meal plan that permits choice and spontaneity. Snacks may be omitted in the morning and the afternoon depending on blood glucose levels, physical activity, and weight management goals. However, the evening snack should usually be kept to help decrease the risk of hypoglycemia during the night. The risk of eating disorders needs to be recognized and addressed; adolescents with diabetes mellitus may try to manage their weight by reducing or skipping their insulin. Older adolescents with varying work and school schedules may appreciate the more flexible multiple daily insulin injection regimens or insulin pump therapy. This intensification of management will need to be coordinated with the health professional, and additional education about carbohydrates and insulin adjustment will need to be provided.

Adolescents with type 2 diabetes mellitus need continuous support and encouragement from the family to promote healthy behaviors that include a moderate carbohydrate and fat intake, regular physical activity, and decreased sedentary activities.

REFERRAL

Referral to an interdisciplinary pediatric diabetes mellitus management program with a pediatric endocrinologist, nurse, registered dietitian, and social worker should be considered for the following groups (see Tool J: Nutrition Resources):

- Infants, children, and adolescents with newly diagnosed type 1 or type 2 diabetes mellitus
- Infants, children, and adolescents who receive multiple daily insulin injections or insulin pump therapy for improved glucose control
- Older children and adolescents with frequent hospitalizations for ketoacidosis or severe hypoglycemia
- Children and adolescents with psychosocial problems

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Helping an Active Adolescent Manage Diabetes

Charlie Davis is an active 14-year-old who loves to play basketball. One evening, he tells his parents that he wants to try out for the basketball team.

The coach has seen Charlie play basketball with his classmates and thinks that he has potential.

Mr and Mrs Davis are happy but also concerned. Charlie was diagnosed with diabetes 6 months ago. It took the family almost 2 months to learn how to balance his food intake and insulin dose to keep his blood glucose in a healthy range. If Charlie decides to play basketball, the family might have to change its routine again.

Mr and Mrs Davis call their physician, Dr Yamaguchi, for advice. They ask how risky it would be for Charlie to play on a basketball team and how it could affect his blood glucose levels. Dr Yamaguchi assures them that many adolescents with diabetes are physically active. He suggests that Charlie and his parents come in for a visit if he makes the basketball team.

Charlie makes the team, and his parents reluctantly agree to let him play if he learns how to adjust his food intake and insulin dose. At Dr Yamaguchi's office, members of the health care team recommend more frequent blood glucose

monitoring to learn the affect of physical activity on his blood glucose levels. They teach Charlie how to treat a low blood glucose reaction (hypoglycemia), and the importance of carrying fast-acting carbohydrate snacks with



Members of the health care team recommend more frequent blood glucose monitoring to learn the affect of physical activity on his blood glucose levels.



him to consume when he has hypoglycemia. His eating schedule is altered to include a snack before and after each practice and game. Charlie also learns how to choose appropriate foods from fast-food and other restaurants in case his team goes out to eat, and he learns that postexercise hypoglycemia may occur 3 to 12 hours after unusually intense or long workouts. Dr Yamaguchi suggests that Charlie and his parents talk with the coach about Charlie's needs and that the coach be taught how to identify and treat hypoglycemia. Dr Yamaguchi also asks Charlie to schedule a follow-up visit in 1 month.

During the follow-up visit, Charlie reports that it took a couple of weeks for him to learn what types of pregame snacks he needs to keep his blood glucose level from dropping too low but that he has not had a low blood glucose reaction since the second week of practice, which was 2 weeks ago. He is excited to share that he has been chosen as a starting player for the team.



Eating Disorders

Unhealthy eating behaviors and preoccupation with body size can lead to life-threatening eating disorders including anorexia nervosa, bulimia nervosa, and eating disorder not otherwise specified, as described in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR)*.^{1,2} Binge-eating disorder, a more recently defined eating disorder, was granted provisional status in the *DSM-IV-TR*.² This disorder is not as well understood as other eating disorders owing to the relatively recent addition of this diagnosis. (See Boxes 1–4 for *DSM-IV-TR* criteria for anorexia nervosa, bulimia nervosa, eating disorders not otherwise specified, and binge-eating disorder.)

SIGNIFICANCE

Eating disorders have been observed in both sexes and across socioeconomic and racial/ethnic groups. Anorexia nervosa and bulimia nervosa affect between 2% and 4% of the population.³ Eating disorder not otherwise specified, a common diagnosis encompassing half or more of all cases of eating disorders, may affect up to an additional 5% of the population.^{3,4} Finally, binge-eating disorder affects an estimated 3% to 5% of the general population and approximately 30% of adults actively trying to lose weight.⁵

Disordered eating behaviors, such as self-induced vomiting, binge-eating, laxative use, or fasting, are prevalent among adolescents. Research has shown that 12% of adolescent females and 5% of adolescent males report engaging in these behaviors.⁶ With anorexia

BOX 1. DIAGNOSTIC CRITERIA FOR 307.1 ANOREXIA NERVOSA^a

- A. Refusal to maintain body weight at or above a minimally normal weight for age and height (eg, weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected).
- B. Intense fear of gaining weight or becoming fat, even though underweight.
- C. Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight.
- D. In postmenarcheal females, amenorrhea, ie, the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone administration.)

Specify type:

Restricting Type: During the current episode of Anorexia Nervosa, the person has not regularly engaged in binge-eating or purging behavior (ie, self-induced vomiting or the misuse of laxatives, diuretics, or enemas).

Binge-Eating/Purging Type: During the current episode of Anorexia Nervosa, the person has regularly engaged in binge-eating or purging behaviors (ie, self-induced vomiting or the misuse of laxatives, diuretics, or enemas).

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BOX 2. DIAGNOSTIC CRITERIA FOR 307.51 BULIMIA NERVOSA^a

- A. Recurrent episodes of binge eating. An episode of binge eating is characterized by both of the following:
 - (1) Eating, in a discrete period of time (eg, within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances
 - (2) A sense of lack of control over eating during the episode (eg, a feeling that one cannot stop eating or control what or how much one is eating)
- B. Recurrent, inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise.
- C. The binge-eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for 3 months.
- D. Self-evaluation is unduly influenced by body shape and weight.
- E. The disturbance does not occur exclusively during episodes of Anorexia Nervosa.

Specify type:

Purging Type: During the current episode of Bulimia Nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas.

Nonpurging Type: During the current episode of Bulimia Nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas

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BOX 3. DIAGNOSTIC CRITERIA FOR 307.50 EATING DISORDER NOT OTHERWISE SPECIFIED^a

The Eating Disorder Not Otherwise Specified category is for disorders of eating that do not meet the criteria for any specific eating disorder. Examples include

1. For females, all of the criteria for Anorexia Nervosa are met except the individual has regular menses.
2. All of the criteria for Anorexia Nervosa are met except that, despite significant weight loss, the individual's current weight is in the normal range.
3. All of the criteria for Bulimia Nervosa are met except that the binge-eating and inappropriate compensatory mechanisms occur at a frequency of less than twice a week or for a duration of less than 3 months.
4. The regular use of inappropriate compensatory behavior by an individual of normal body weight after eating small amounts of food (eg, self-induced vomiting after the consumption of two cookies).
5. Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
6. Binge-eating disorder: recurrent episodes of binge-eating in the absence of the regular use of inappropriate compensatory behaviors characteristic of Bulimia Nervosa.

^aReprinted, with permission, from: American Psychiatric Association.²

nervosa, estimates of mortality rates from all causes vary greatly, averaging 5% to 8%, with some as high as 20%.⁷⁻¹⁰ These deaths may be due to cardiac arrhythmia, acute cardiovascular failure, gastric hemorrhaging, or suicide. The major medical complications seen in individuals with eating disorders include the following¹¹:

- Cardiac arrhythmia
- Dehydration and electrolyte imbalances
- Delayed growth and development
- Endocrinologic disturbances (eg, menstrual dysfunction, hypothermia)
- Gastrointestinal problems

- Oral health problems (eg, enamel demineralization, salivary dysfunction)
- Osteopenia, osteoporosis
- Protein/calorie malnutrition and its consequences

NUTRITIONAL ADEQUACY

The actual food intake of children and adolescents with eating disorders varies considerably and is difficult to assess due to secrecy, shame, and the inability to accurately quantify food consumed. Food intake is influenced by food

BOX 4. DIAGNOSTIC RESEARCH CRITERIA FOR BINGE-EATING DISORDER^a

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|--|--|
| <p>A. Recurrent episodes of binge-eating. An episode of binge eating is characterized by both of the following:</p> <ol style="list-style-type: none"> (1) Eating, in a discrete period of time (eg, within any 2-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances (2) A sense of lack of control over eating during the episode (eg, a feeling that one cannot stop eating or control what or how much one is eating) <p>B. The binge-eating episodes are associated with three (or more) of the following:</p> <ol style="list-style-type: none"> (1) Eating much more rapidly than normal (2) Eating until feeling uncomfortably full (3) Eating large amounts of food when not feeling physically hungry (4) Eating alone because of being embarrassed by how much one is eating (5) Feeling disgusted with oneself, depressed, or guilty after overeating (6) Experiencing marked distress regarding binge eating (7) Occurring, on average, at least two days a week for six months | <p>C. The method of determining frequency differs from that used for bulimia nervosa; future research should address whether the preferred method of setting a frequency threshold is counting the number of days on which binges occur or counting the number of episodes of binge-eating.</p> <p>D. The binge-eating is not associated with the regular use of inappropriate compensatory behaviors (eg, purging, fasting, excessive exercise) and does not occur exclusively during the course of anorexia nervosa or bulimia nervosa</p> |
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avoidance, the duration of restrictive eating episodes, the presence of binge-eating, and other factors. Although children and adolescents with eating disorders often have unhealthy eating behaviors, supplements are not a substitute for a healthy balanced diet.

Following are the nutritional inadequacies commonly seen in children and adolescents with eating disorders:

- **Energy.** Low energy intake, sometimes less than 500 calories per day, is a hallmark of anorexia nervosa.
- **Protein.** Protein intake is often low enough to result in clinical signs of protein deficiency in children and adolescents with restrictive types of eating disorders. Meat, poultry, fish, eggs, and dairy products are good sources of protein that children and adolescents with eating disorders sometimes avoid.
- **Calcium.** Because children and adolescents with eating disorders typically have insufficient dietary calcium intake, which can cause bone mineral loss, it is essential to maximize intake of milk, yogurt, and other dairy products and to use calcium supplements if needed.
- **Zinc.** When protein intake is low, zinc intake is usually limited as well. It is especially important to promote zinc- and protein-rich foods (eg, milk, meat, whole grains) because of zinc's role in taste dysfunction, appetite, and growth.
- **Vitamin B₁₂.** Intake of vitamin B₁₂ may be a concern only in those with restrictive eating practices who are also strict vegetarians and who may not consume enough dairy products or eggs to obtain the recommended daily allowance of vitamin B₁₂. (See the Vegetarian Eating Practices chapter.)

DIAGNOSTIC CRITERIA

Eating concerns and disorders lie on a continuum ranging from mild dissatisfaction with one's body shape to serious eating disorders such as anorexia nervosa, bulimia nervosa, binge-eating disorder, and eating disorder not otherwise specified. Along the continuum between these endpoints lie normative dieting behaviors and disordered eating behaviors, such as self-induced vomiting, fasting, or laxative use. While engaging in disordered eating behaviors does not necessarily mean that an individual can be formally

diagnosed with a clinical eating disorder, such behaviors can negatively impact adolescents' growth potential, mental health status, and long-term physical health.¹¹ Furthermore, children and adolescents who engage in these behaviors are more likely than their peers to develop a formally diagnosed clinical eating disorder.¹²

SCREENING AND ASSESSMENT

Early identification of children and adolescents with eating disorders has been linked to better long-term outcomes. However, it can be difficult to identify children and adolescents who have eating disorders because they may avoid medical visits; present with gastrointestinal complaints, amenorrhea, or sports injuries; or ask for a diet or drugs to help them lose weight. Parents sometimes seek medical help for their children or adolescents because of concerns about unexplained weight loss or suspicion of self-induced vomiting.

SCREENING

Eating disorder screening, which can be incorporated into any health visit, includes many components of an annual physical or sports checkup. In addition to conducting the physical examination (including determination of body mass index [BMI] for age percentile), the health professional should talk with the child or adolescent to obtain information about body image and weight history, eating behaviors and meal patterns, physical activity, and health history, and should administer a brief psychosocial assessment. If any warning indicators of eating disorders are present (Tables 1 and 2), the health professional needs to evaluate further, with the use of the assessments that follow.

The presence of a warning sign does not always indicate an eating disorder. Physically active children and adolescents may experience occasional gastrointestinal complaints, dizziness, irregular meal patterns, and menstrual irregularities without having an eating disorder. Consultation with health professionals experienced in eating disorders can help distinguish “typical” child or adolescent eating behaviors from disordered eating behaviors or an eating disorder.

Bulimia nervosa can damage teeth, as vomiting exposes the teeth to acidic vomitus, which demineralizes the enamel and slowly dissolves the teeth. The health professional should refer an individual to a dentist if damage is apparent. With bulimia nervosa, enlargement of the parotid glands may also be present.

ASSESSMENT

If the child or adolescent is at high risk for an eating disorder (based on the warning signs listed in Tables 1 and 2), a number of assessments should be performed in addition to the initial screening. These assessments are best done by an interdisciplinary team of health specialists working together to evaluate the child or adolescent at high risk. Both adolescents and their parents need to be interviewed, but it is recommended that adolescents and their parents be interviewed individually.

MEDICAL HISTORY AND PHYSICAL ASSESSMENT

- Rule out organic illness as an explanation for weight loss or menstrual abnormalities.
- Ask about history of binge-eating and/or compensatory behaviors (eg, self-induced vomiting; laxative, diuretic, or diet pill use; excessive physical activity). If the child or adolescent is diabetic with elevated hemoglobin A_{1C} levels, evaluate the possibility of insulin-withholding as a means of weight control.
- Repeat assessment for orthostatic changes in pulse and blood pressure.
- Laboratory tests are not definitive markers for diagnosing the presence of eating disorders; children and adolescents with eating disorders often have results within the normal range when screened with the following tests¹⁵:
 - *Amylase*. Pancreatic amylase is elevated in some children or adolescents who vomit regularly.
 - *Calcium and magnesium*. Hypocalcemia (decreased calcium in the blood) and hypomagnesemia (decreased magnesium in the blood) may be observed with laxative abuse, malnutrition, and inadequate nutrition intake. However, absence of hypocalcemia should not be misconstrued to mean

TABLE 1. ANOREXIA NERVOSA: SCREENING ELEMENTS AND WARNING SIGNS^a

Screening Elements	Warning Signs
Body image	Distorted body image Extreme dissatisfaction with body shape or weight Profound fear of gaining weight or becoming fat
Eating and related behaviors	Very low caloric intake Fasting or restrictive dieting Denial of hunger cues Erratic meal patterns or frequent meal-skipping Poor appetite Difficulty eating in front of others Food seen as good or bad
Health history/examination	Body mass index <20th percentile Unexplained weight change Amenorrhea Fainting episodes or frequent lightheadedness Constipation or diarrhea Bloating/nausea Hypothermia; cold intolerance Orthostatic hypotension (>10 mm Hg after posture changes) Bradycardia (resting heart rate of ≤60 beats/minute)
Physical activity behaviors	Participation in physical activity with weight or size requirement (eg, gymnastics, wrestling, ballet) Overtraining or compulsive attitude about physical activity
Psychosocial	Depressed affect Frequent thoughts about food or weight Feeling pressure from others to be a certain shape or weight Perfectionist History of physical or sexual abuse or other traumatizing life event

^aSources: American Psychiatric Association¹³ American Dietetic Association,¹⁴ and American Medical Association.¹⁵

that dietary intake is adequate, as loss of calcium from bones precedes a decrease in calcium in the blood.

- *Bicarbonate*. High levels of bicarbonate may be observed in individuals who purge either with diuretics or with vomiting. Low levels of bicarbonate may be observed in individuals who misuse laxatives.
- *Potassium*. Hypokalemia (decreased potassium in the blood) may be observed with prolonged malnutrition or with purging.
- *Urine ketones*. These compounds may be elevated because of chronic fasting or inadequate intake.
- *Urine specific gravity*. This measurement may be elevated (suggesting dehydration) or may be low because of excessive fluid intake.
- Assess the need for hospitalization.¹⁶ (See the Referral and Management section on the following page.)

NUTRITION ASSESSMENT

Request a 3- or 5-day food/physical activity record that provides information on the specific types and quantities of food consumed, as well as the places and times food was eaten, the number of other people present, and the types of physical activities performed during that time. Some children and adolescents do not want to talk about their eating and physical activity behavior and are more likely to answer health-focused questions phrased in a supportive, nonblaming way. For example, “To make sure your body is getting everything it needs, I’m going to ask you a couple of questions about what you are eating and drinking. Can you tell me everything you had to eat and drink yesterday?” A food-frequency questionnaire could also be used to establish eating patterns over the past month.

TABLE 2. BULIMIA NERVOSA: SCREENING ELEMENTS AND WARNING SIGNS^a

Screening Elements	Warning Signs
Body image	Distorted body image Extreme dissatisfaction with body shape or weight Profound fear of gaining weight or becoming fat
Eating and related behaviors	Wide variations in caloric intake Fasting or restrictive dieting (episodic) Binge-eating Unexplained disappearance of large quantities of food Denial of hunger cues Erratic meal patterns or frequent meal-skipping Poor appetite Difficulty eating in front of others Food seen as good or bad
Health history/examination	Unexplained weight change or fluctuations >10 lbs Irregular menses Constipation or diarrhea Bloating/nausea/abdominal pain Dental caries Orthostatic hypotension (changes >10 mm Hg after posture changes)
Physical activity behaviors	Participation in physical activity with weight or size requirement (eg, gymnastics, wrestling, ballet) Overtraining or compulsive attitude about physical activity
Psychosocial	Depressed affect Frequent thoughts about food or weight Feeling pressure from others to be a certain shape or weight Perfectionist History of physical or sexual abuse or other traumatizing life event

^aSources: American Psychiatric Association¹³ American Dietetic Association,¹⁴ and American Medical Association.¹⁵

- Assess the presence of fear of certain foods by asking the child or adolescent if there are foods they feel safe eating versus foods they fear eating.
- Ask the child or adolescent to describe any food-related rituals or food rules that she follows. Discuss when these rituals or rules first presented themselves.
- Take the child's or adolescent's health and weight history, including history of binge-eating, purging (eg, self-induced vomiting), use of laxatives or diuretics, and level of physical activity.
- Rule out clinical nutrition deficiencies as causes of symptoms such as hair loss or dry skin.

PSYCHOSOCIAL ASSESSMENT

- Interview the child or adolescent and the parents about circumstances surrounding the onset of changes in eating behavior or weight.¹³
- Assess for depression, and rule out other psychiatric disorders (eg, anxiety disorder, obsessive-compulsive disorder, bipolar disorder) as primary or comorbid conditions that might explain changes in eating behavior and preoccupation with body weight and shape.¹³
- Assess risk of suicide.¹³

REFERRAL AND MANAGEMENT

Comprehensive assessment and treatment require an interdisciplinary team that has experience in treating eating disorders in children or adolescents and that can provide nutrition anticipatory guidance, medical care and monitoring, psychiatric evaluation, and individual and/

or family therapy. Referral to an eating disorder treatment program should be considered if an interdisciplinary team is not available or if hospitalization is indicated.

Hospitalization may be needed if the child or adolescent is severely malnourished, shows metabolic disturbances, or has a significant psychiatric comorbidity.¹⁷ If the child or adolescent has anorexia nervosa, it is essential to ensure a gradual and carefully planned return to normal eating to prevent the “refeeding syndrome” associated with hypophosphatemia. Close monitoring of food intake and output, fluid status, physical activity, and body weight is necessary to accurately adjust the dietary recommendations for steady weight gain.

At minimum, children and adolescents with eating disorders need to be evaluated and followed long term by a physician, a mental health professional (including at least one evaluation by a psychiatrist), and a dietitian. Because of the complexity of these disorders and the need to set clear, consistent behavioral limits, teamwork is essential.

ANTICIPATORY GUIDANCE

The main goals in providing anticipatory guidance to children and adolescents with eating disorders are to enable them to achieve and maintain a BMI within the normal range (between the 15th and 85th percentiles), function well at school or work, and resume healthy eating behaviors. Nutrition anticipatory guidance needs to be individually tailored and should be coordinated with the medical and psychiatric/psychological management of the child or adolescent. Following are 4 interim nutrition goals for children or adolescents who have eating disorders, with specific strategies registered dietitians can use to help them achieve these goals:

- Improve and restore nutritional adequacy.
 - Set guidelines for food intake, based on the number of servings of specific foods (not calories).
 - Recommend taking a vitamin and mineral supplement daily.
 - Encourage children and adolescents to select foods that meet daily nutrition needs.
- Maintain body weight (avoid additional weight loss or large weight fluctuations).

- Challenge the child’s or adolescent’s body image, comparing it with appropriate body weights and shapes.
- Encourage the child or adolescent to avoid self-weighing.
- Dispel myths about how weight loss occurs, and explain why bodies store fat and why some fat from food is essential.
- Decrease the frequency of binge-eating and compensatory behaviors.
 - Encourage the child or adolescent to eat 3 scheduled meals and 1 or 2 snacks each day.
 - Help the child or adolescent identify situations that may trigger binge-eating (eg, parties), and plan ways to manage these situations.
- Seek support from the family.
 - Discourage family members from making comments to the child or adolescent about appearance, weight, or eating behaviors.
 - Ask parents to remove all diet products and books, diet foods, and diet pills from the home.
 - Establish and maintain regular family meals.

Health professionals can help prevent eating disorders by promoting a positive body image and healthy attitudes toward food and physical activity.

INFANCY AND EARLY CHILDHOOD

Parents are usually very aware of their young children’s eating habits and may have concerns about nutritional adequacy of their diets, their risk of obesity, or their avoidance of foods. Eating disorders are not evident during this time.

- Emphasize the wide range of normal body weights for infants and children, and reassure parents who mistakenly believe their infant or child is overweight.
- Discourage restricted eating regimens for healthy infants and children.
- Promote feeding relationships that let infants and children respond to hunger and satiety cues.
- Encourage families to eat meals together regularly. Discuss ways to keep mealtimes pleasurable and to minimize struggles around food.
- Instruct family members not to tease the child about body weight, shape, or physical appearance and to avoid unhealthy dieting themselves.

- Encourage parents to emphasize regular physical activity and promote a positive body image.
- Discourage the use of food to manipulate behavior, either as punishment or as incentive.

MIDDLE CHILDHOOD

The eating and physical activity behaviors of children ages 5 to 10 are greatly affected by their expanding social world, and parents may feel they do not have much influence during this time. Parents need to be reminded that family behaviors and attitudes still significantly shape children's behaviors, and children should be encouraged to have a positive attitude toward food and a positive body image. Although eating disorders are less common in middle childhood than in adolescence, attitudes about body shape and size are developing, and experimentation with dieting has been observed.

- Suggest that parents review the kinds of foods available at home, especially snack foods and foods packed in school lunches. Encourage a balance of healthy foods.
- Discourage meal-skipping or other restrictive eating behaviors, and encourage families to eat meals together whenever possible, at least once a day.
- Instruct family members not to tease the child about body weight, shape, or physical appearance and to avoid unhealthy dieting themselves.
- For 8- to 10-year-olds, briefly outline the ways their bodies will be changing as they experience puberty.
- Encourage regular physical activity for both the child and the family, with an emphasis on activities that the child enjoys and that contribute to overall fitness. (See the Healthy Eating and Physical Activity chapter.)

ADOLESCENCE

Puberty is the major physical hallmark of adolescence, with the normal biological changes sometimes viewed negatively by females (eg, body fat deposits, menses) or more positively by males (eg, greater height and muscle mass). Food and physical activity behaviors are often driven by the desire for physical attractiveness, by sports

performance, and by friends' behaviors. Eating disorders develop most often during adolescence. Both adolescents and their parents need nutrition anticipatory guidance, but it is recommended that adolescents receive guidance individually.

- Describe pubertal changes, preferably before they occur, and be available as a "safe" person with whom adolescents can talk about body issues. With females, emphasize that body fat increases during this growth period; with males, discuss the wide variability in the timing of growth and maturation.
- Use BMI charts to assess an adolescent's relative weight, and discuss the broad range of weights considered normal for body shape and size.
- Discourage restrictive dieting or meal-skipping.
- Encourage regular, but not excessive, physical activity to maintain health and weight.
- Instruct family members to avoid teasing the adolescent about body weight, shape, or physical appearance and to avoid unhealthy dieting themselves.
- For overweight adolescents, carefully phrase recommendations for weight loss, and help them identify behaviors they can change.

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Food Allergy

Adverse food reaction is the term used to classify abnormal reactions caused by foods. Adverse food reactions are broken down into 2 categories: food allergy/hypersensitivity and food intolerance. Food allergy is an adverse response to a food protein caused by the immune system. Food intolerance is an undesirable response to foods that is not immunologic in nature.

Antibodies (also known as immunoglobulins) are found in blood or other bodily fluids, and are used by the immune system to identify and neutralize foreign objects, such as bacteria and viruses. Immunoglobulin E (IgE) protects the body from parasites and parasitic worms. In some individuals, IgE becomes misdirected and attacks specific proteins. Food allergy/hypersensitivity refers to a condition in which a person's IgE reacts to the ingestion of a particular food protein, also called an allergen. An allergic reaction occurs within seconds to 1 to 2 hours after exposure to a food protein or allergen. Trace amounts of the allergenic food may be enough to trigger a mild or life-threatening reaction (anaphylaxis). Symptoms from allergic reactions can be detected in the skin (eg, hives), respiratory tract (eg, congestion, wheezing), gastrointestinal (eg, swelling of lips, vomiting), and/or cardiovascular (eg, shock).

All nonimmune-mediated reactions to foods are referred to as food intolerance or non-allergic food hypersensitivity. This includes (a) symptoms caused by the lack of an essential enzyme (eg, lactose intolerance), (b) reactions to pharmacologically active chemicals in foods (eg, monosodium glutamate), (c) reactions to naturally occurring pharmacologically active agents in foods (eg, caffeine), and (d) reactions to toxic compounds in foods (eg, aflatoxin). The adverse response is usually dose-dependent.

SIGNIFICANCE

The incidence of food allergies and other atopic diseases, such as asthma and atopic dermatitis, are increasing.^{1,2} Approximately 6% of infants and children in the United States have food allergies. Common allergies include milk, eggs, soy, and wheat; however, most children become tolerant to these foods by school age or late childhood.^{3,4} Approximately 20% of children who are allergic to peanuts become tolerant to them by school age.⁵ Allergies to tree nuts, fish, and shellfish tend to develop in older children and are considered lifelong allergies.

The quality of life for a family with a child who has food allergy is affected in a variety of ways.⁶ There are health and nutrition concerns, emotional issues (eg, anxiety about reactions, dealing with the community), and worrying that the child's food allergy will be lifelong.

Currently, avoidance of all forms of the food allergen is the only way to prevent a food allergic reaction. Medical treatment may be necessary during an allergic reaction. Dietary consultation provides the education necessary for the family to understand how to avoid the food allergen(s) and provide a balanced and nutritionally adequate diet for normal growth and development.

DIAGNOSIS

A thorough medical history, possibly a food diary, physical examination, laboratory studies, trial elimination diet, and oral food challenges are used to distinguish the type of adverse food reaction. An incomplete workup and unorthodox procedures can result in incorrect diagnoses, unnecessary diet restrictions and subsequent nutrient deficiencies, and delaying the treatment of a treatable disease.

The medical history identifies the suspected food(s) by obtaining information regarding the amount of the food ingested, length of time from ingestion to the development of symptoms, consistency of symptoms on other occasions when the food is eaten, and length of time since the last reaction. A diet diary can identify a food that is common to different products or reveal hidden sources of a food allergen. The diet diary needs to document the time of meals and snacks, foods consumed (including brand names and labels, condiments, or recipes), medications or supplements, and the timing of symptoms. A registered dietitian is an invaluable expert to assist in interpreting diet diaries.

The physical examination can identify atopic diseases such as atopic dermatitis (eczema), allergic rhinitis, and asthma, which increase the likelihood that the symptoms are related to a food allergy. Thirty-five percent of children with atopic dermatitis have food allergies as a trigger for their atopic dermatitis.⁷

Prick skin testing (PST) and radioallergosorbent test (RAST) both detect food-specific IgE. These skin and serum tests identify if a food is likely to be the cause for the allergic symptom. Negative results for either test confirm the absence of an IgE-mediated reaction. Both have a negative predictive value of 95%. A positive PST or RAST indicates the presence of food-specific IgE but

does not confirm whether the food is responsible for the allergic symptoms. The positive predictive accuracy is less than 50%. An accurate medical history is critical to identify the suspicious foods instead of screening by using a large panel of tests that may provide a list of foods that are not responsible for the symptoms.

When the history of reaction to a specific food is apparent and is supported by a positive test, the workup can be considered complete. If the suspected foods are questionable, a trial elimination diet may be needed. The elimination diet removes all forms of the suspected food allergen(s) from the diet. The length of the trial may be 2 to 6 weeks based on the disorder (IgE-mediated food allergy vs enterocolitis). If the symptoms do not resolve, the likelihood of the eliminated foods causing the symptoms is low. If symptoms resolve and several foods were eliminated, oral food challenges may be needed to determine the cause of the symptoms.

Oral food challenges provide the most definitive means to diagnose a food allergy or other adverse reaction to foods. Open feedings, where everyone knows what is being fed, are appropriate for screening. The food challenge may need to be blinded, where the child doesn't know what is being fed, if open food challenges are positive.^{8,9} All food challenges are at risk of anaphylaxis. Emergency medicines must be available before beginning a food challenge. Tolerance of a normal serving size of the food is used to determine if one is no longer sensitive to that allergen.

NUTRITIONAL ADEQUACY

Food allergies can be "prevented" by complete avoidance of the food allergen or allergens. The prescribed elimination diet may be the same one used to confirm the diagnosis. The number of foods being restricted and availability of appropriate food substitutes will determine the nutritional quality of the diet. If a child is allergic to a single food (eg, peanut, fish), the nutritional adequacy of the diet may not be compromised. But the elimination of milk, eggs, soybeans, or wheat can have a major impact on the quality of a diet. These foods are found in the food supply in many forms, making complete elimination more difficult.

Diet histories or food diaries are tools used to assess adequacy and appropriateness of the diet. Nutritional requirements of a child with a food allergy are no different than those of a child without a food allergy. Therefore, the Dietary Reference Intakes for energy, protein, fat, vitamins, and minerals are used to determine adequacy of the child's diet.¹⁰ A child who is allergic to milk needs to have their diet evaluated for adequate intake of calcium and vitamin D, as well as protein, vitamin A, and riboflavin. A child is at greater nutrition risk if allergic to milk, eggs, peanut, and soy; not consuming a safe milk alternative; and not eating meats. This child's diet is at risk of being deficient in adequate protein; vitamins A, B, and D; calcium; iron; and zinc. Safe alternative sources of these nutrients should be incorporated into the child's diet. Allergen-free formulas, fortified foods, and allergen-free supplements may be needed if a child is unable to consume adequate amounts of specific nutrients from food.

MyPyramid for Kids is a helpful tool to determine if a child is consuming the appropriate number of servings from each food group for a balanced diet. This tool can be used for education on safe alternatives to offer the child.¹¹

Anthropometrics, assessment of growth and development, and nutritional status should be performed by health professionals. Principles of assessing growth of children with food allergy are the same as those used for healthy children. (See the Nutrition Supervision chapters.)

ANTICIPATORY GUIDANCE

Nutrition anticipatory guidance is the cornerstone for good compliance. The child and family need to learn how to avoid all forms of the food allergen(s). This can be achieved by learning how to read a label and identify forms of the food to be avoided, sources of cross-contact, where allergens are hidden, and alternative food sources for nutrients.

The food label provides communication from the food industry to consumers about the product's ingredients. A food label must be read every time it is considered for purchase to determine if that

product is free of the specific allergen. The Food Allergen Labeling and Consumer Protection Act requires that the major allergens (eg, milk, egg, wheat, soy, peanut, tree nuts, fish, seafood) be clearly identified on the food label.

Advisory labeling declares potential cross-contact such as "may contain (allergen)" or "produced in a facility that also produces (allergen)." Advisory labeling is voluntary and unregulated. Calling the manufacturers of these products to obtain more information is recommended.

Cross-contact occurs when an allergen-containing food comes in contact with a "safe" food. As a result, each food contains small and usually hidden amounts of the other food. This may occur with any manufactured food (eg, egg-containing and egg-free pastas, breakfast cereals with or without nuts). The primary cause of cross-contact in eating establishments is shared utensils and equipment. Purchasing sealed packages with ingredient labels from grocery stores is recommended to avoid cross-contact. Encourage the household to be allergen-free. Otherwise, the family should prepare safe foods first, avoid sharing utensils, and cover and remove safe food from the cooking area while the rest of the food is prepared.

Most accidental ingestions occur in restaurants. The parent of a child with a food allergy may want to contact the manager or chef to determine if the restaurant would be able to provide safe foods. It is best to avoid buffets and dishes with sauce, and select simple, single food items. Always bring safe foods in case there are problems.

During nutrition anticipatory guidance, the registered dietitian will review where food allergens are commonly found. It cannot be assumed that families know that milk is used to make butter or cheese. Many families rely on processed foods and do not know cooking basics (eg, eggs are used to make muffins). Cookbooks with allergen-free recipes are useful tools to help families prepare safe foods that look and taste like the commercially prepared allergen-containing foods.

PRENATAL AND INFANCY

It is usually unnecessary to restrict a woman's diet during pregnancy beyond eliminating the foods to which she is allergic. The benefits of nutritional intervention that may prevent or delay the onset of atopic disease are largely limited to infants at high risk of developing allergy (ie, infants with at least one parent or sibling with allergic/atopic disease). The current evidence suggests¹²

- Maternal dietary restrictions during pregnancy do not play a significant role in preventing atopic disease in infants.
- Exclusive breastfeeding of an infant at high risk for food allergies for at least 4 months compared with feeding an infant intact cow's milk protein formula decreases the cumulative incidence of atopic dermatitis and cow's milk allergy during the first 2 years of life.
- Extensively hydrolyzed formulas and, less effectively, partially hydrolyzed formulas may delay or prevent atopic disease compared with cow's milk formula.
- There is no evidence for the use of soy-based formula in allergy prevention.
- Delaying the introduction of solid foods until 4 to 6 months of age is appropriate; however, there is no evidence that delaying beyond this period provides a protective effect on the development of atopic disease regardless of whether the infant is breastfed or fed cow's milk protein formula. This includes delaying the introduction of foods that are considered to be highly allergenic foods, such as fish, eggs, and foods containing peanut protein.
- Data are insufficient to support a protective effect of any dietary intervention for prevention of atopic disease in infants after 4 to 6 months of age.

If an infant or child develops signs or symptoms of a food allergy triggered by the ingestion of food, the food allergen must be identified and restricted. For the infant diagnosed with a food allergy, exclusive breastfeeding should be encouraged for a minimum of 4 months. Foods confirmed to cause allergy symptoms in the infant should be eliminated from the mother's diet while she is breastfeeding. The mother will need nutrition anticipatory guidance to promote nutritional adequacy of her diet. If infant formula

is required either to supplement breast milk or to be used exclusively, an extensive hydrolyzed protein-based formula is the best choice.

The introduction of solid foods can begin between 4 and 6 months of age. Parents should introduce one new single-ingredient food every 5 to 7 days and look for signs of intolerance (eg, rash, vomiting, diarrhea).

Mashed or chopped foods should be introduced in the diet around 9 months of age to avoid oral aversion to these foods. The child with food allergies learns how to eat a variety of foods, and there are fewer battles over food if everyone eats foods that are safe for the child at family meals. The home needs to be free of the specific food allergens or the allergenic foods need to be out of reach once the infant begins crawling.

EARLY CHILDHOOD

A clear division of responsibility in feeding must be established at this age. The parent determines the structure of meals and snacks and selects the foods to be offered, and the child determines the amount eaten.¹³ When a child with a food allergy is able to choose freely from the foods offered at meals, or when family members have accommodated a food allergy by changing the way they eat, there is less likelihood of food-related struggles and risk of the child ingesting food she is allergic to. Young children need to be taught to not take food from anyone without a parent's approval.

Child care and school settings provide new challenges for children with food allergies. Encourage parents to meet with the child care or school personnel to discuss the child's food allergy. Provide all personnel with a food allergy action plan, provided by the child's physician, that outlines foods to avoid and how to treat an allergic reaction. Also encourage the family to review child care or school menus to identify food allergens and to suggest substitutions. Personnel also benefit from education on how to read food labels to identify food allergens and how to avoid unintentional ingestions (eg, not allowing trading or sharing of foods). Encourage the child to wear medical identification jewelry. Annual evaluations are recommended because many food allergies are outgrown later in childhood.¹⁴

MIDDLE CHILDHOOD AND ADOLESCENCE

Older children and adolescents with food allergies need to gradually assume responsibility for avoiding the foods they are allergic to. Risk-taking behaviors become greater when children and adolescents spend more time without supervision, which may lead to fatal allergic reactions.¹⁵ Adolescents consider social isolation as the hardest part of living with a food allergy. Communication with friends about their food allergy lessens isolation. Reinforce that the symptoms are an allergic reaction, the importance of always carrying emergency medication (epinephrine), and when to use the medication. Reeducate them on the importance of reading labels, how to order a safe meal at a restaurant, and to not eat any food if they are not sure it is safe.

REFERRAL

Families of infants, children, and adolescents with food allergies can be referred to organizations such as the Food Allergy & Anaphylaxis Network, which provides educational materials with strategies for living with food allergies and networking opportunities for individuals with food allergies and their families. (See Tool J: Nutrition Resources.)

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Human Immunodeficiency Virus

Human immunodeficiency virus (HIV) attacks the immune system, the body's defense against infection, making the body less able to fight disease. HIV is considered to have progressed to acquired immune deficiency syndrome (AIDS) when a person develops an opportunistic infection (ie, one that might not have developed if HIV had not been present) or cancer, or when the person has a "helper" T-cell (CD4) count of less than 200/mm³ of blood. T-cells help infection-fighting antibodies form in the blood; they are weakened or destroyed by HIV.

SIGNIFICANCE

The first cases of pediatric AIDS were reported in 1982. Since then, 15,860 cases of AIDS in infants, children, and adolescents have been reported to the Centers for Disease Control and Prevention.¹ From 2002 to 2006, the number of reported AIDS cases decreased in infants and children, but increased in adolescents. Among children, males account for 65% and females account for 35% of newly reported AIDS cases. Among adolescents, males account for 61% and females account for 39% of newly reported AIDS cases.¹

African Americans in the United States are disproportionately affected by AIDS. Among newly reported AIDS cases in children, African-American children account for 73% of cases but for only 15% of the overall population. In contrast, Hispanic children account for 11% of cases and for 21% of the population, non-Hispanic white children account for 10% of cases and for 58% of the population, and Asian/Pacific Islander children account for 2% of cases and for 5% of the population. No new AIDS cases have been reported among American Indian/Alaska Native children, who account for 1% of the population.¹ Among newly reported AIDS cases in adolescents, African-American adolescents account for 69% of cases but for only 16% of the population. In contrast, Hispanics account for 19% of cases and for 17% of the population, non-Hispanic white adolescents account for 10% of cases and for 62% of the population, and Asian/Pacific Islander and American Indians/Alaska Native adolescents account for less than 2% of cases and for 5% of the population.¹

Cultural, racial, and social and economic factors (eg, poverty, underemployment, lack of access to health care) must be considered in efforts to prevent and treat HIV. These factors affect the health status of all individuals, but they disproportionately affect the health status of African Americans, Hispanics, Alaska Natives, and American Indians.²

SYMPTOMS

Symptoms of untreated HIV infection in infants, children, and adolescents include the following:

- Failure to gain weight and grow
- Chronic diarrhea without a specific cause
- Enlarged liver and spleen, which appear as a swollen belly
- Swollen lymph nodes
- Chronic yeast infections (eg, candidiasis, thrush)
- Pneumonia and other bacterial, viral, fungal, and parasitic infections

Adolescents with HIV may also experience fever or flu-like symptoms shortly after they are first exposed to and infected by HIV (primary infection; “seroconversion syndrome”). In addition, developmental delays in children and adolescents are commonly seen when the nervous system is affected by HIV. Infants, children, and adolescents may be infected with HIV for many years before developing symptoms of HIV infection or developing AIDS.

TRANSMISSION

HIV is not transmitted by casual contact. More than 90% of infants and children with HIV become infected with the virus via their mothers during the period shortly before, during, or after birth in a process referred to as perinatal transmission.¹ If preventive measures (eg, antiretroviral use and elective caesarean section) are not taken, then pregnant women with HIV have a 15% to 25% risk of transmitting HIV to their infants during pregnancy or birth.³ Most perinatal transmission of HIV occurs late in pregnancy or during birth.⁴ How HIV is transmitted to the fetus or newborn is not entirely understood. It may be transmitted across the placenta to the fetus or by exposure of the infant to infected blood and secretions during labor and delivery.⁴

HIV virus may also be transmitted from mothers with HIV to their infants through breast milk. Breastfeeding may be responsible for at least 24% of all mother-to-infant HIV transmission in infants who are born to HIV-infected mothers and who are breastfed.⁵ Many factors influence the risk of HIV transmission through breastfeeding. Factors that increase the risk of HIV transmission include⁶

- Longer duration of breastfeeding
- Poor maternal immune status (low CD4+ cell count)
- High HIV levels in the mother
- Poor breast hygiene (eg, mastitis, breast abscess, cracked or bleeding nipples)
- Mixed infant feeding (ie, giving the infant foods or beverages in combination with breast milk, especially within the first few months of life)
- Damage to the lining of the infant’s mouth or gut (caused by infections, such as thrush or by consumption of foods or beverages other than breast milk)

The World Health Organization recommends that all women with HIV be advised of both the risks and benefits of breastfeeding so that they can make an informed decision. In areas where safe alternatives to breastfeeding (eg, infant formula and clean water) are available and affordable, breastfeeding should be avoided.³

Among infants and children in the United States, HIV is less commonly transmitted in the following ways:

- Breastfeeding
- Pre-mastication of food given to an infant or young child by a parent or care provider infected with HIV
- Puncturing of skin with a needle containing blood of a person infected with HIV
- Exposure of open skin or mucous membranes to body fluids (ie, blood, semen, vaginal fluid) of a person with HIV
- Receipt of blood or blood products of a person infected with HIV (eg, during treatment for coagulation disorders)

Most newly diagnosed adolescents contract HIV in the following 2 ways¹:

- Exchange of body fluids (ie, semen, vaginal fluid) during sexual activity with a person who has HIV
- Sharing of HIV-contaminated needles for injection-drug use

TREATMENT

There is no cure for HIV, but with the continuous development of new and effective medications, it has become a manageable chronic disease for many people. Researchers continue to work on developing an HIV vaccine.⁷ A number of drugs have been developed that fight HIV. Currently, there are 5 classes of drugs, with multiple drugs in each class. There are 25 different drugs approved for adolescents; 13 approved for children, and 9 approved for infants.^{8,9} Each class of drugs works in a unique way to fight HIV, so it is common for multiple drugs from different classes to be prescribed at the same time.

Using multiple drugs from at least 2 to 3 different classes is the idea behind highly active anti-retroviral therapy (HAART). HAART was developed to reduce a person's viral load to undetectable levels and to maintain these low levels longer than was previously possible.

Herbal products that claim to reduce the symptoms of HIV are not recommended for infants, children, or adolescents. Parents considering giving their infant, child, or adolescent with HIV an herbal product are encouraged to first discuss their plans with a health professional. It is important for parents and health professionals to maintain open communication about the use of such products, because little is known about their safety and efficacy or about how they interact with HIV medications. Some herbs may interfere with the body's ability to absorb medications; others may increase absorption. Herbs that interfere with the body's absorption of antiviral medications may allow HIV to multiply and become resistant. Herbs that increase medication absorption may cause severe medication side effects. In addition, the smaller size of infants, children, and adolescents with HIV (compared with adults with HIV) places infants, children, and adolescents at greater risk for overdose.

NUTRITION SUPERVISION

Nutrition status and HIV are interconnected. For those with HIV, poor nutrition can negatively affect the immune system and increase the risk for opportunistic infections. At the same time, HIV can cause malnutrition. HIV, HIV medications, and infections that are common with HIV can lead to malnutrition in the following ways¹⁰:

- Decreased food intake related to poor appetite, nausea, infections in the mouth or throat, or depression
- Loss of nutrients through vomiting or diarrhea
- Increased nutrient needs due to fever or high HIV load

Many infants, children, and adolescents with HIV do not gain weight or grow normally^{11,12} and may experience loss of lean body mass (muscle).¹³ However, HAART can promote improved growth.^{14,15}

Eating healthy foods to promote weight gain and growth is especially important for infants, children, and adolescents with HIV. Not only are these infants, children, and adolescents growing, but they are also coping with the adverse impact of HIV on their bodies and with the side effects of treatment. Good nutrition helps prevent infections related to weight loss or wasting and is also vital for optimal growth and development, which may be more difficult for infants, children, and adolescents with HIV to achieve. Eating and drinking extra food to increase calorie and protein intake may be particularly important after recovering from an acute opportunistic infection.¹³

Children and adolescents with HIV are at higher risk than their counterparts who do not have HIV for developing low bone-mineral density, which can result in osteoporosis and increased risk for bone fractures. Both HIV and certain HIV medications may cause low bone-mineral density.¹⁶ To promote optimal bone health, children and adolescents should consume adequate calcium and vitamin D and should avoid smoking and alcohol consumption.¹⁵

In recent years, the number of older children and adolescents with HIV who are overweight has increased. There seems to be a higher prevalence of overweight among adolescents with HIV who did not acquire HIV perinatally.¹⁷

Lipodystrophy syndrome is a group of symptoms that may include redistribution of body fat (loss of fat in the face, arms, legs, and buttocks and accumulation of fat around the abdomen and behind the neck), high blood levels of cholesterol and triglycerides, and difficulty controlling blood glucose (sugar) levels.¹⁸ In children and adolescents, lipodystrophy syndrome is associated with HAART, especially when protease inhibitors are used and viral loads are well controlled.^{18–20} Changes in diet and antiretroviral agents along with medically supervised physical activity programs may help to reverse some of these side effects.

ASSESSMENT

A registered dietitian should complete a baseline nutrition assessment as soon as possible after an infant, child, or adolescent is diagnosed with HIV in order to initiate appropriate interventions aimed at the prevention or treatment of malnutrition and compromised growth. Another nutrition assessment should then be conducted every 3 months.¹⁰ More frequent assessments are warranted when clinical symptoms or growth abnormalities are present.

A nutrition assessment includes comparing the growth of the infant, child, or adolescent to a reference population or to growth standards by plotting measurements on a clinical growth chart.²¹ Measurements include head circumference for age (birth–36 months), weight for age, and length for age (birth–36 months) or stature for age (2–20 years). Evaluating weight for length (birth–36 months) and body mass index for age (2–20 years) is another important component of the nutrition assessment. Weight and length or stature growth velocity should be monitored. A slowed growth rate indicates the need to evaluate for nutrition intervention. Body composition can be evaluated using skinfold measurements and circumferences or bioelectrical impedance analysis. Changes in body composition, such as decreased muscle mass or changes in fat distribution, can be detected by these methods and may signify the need for nutrition intervention.

The biochemical markers that should be standard components of evaluation are albumin, prealbumin, hemoglobin and hematocrit, iron studies,

glucose, cholesterol, and triglycerides. If micronutrient deficiencies are suspected, specific blood assays should be conducted. For example, vitamin D levels should be monitored when there is a risk for low bone mineral density.¹⁶

The nutrition intake of an infant, child, or adolescent with HIV should be assessed using 24-hour recall, food records, food-frequency questionnaires, or a combination of these. Signs of inadequate nutrition intake or excessive nutrient losses through diarrhea or vomiting are important to investigate, and nutrition intervention should be incorporated in the infant, child, or adolescent's nutritional care plan.

Physical activity, use of herbs or dietary supplements, and health information should be evaluated as well.¹⁰ Benefits of physical activity include maintenance of lean body mass and healthy weight. Physical activity should be evaluated for its level and intensity, which should be tolerated by the child or adolescent, approved by the health care team, and balanced with energy intake. Reviewing herbs and dietary supplements is important for identifying interactions with medications and potentially harmful side effects. The infant, child, or adolescent's medical history should be reviewed for food allergies and health conditions other than HIV that may require specialized nutrition intervention.

ANTICIPATORY GUIDANCE

Following are tips to help ensure optimal nutrition for infants, children, or adolescents with HIV:

- Consult a registered dietitian for help in designing a healthy, well-balanced eating plan that contains a variety of nutritious foods.
- Serve 3 healthy meals plus 2 to 3 healthy snacks per day. Emphasize snacking, especially if weight loss or nutrient deficiencies are apparent.
- Offer healthy foods high in protein. Meat products (eg, beef, fish, poultry), eggs, milk, milk products (eg, cheese, yogurt) are good sources of protein. Soy products are also good sources of high biological-value protein and can be used to augment or substitute meat, milk, and milk products. Beans, seeds, nuts, and nut butters are rich in protein as well and can be used to supplement other protein sources.

- Encourage the consumption of plenty of fluids.
- Minimize the consumption of foods containing simple carbohydrates (eg, candy, soda, juice).
- Practice safe food-handling techniques. (See Tool H: Basics for Handling Food Safely.)
- Encourage physical activity on most days of the week.

Nausea

- Offer small meals every 2 hours and fluids, as tolerated, every 1 to 2 hours.
- Serve plain, low-fat foods (eg, rice or pasta, potatoes, cooked or canned fruits and vegetables, baked chicken or turkey, sherbet, toast, crackers, cereal).
- Serve fluids before meals, because they can increase the feeling of fullness if given before or with meals. Try cool or slightly chilled fluids.
- Avoid carbonated beverages.
- Avoid serving foods with strong flavors, odors, or spices and foods that are high in fat or very sweet.

Diarrhea

- Offer small meals every 2 hours and fluids, especially diluted fruit juices, as tolerated every 1 to 2 hours.
- Serve simply prepared foods that are low in insoluble fiber (eg, plain rice or pasta, cooked cereal, soft-cooked eggs, bananas, canned fruit packed in juice, baked chicken or turkey, white bread, saltines, toast).
- Avoid serving milk and milk products if diarrhea worsens, as lactose intolerance may be a causative factor.
- Offer foods that are high in sodium (eg, bouillon, broth) and potassium (eg, bananas, peaches, apricots, potatoes) to replace lost minerals.
- Avoid serving spicy foods and foods that are high in fat.
- Do not offer foods that contain caffeine (eg, chocolate, coffee, tea, colas).

Weight Loss

- Offer foods high in calories (eg, peanut butter, nuts, avocado, hummus, cheese, yogurt, ice cream, pudding, custard, whole milk, half and half, macaroni and cheese, dried fruit, cooked cereal made with whole milk).

- Increase the caloric content of foods.
 - Use sweetened condensed milk or evaporated milk in pudding, milkshakes, and baked foods.
 - Add powdered milk to cooked cereal, mashed potatoes, soup, and pudding.
 - Prepare milkshakes made with whole milk, fresh or frozen fruits or peanut butter, and ice cream.
 - Add cheese, butter, or margarine to foods.
 - Add extra oil to foods (eg, add olive oil to pasta).
- Consider recommending an oral nutrition supplement.
- If weight loss continues, enteral or parenteral nutrition support may be indicated.

Overweight

- Avoid serving foods high in fat and sugar and low in vitamins, minerals, and fiber (eg, soda, candy, potato chips, french fries). (See the Obesity chapter.)
- Provide lean protein sources (eg, chicken breasts, fish, beans, low-fat milk and milk products) and plenty of fruits, vegetables, and whole grains (eg, whole-wheat bread and pasta, brown rice).

Difficulty Taking Medications

- Take medications as directed. Some medications should be taken with meals high in fat, others with meals low in fat, and still others with no food at all.
- Refrigerate liquid medications to minimize their odor and taste.
- Offer ice chips or a frozen snack (eg, ice pops) to dull the child's or adolescent's taste buds before giving medication.
- Use foods to minimize the odor and taste of medication. Check with the infant's, child's, or adolescent's medical provider to ensure that the foods will not compromise the effectiveness of the medication.
 - Add liquid medications to thick foods (eg, peanut butter, pudding).
 - Add medications (that can be dissolved) to soft foods (eg, applesauce, milk, ice cream).

Vitamin and Mineral Deficiency

Infants, children, and adolescents with HIV may not be consuming adequate amounts of vitamins and minerals because of poor appetite, nutritional losses as a result of vomiting or diarrhea, or increased demands on the body to fight infection.

- Give a multivitamin and mineral supplement in liquid or pill form to children and adolescents ages 1 or older with HIV. The supplement should provide amounts at or near the Dietary Reference Intake.¹⁰

Low Bone Density

- Offer foods naturally rich in calcium (eg, milk, yogurt, cheese) and those fortified with calcium and vitamin D (eg, fortified orange juice, tofu, soy milk).
- Increase the calcium content of foods.
 - Add powdered milk to cooked cereal, mashed potatoes, soup, and pudding.
 - Use yogurt as a substitute for sour cream or mayonnaise in recipes.
- Avoid alcohol consumption.

High Cholesterol and Triglycerides and Poor Glucose Control

- Limit dietary saturated fats (eg, fats in animal and milk and milk products) and trans fats (eg, may be present in commercially fried foods and baked goods), and replace them with healthy fats (eg, fats in nuts, nut butters, avocado, hummus, olive and canola oils, salmon, tuna fish).
- Avoid overconsumption of carbohydrates. This can be accomplished by limiting concentrated sweets (eg, candy, soda, juice), which are poor sources of nutrients, and by avoiding large portion sizes of other foods that contain carbohydrates (eg, bread, pasta, rice, potatoes, cereal, fruits, vegetables). Instead of eating large amounts of carbohydrates at a time, spread out carbohydrate consumption evenly throughout the day.
- Increase fiber intake by eating vegetables, whole-grain bread and cereal, oatmeal, beans, and fruits.

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Hyperlipidemia

Hyperlipidemia or hyperlipoproteinemia typically refers to any elevation of blood lipid levels (eg, total cholesterol, triglycerides, or lipoproteins).¹ Although terms such as hypercholesterolemia are often used interchangeably with hyperlipidemia, there are subtle differences. Hypercholesterolemia refers to elevated blood cholesterol. Dyslipoproteinemia or dyslipidemia describes abnormal levels of blood lipoproteins (eg, low levels of high-density lipoprotein [HDL], elevated low-density [LDL], or elevated very-low-density lipoprotein). Table 1 lists the range of acceptable, borderline, and high total cholesterol; LDL cholesterol; and triglyceride levels for children and adolescents at risk for atherosclerosis (hardening of the arteries). Additionally, an HDL cholesterol less than 35 mg/dL is considered abnormal for children and adolescents.²

TABLE 1. CLASSIFICATION OF CHOLESTEROL LEVELS IN CHILDREN AND ADOLESCENTS^a

	Total Cholesterol, mg/dL	LDL Cholesterol, mg/dL	Triglycerides, mg/dL
Acceptable	<170	<110	
Borderline	170–199	110–129	
High	≥200	≥130	>150

^aSources: National Institutes of Health,¹ Kavey et al,² and Gidding et al.³

SIGNIFICANCE

Blood cholesterol levels have decreased among adolescents over the past 2 decades; however, approximately 10.8% of adolescents (ages 12–19) have a total cholesterol level greater than 200 mg/dL.⁴ In adolescents (ages 12–19), 23.2% had elevated triglycerides and 23.4% had low HDL cholesterol.⁵

There are age, gender, racial/ethnic, and pubertal differences in blood lipid levels among children and adolescents. The American Heart Association (AHA) has determined age- and gender-specific cutpoints for total cholesterol, LDL cholesterol, HDL cholesterol, and triglycerides in adolescents (ages 12–20). However, longitudinal studies are needed to validate the cutpoints before they can be used instead of the National Cholesterol Education Program (NCEP) criteria.⁶

In adults, elevated total cholesterol levels are strongly associated with atherosclerosis and death from coronary heart disease (CHD).⁷ The process of atherosclerosis begins in childhood, with the appearance of fatty streaks in the arteries. Dietary interventions can lower total and LDL cholesterol levels (saturated- and trans-fat reduction), as well as triglycerides (simple sugar reduction) and are considered the initial therapy for hyperlipidemia. Physical activity can increase HDL cholesterol.¹

PREVENTION

Strategies for the prevention of atherosclerosis include choosing foods that meet nutrition requirements, supporting an active lifestyle, and promoting health as recommended in the *Dietary Guidelines for Americans*.⁸

The following recommendations have been issued for the prevention of atherosclerosis among children and adolescents.

DIETARY RECOMMENDATIONS FOR CHILDREN: BIRTH THROUGH AGE 2

- Children should not have their fat or dietary cholesterol intake restricted because of the high energy needs during this time of rapid growth and development.^{9,10}
- Reduced fat milk may be considered for children older than 12 months who are at risk for obesity, or have a family history of cardiovascular disease, dyslipidemia, or obesity.¹¹

DIETARY RECOMMENDATIONS FOR CHILDREN AND ADOLESCENTS: AGE 2 AND OLDER

- At age 2, children gradually need to begin eating fewer high-fat foods, so that by age 5, they receive no more than 30% of their calories from fat.¹⁰
- Saturated fat should be less than 10% of the total calories.^{2,10,12}
- Polyunsaturated fatty acids should account for up to 10% of total calories.¹²
- Limit trans fatty acid intake to less than 1% of total calories.^{2,11}
- Over several days, total fat should average not more than 30% but not less than 20% of total calories.^{10,12}
- Dietary cholesterol should be no more than 300 mg per day.^{2,10,12}
- Consume a variety of foods to provide adequate calories for growth, development, and maintenance of a desirable weight.^{2,12}
- Salt should be less than 6 g per day.²
- Limit sugar intake.²

OTHER NON-DIETARY RECOMMENDATIONS FOR CHILDREN AND ADOLESCENTS

- Participate in 60 minutes of moderate to vigorous fun physical activity daily.²
- Limit sedentary activity, including screen time, to 2 hours or less each day.²
- Avoid tobacco use, cease smoking if one currently smokes, and avoid environmental tobacco exposure.²

SCREENING

Early identification and treatment of children and adolescents with elevated lipid levels may reduce their risk of developing premature CHD. The most significant risk factor for hyperlipidemia is family history of premature cardiovascular disease and/or high blood cholesterol. Children and adolescents older than 2 years who meet any of the following criteria should have a fasting lipid profile completed to assess their individual risk. However, values obtained from the fasting lipid profile during puberty may reflect a lower LDL cholesterol often seen during pubertal maturation. Lipid values around age 10 years may be most similar to the ultimate adult values.¹¹ If the lipid values are within the normal range, the child or adolescent should be rescreened every 2 to 3 years.¹¹ Risk factors include

- A parent or grandparent (≤ 55 years of age in men and ≤ 65 years of age in women) who has been diagnosed with coronary atherosclerosis (on the basis of a coronary arteriography), including those who have undergone balloon angioplasty or coronary artery bypass surgery^{2,10-12}
- A parent or grandparent (≤ 55 years of age in men and ≤ 65 years of age in women) with documented myocardial infarction, angina pectoris, peripheral vascular disease, cerebrovascular disease, or sudden cardiac death^{2,9-12}
- Children and adolescents whose family history cannot be reliably obtained—particularly those with other risk factors^{9,10,11,13}
- Overweight or obese^{11,14}
- Hypertension¹¹
- Cigarette smoking¹¹
- Diabetes mellitus¹¹

Pharmacologic therapy should be considered for children and adolescents age 8 and older, after 6 to 12 months of dietary changes have been attempted; with LDL cholesterol 190 mg/dL or greater with no other cardiovascular disease risk factors, for those with LDL cholesterol greater than 160 mg/dL with either 2 or more other risk factors and who do not reach treatment goals with lifestyle changes or a family history of premature cardiovascular disease, or LDL cholesterol greater than 130 mg/dL with diabetes mellitus.^{12,14,15} Initial therapy recommendations in children by the NCEP guidelines call for the use of bile acid-binding resins. More commonly statins have been used due to poor compliance with bile acid-binding resins because they may cause gastrointestinal distress.¹⁴ The American Academy of Pediatrics recommends an initial goal of lowering LDL cholesterol to less than 160 mg/dL; however, depending on family history and/or other risk factors, goals of 130 mg/dL or 110 mg/dL may be more appropriate.¹¹ Currently there are no recommended cut-off triglyceride or HDL cholesterol levels for initiation of pharmacologic therapy in children.¹⁴

Other risk factors that contribute to early onset of CHD include the following:^{10,16}

- Family history of premature CHD, cerebrovascular disease, or occlusive peripheral vascular disease
- Cigarette smoking
- Elevated blood pressure
- Low HDL cholesterol concentrations (<35 mg/dL)²
- Overweight (85th–94th percentile), obese (95th–98th percentile), severely obese (≥99th percentile)¹⁷
- Diabetes mellitus
- Physical inactivity

Additionally, the AHA has identified the following conditions in children and adolescents as indicative of increased risk for cardiovascular disease and requiring treatment at lower levels than other children.¹⁸

- Tier 1 (high risk): homozygous familial hypercholesterolemia, type 1 diabetes mellitus, chronic kidney disease, end-stage renal disease, post-orthostatic heart transplantation, Kawasaki disease with current coronary aneurysms

- Tier 2 (moderate risk): heterozygous familial hypercholesterolemia, Kawasaki disease with regressed coronary aneurysms, type 2 diabetes mellitus, chronic inflammatory disease
- Tier 3 (at-risk): post-cancer treatment survivors, congenital heart disease, Kawasaki disease without detected coronary involvement

NUTRITION SCREENING

- Interview the child or adolescent and parents to assess food purchasing and preparation habits as well as eating patterns. Provide nutrition counseling.^{19,20}
- Ask the child or adolescent to complete a 3-day food record to supplement the dietary interview. (If the child is <10, the parent should complete the food record.)^{19,20}

MONITORING

Children and adolescents with hyperlipidemia need to have their blood cholesterol, eating behaviors, and other risk factors monitored regularly. Children and adolescents with normal lipid values should be rescreened within 3 to 5 years.¹¹ If blood lipid levels have not improved or dietary goals have not been achieved, more intensive counseling may be required. With familial lipid disorders, blood lipid levels may not improve sufficiently, even with excellent adherence to a regimen.¹¹ This may be an appropriate time for referral to a lipid center and/or consideration of drug therapy. Even with drug therapy, dietary changes are still an important therapy component.¹¹

ANTICIPATORY GUIDANCE

Following are the major components of nutrition anticipatory guidance for children and adolescents with hyperlipidemia.

- Seek support from the child's or adolescent's family.
- Educate children and adolescents and their families to follow a diet containing less than 7% of total calories from saturated fat and less than 200 mg of dietary cholesterol per day.^{3,11}
- Educate children or adolescents and their families who are overweight or obese about weight management, including changes to diet and physical activity.¹¹

- Ensure the nutritional adequacy of the child’s or adolescent’s diet.
 - Teach skills for appropriately selecting and preparing food.
 - Help the child or adolescent and the family plan ahead for special occasions and provide flexibility in food choices.
 - Encourage the reduction of other CHD risk factors, such as tobacco or anabolic steroid use.
 - Encourage regular physical activity and sound approaches to weight management.
 - Discuss the incorporation of foods containing plant stanols and sterols into a healthy diet.¹²
 - Encourage the consumption of fiber-rich foods, especially those containing soluble fiber.¹¹
- Table 2 provides the daily estimated calories and recommended servings for food groups by age and gender.

REFERRAL

Referral to a specialized lipid center should be considered for children and adolescents with a significant family history of premature heart disease or familial lipid disorders. Comprehensive nutrition counseling for the family is needed to help the child or adolescent adhere to the diet. Diet restrictions should be determined with a registered dietitian.^{11,18}

TABLE 2. ESTIMATED CALORIES AND RECOMMENDED SERVINGS FOR MILK/ MILK PRODUCTS, LEAN MEATS/BEANS, FRUITS, VEGETABLES, AND GRAINS BY AGE AND GENDER^{a,b}

	1 Year	2–3 Years	4–8 Years	9–13 Years	14–18 Years
Calories^c	900 kcal	1,000 kcal			
Female			1,200 kcal	1,600 kcal	1,800 kcal
Male			1,400 kcal	1,800 kcal	2,200 kcal
Fat	30%–40% kcal	30%–35% kcal	25%–35% kcal	25%–35% kcal	25%–35% kcal
Milk/milk products^d	2 cups ^e	2 cups	2 cups	3 cups	3 cups
Lean meats/beans	1½ oz	2 oz		5 oz	
Female			3 oz		5 oz
Male			4 oz		6 oz
Fruits^f	1 cup	1 cup	1½ cup	1½ cup	
Female					1½ cup
Male					2 cup
Vegetables^f	¾ cup	1 cup			
Female			1 cup	2 cup	2½ cup
Male			1½ cup	2½ cup	3 cup
Grains^g	2 oz	3 oz			
Female			4 oz	5 oz	6 oz
Male			5 oz	6 oz	7 oz

^aSources: Gidding et al³ and US Department of Health and Human Services.⁸
^bCalorie estimates are based on sedentary lifestyle. Increased physical activity will require additional calories (up to 200 kcal/day if moderately physically active and 200 to 400 kcal/day if very physically active).
^cFor children ages 2 and older; adapted from the *Dietary Guidelines for Americans*.⁸ Nutrient and energy contributions from each group are calculated according to the nutrient-dense forms of food in each group (eg, lean meats/beans, fat-free milk).
^dMilk listed is fat-free milk (except for 1-year-old children). If 1%, 2%, or whole milk is substituted, use, for each cup, 19, 39, or 63 kcal, respectively, of discretionary calories and 2.6, 5.1, or 9.0 g of total fat, of which 1.3, 2.6, or 4.6 g are saturated fat.
^eFor 1-year-old children, 2% milk is included. If 2 cups of whole milk are substituted, 48 kcal of discretionary calories will be used.
^fServing sizes are ¼ cup for 1 year of age, ½ cup for 2 to 3 years of age, and ¾ cup for ≥4 years of age. A variety of vegetables should be selected from each subgroup over the week.
^gHalf of all grains should be whole grains.

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Hypertension

In children and adolescents, primary or essential hypertension is diagnosed when persistently elevated blood pressure cannot be explained by any underlying organic cause. According to the National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents, children and adolescents 1 to 17 years of age are considered hypertensive if their average systolic and/or diastolic blood pressure readings are at or above the 95th percentile (based on age, sex, and height) on at least 3 separate occasions. Definitions of normal blood pressure, pre-hypertension, and hypertension are as follows¹:

- Normal blood pressure: less than 90th percentile
- Pre-hypertension: 90th percentile to the 94th percentile or if blood pressure exceeds 120/80 mm Hg even if blood pressure is less than 90th percentile to the 94th percentile
- Hypertension: 95th percentile or greater (on 3 separate occasions)
- Stage 1 hypertension: 95th percentile to the 99th percentile plus 5 mm Hg
- Stage 2 hypertension: greater than the 99th percentile plus 5 mm Hg

Children and adolescents with frequent blood pressure readings between the 90th percentile and the 94th percentiles for their age, sex, and height or greater than 120/80 mm Hg (even if <90th percentile) are defined as having pre-hypertension and are at risk for developing hypertension. These children and adolescents should be followed regularly for early detection of further elevation in blood pressure. Tables 1 and 2 present the blood pressure standards for the 50th, 90th, 95th, and 99th percentiles for males and females ages 1 to 17 years, by age and percentile of height.¹

For adolescents ages 18 and older, the severity of elevated blood pressure, when observed on 2 or more occasions, is evaluated on the basis of the adult criteria in Table 3.²

SIGNIFICANCE

Primary hypertension is an independent risk factor for cardiovascular disease. Familial patterns for primary hypertension have established that high blood pressure has its origins in childhood and adolescence. If left untreated, high blood pressure generally will persist into adulthood. Primary hypertension is now considered the most common form of mild-to-moderate hypertension among adolescents, particularly those who are overweight and/or have a family history of high blood pressure.

TABLE 1. BLOOD PRESSURE LEVELS FOR BOYS BY AGE AND HEIGHT PERCENTILE^a

Blood Pressure Levels for Boys by Age and Height Percentile

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	80	81	83	85	87	88	89	34	35	36	37	38	39	39
	90th	94	95	97	99	100	102	103	49	50	51	52	53	53	54
	95th	98	99	101	103	104	106	106	54	54	55	56	57	58	58
	99th	105	106	108	110	112	113	114	61	62	63	64	65	66	66
2	50th	84	85	87	88	90	92	92	39	40	41	42	43	44	44
	90th	97	99	100	102	104	105	106	54	55	56	57	58	58	59
	95th	101	102	104	106	108	109	110	59	59	60	61	62	63	63
	99th	109	110	111	113	115	117	117	66	67	68	69	70	71	71
3	50th	86	87	89	91	93	94	95	44	44	45	46	47	48	48
	90th	100	101	103	105	107	108	109	59	59	60	61	62	63	63
	95th	104	105	107	109	110	112	113	63	63	64	65	66	67	67
	99th	111	112	114	116	118	119	120	71	71	72	73	74	75	75
4	50th	88	89	91	93	95	96	97	47	48	49	50	51	51	52
	90th	102	103	105	107	109	110	111	62	63	64	65	66	66	67
	95th	106	107	109	111	112	114	115	66	67	68	69	70	71	71
	99th	113	114	116	118	120	121	122	74	75	76	77	78	78	79
5	50th	90	91	93	95	96	98	98	50	51	52	53	54	55	55
	90th	104	105	106	108	110	111	112	65	66	67	68	69	69	70
	95th	108	109	110	112	114	115	116	69	70	71	72	73	74	74
	99th	115	116	118	120	121	123	123	77	78	79	80	81	81	82
6	50th	91	92	94	96	98	99	100	53	53	54	55	56	57	57
	90th	105	106	108	110	111	113	113	68	68	69	70	71	72	72
	95th	109	110	112	114	115	117	117	72	72	73	74	75	76	76
	99th	116	117	119	121	123	124	125	80	80	81	82	83	84	84
7	50th	92	94	95	97	99	100	101	55	55	56	57	58	59	59
	90th	106	107	109	111	113	114	115	70	70	71	72	73	74	74
	95th	110	111	113	115	117	118	119	74	74	75	76	77	78	78
	99th	117	118	120	122	124	125	126	82	82	83	84	85	86	86
8	50th	94	95	97	99	100	102	102	56	57	58	59	60	60	61
	90th	107	109	110	112	114	115	116	71	72	72	73	74	75	76
	95th	111	112	114	116	118	119	120	75	76	77	78	79	79	80
	99th	119	120	122	123	125	127	127	83	84	85	86	87	87	88
9	50th	95	96	98	100	102	103	104	57	58	59	60	61	61	62
	90th	109	110	112	114	115	117	118	72	73	74	75	76	76	77
	95th	113	114	116	118	119	121	121	76	77	78	79	80	81	81
	99th	120	121	123	125	127	128	129	84	85	86	87	88	88	89
10	50th	97	98	100	102	103	105	106	58	59	60	61	61	62	63
	90th	111	112	114	115	117	119	119	73	73	74	75	76	77	78
	95th	115	116	117	119	121	122	123	77	78	79	80	81	81	82
	99th	122	123	125	127	128	130	130	85	86	86	88	88	89	90

^aReprinted from: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents.¹

TABLE 1. BLOOD PRESSURE LEVELS FOR BOYS BY AGE AND HEIGHT PERCENTILE,^a CONTINUED

Blood Pressure Levels for Boys by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)						Diastolic BP (mmHg)							
		← Percentile of Height →						← Percentile of Height →							
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	99	100	102	104	105	107	107	59	59	60	61	62	63	63
	90th	113	114	115	117	119	120	121	74	74	75	76	77	78	78
	95th	117	118	119	121	123	124	125	78	78	79	80	81	82	82
	99th	124	125	127	129	130	132	132	86	86	87	88	89	90	90
12	50th	101	102	104	106	108	109	110	59	60	61	62	63	63	64
	90th	115	116	118	120	121	123	123	74	75	75	76	77	78	79
	95th	119	120	122	123	125	127	127	78	79	80	81	82	82	83
	99th	126	127	129	131	133	134	135	86	87	88	89	90	90	91
13	50th	104	105	106	108	110	111	112	60	60	61	62	63	64	64
	90th	117	118	120	122	124	125	126	75	75	76	77	78	79	79
	95th	121	122	124	126	128	129	130	79	79	80	81	82	83	83
	99th	128	130	131	133	135	136	137	87	87	88	89	90	91	91
14	50th	106	107	109	111	113	114	115	60	61	62	63	64	65	65
	90th	120	121	123	125	126	128	128	75	76	77	78	79	79	80
	95th	124	125	127	128	130	132	132	80	80	81	82	83	84	84
	99th	131	132	134	136	138	139	140	87	88	89	90	91	92	92
15	50th	109	110	112	113	115	117	117	61	62	63	64	65	66	66
	90th	122	124	125	127	129	130	131	76	77	78	79	80	80	81
	95th	126	127	129	131	133	134	135	81	81	82	83	84	85	85
	99th	134	135	136	138	140	142	142	88	89	90	91	92	93	93
16	50th	111	112	114	116	118	119	120	63	63	64	65	66	67	67
	90th	125	126	128	130	131	133	134	78	78	79	80	81	82	82
	95th	129	130	132	134	135	137	137	82	83	83	84	85	86	87
	99th	136	137	139	141	143	144	145	90	90	91	92	93	94	94
17	50th	114	115	116	118	120	121	122	65	66	66	67	68	69	70
	90th	127	128	130	132	134	135	136	80	80	81	82	83	84	84
	95th	131	132	134	136	138	139	140	84	85	86	87	87	88	89
	99th	139	140	141	143	145	146	147	92	93	93	94	95	96	97

^aReprinted from: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents.¹

TABLE 2. BLOOD PRESSURE LEVELS FOR GIRLS BY AGE AND HEIGHT PERCENTILE^a

		Blood Pressure Levels for Girls by Age and Height Percentile													
Age (Year)	BP Percentile ↓	Systolic BP (mmHg)							Diastolic BP (mmHg)						
		← Percentile of Height →							← Percentile of Height →						
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
1	50th	83	84	85	86	88	89	90	38	39	39	40	41	41	42
	90th	97	97	98	100	101	102	103	52	53	53	54	55	55	56
	95th	100	101	102	104	105	106	107	56	57	57	58	59	59	60
	99th	108	108	109	111	112	113	114	64	64	65	65	66	67	67
2	50th	85	85	87	88	89	91	91	43	44	44	45	46	46	47
	90th	98	99	100	101	103	104	105	57	58	58	59	60	61	61
	95th	102	103	104	105	107	108	109	61	62	62	63	64	65	65
	99th	109	110	111	112	114	115	116	69	69	70	70	71	72	72
3	50th	86	87	88	89	91	92	93	47	48	48	49	50	50	51
	90th	100	100	102	103	104	106	106	61	62	62	63	64	64	65
	95th	104	104	105	107	108	109	110	65	66	66	67	68	68	69
	99th	111	111	113	114	115	116	117	73	73	74	74	75	76	76
4	50th	88	88	90	91	92	94	94	50	50	51	52	52	53	54
	90th	101	102	103	104	106	107	108	64	64	65	66	67	67	68
	95th	105	106	107	108	110	111	112	68	68	69	70	71	71	72
	99th	112	113	114	115	117	118	119	76	76	76	77	78	79	79
5	50th	89	90	91	93	94	95	96	52	53	53	54	55	55	56
	90th	103	103	105	106	107	109	109	66	67	67	68	69	69	70
	95th	107	107	108	110	111	112	113	70	71	71	72	73	73	74
	99th	114	114	116	117	118	120	120	78	78	79	79	80	81	81
6	50th	91	92	93	94	96	97	98	54	54	55	56	56	57	58
	90th	104	105	106	108	109	110	111	68	68	69	70	70	71	72
	95th	108	109	110	111	113	114	115	72	72	73	74	74	75	76
	99th	115	116	117	119	120	121	122	80	80	80	81	82	83	83
7	50th	93	93	95	96	97	99	99	55	56	56	57	58	58	59
	90th	106	107	108	109	111	112	113	69	70	70	71	72	72	73
	95th	110	111	112	113	115	116	116	73	74	74	75	76	76	77
	99th	117	118	119	120	122	123	124	81	81	82	82	83	84	84
8	50th	95	95	96	98	99	100	101	57	57	57	58	59	60	60
	90th	108	109	110	111	113	114	114	71	71	71	72	73	74	74
	95th	112	112	114	115	116	118	118	75	75	75	76	77	78	78
	99th	119	120	121	122	123	125	125	82	82	83	83	84	85	86
9	50th	96	97	98	100	101	102	103	58	58	58	59	60	61	61
	90th	110	110	112	113	114	116	116	72	72	72	73	74	75	75
	95th	114	114	115	117	118	119	120	76	76	76	77	78	79	79
	99th	121	121	123	124	125	127	127	83	83	84	84	85	86	87
10	50th	98	99	100	102	103	104	105	59	59	59	60	61	62	62
	90th	112	112	114	115	116	118	118	73	73	73	74	75	76	76
	95th	116	116	117	119	120	121	122	77	77	77	78	79	80	80
	99th	123	123	125	126	127	129	129	84	84	85	86	86	87	88

^aReprinted from: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents.¹

TABLE 2. BLOOD PRESSURE LEVELS FOR GIRLS BY AGE AND HEIGHT PERCENTILE,^a CONTINUED

Blood Pressure Levels for Girls by Age and Height Percentile (Continued)

Age (Year)	BP Percentile ↓	Systolic BP (mmHg)						Diastolic BP (mmHg)							
		← Percentile of Height →						← Percentile of Height →							
		5th	10th	25th	50th	75th	90th	95th	5th	10th	25th	50th	75th	90th	95th
11	50th	100	101	102	103	105	106	107	60	60	60	61	62	63	63
	90th	114	114	116	117	118	119	120	74	74	74	75	76	77	77
	95th	118	118	119	121	122	123	124	78	78	78	79	80	81	81
	99th	125	125	126	128	129	130	131	85	85	86	87	87	88	89
12	50th	102	103	104	105	107	108	109	61	61	61	62	63	64	64
	90th	116	116	117	119	120	121	122	75	75	75	76	77	78	78
	95th	119	120	121	123	124	125	126	79	79	79	80	81	82	82
	99th	127	127	128	130	131	132	133	86	86	87	88	88	89	90
13	50th	104	105	106	107	109	110	110	62	62	62	63	64	65	65
	90th	117	118	119	121	122	123	124	76	76	76	77	78	79	79
	95th	121	122	123	124	126	127	128	80	80	80	81	82	83	83
	99th	128	129	130	132	133	134	135	87	87	88	89	89	90	91
14	50th	106	106	107	109	110	111	112	63	63	63	64	65	66	66
	90th	119	120	121	122	124	125	125	77	77	77	78	79	80	80
	95th	123	123	125	126	127	129	129	81	81	81	82	83	84	84
	99th	130	131	132	133	135	136	136	88	88	89	90	90	91	92
15	50th	107	108	109	110	111	113	113	64	64	64	65	66	67	67
	90th	120	121	122	123	125	126	127	78	78	78	79	80	81	81
	95th	124	125	126	127	129	130	131	82	82	82	83	84	85	85
	99th	131	132	133	134	136	137	138	89	89	90	91	91	92	93
16	50th	108	108	110	111	112	114	114	64	64	65	66	66	67	68
	90th	121	122	123	124	126	127	128	78	78	79	80	81	81	82
	95th	125	126	127	128	130	131	132	82	82	83	84	85	85	86
	99th	132	133	134	135	137	138	139	90	90	90	91	92	93	93
17	50th	108	109	110	111	113	114	115	64	65	65	66	67	67	68
	90th	122	122	123	125	126	127	128	78	79	79	80	81	81	82
	95th	125	126	127	129	130	131	132	82	83	83	84	85	85	86
	99th	133	133	134	136	137	138	139	90	90	91	91	92	93	93

^aReprinted from: National High Blood Pressure Education Program Working Group on High Blood Pressure in Children and Adolescents.¹

TABLE 3. CLASSIFICATION OF BLOOD PRESSURE FOR ADULTS^a

Classification	SBP (mm Hg)		DBP (mm Hg)
Normal	<120	and	<80
Pre-hypertension	120–139	or	80–89
Stage 1 hypertension	140–159	or	90–99
Stage 2 hypertension	≥160	or	≥100

^aFrom: Chobanian et al.²

SCREENING AND ASSESSMENT

BLOOD PRESSURE

Blood pressure screening is a universal recommendation at periodic physical examinations beginning at age 3 years (using the method described in *The Fourth Report on Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents*¹). Screening should be repeated at subsequent health supervision visits. Correct measurement of blood pressure in children requires a cuff sized appropriately for the child's upper right arm. The right arm is preferred for consistency and for comparison with the standardized tables.¹ When an elevated systolic or diastolic blood pressure reading is first obtained, 2 or more measurements at a comparable level, taken consecutively over weeks or months, must be obtained before a diagnosis of hypertension is confirmed. When standardized techniques for measuring blood pressure in children and adolescents are followed, an estimated 1% to 3% will be found to have persistent hypertension. This prevalence is higher among children and adolescents who are overweight or obese. Children younger than age 3 with certain risk factors for elevated blood pressure are selectively screened at all health supervision visits.

OBESITY

Obesity and an excess distribution of fat in the midsection of the body ("central obesity") are recognized as significant risk factors in the development of primary hypertension. Obesity in children and adolescents can be assessed through body mass index (BMI) for age and gender percentiles. Body mass index is a weight-stature index ($BMI = \text{kg}/\text{m}^2$) correlated with subcutaneous and total body fat in children and adolescents. A BMI between the 85th percentile and 94th percentile is considered overweight. A BMI at the 95th percentile or greater is considered obese.³ (See the Obesity chapter.)

BLOOD LIPIDS

Children and adolescents who are hypertensive may also have abnormal blood lipid levels, which increase their risk of developing cardiovascular disease as adults. It is advisable to obtain fasting blood lipid levels for children and adolescents with primary hypertension. (See the Hyperlipidemia chapter.)

DIETARY FACTORS

Dietary modifications that reduce sodium intake and encourage a healthy weight can help lower blood pressure.^{4,5} Children and adolescents who are hypertensive and also have elevated blood lipid levels should be advised to modify their intake of total fat, saturated fat, and cholesterol. Although there is some evidence that an increased intake of calcium, potassium, and magnesium and a decreased intake of caffeine may lower blood pressure, the findings are inconclusive.

The goals of dietary screening and assessment are as follows:

- Evaluate children's and adolescents' diets for nutritional adequacy, based on the dietary guidelines in *MyPyramid*,⁶ with particular emphasis on including low-fat milk and other low-fat dairy products, fruits, vegetables, and whole-grain breads and cereals.
- Identify regularly or frequently eaten foods that are high in sodium and/or fat, and suggest strategies for modifying the diet.
- Identify the family member(s) with the primary responsibility for purchasing food and preparing meals to ensure their involvement in counseling sessions.

PHYSICAL ACTIVITY

Children and adolescents who are physically fit have lower blood pressure levels than those who are not physically active, regardless of whether they are overweight. Children and adolescents who are hypertensive can improve their blood pressure level by participating in more aerobic physical activity on a regular basis. Children and adolescents with primary hypertension

typically can participate in sports and strenuous physical activity without restrictions, except for intense isometric exercise (eg, power lifting and some weight training, which can dramatically increase blood pressure). Young athletes with stage 2 hypertension are restricted from classes III A to III C sports as listed in the American Academy of Pediatrics policy statement “Medical Conditions Affecting Sports Participation” until blood pressure is adequately controlled.

Health professionals should screen for physical activity by asking questions about the type, frequency, and duration of physical activity performed alone, with family members, with peers, at school, and at community recreational facilities.

The goals of physical activity screening and assessment are as follows:

- Identify age-appropriate aerobic physical activities that are acceptable, attainable, and enjoyable for the child or adolescent to pursue regularly.
- Assess the child’s or adolescent’s level of physical inactivity (ie, sedentary behavior) in order to help families set appropriate limits (<2 hours per day) for activities such as watching television and videotapes, playing computer games, and spending time on the telephone.

TOBACCO

Nicotine exposure is associated with elevated blood pressure in adults. Thus it is essential for children and adolescents who are hypertensive to avoid any form of tobacco.

ANTICIPATORY GUIDANCE

Modifying dietary and physical activity behaviors is the initial strategy used in treating children and adolescents with primary hypertension. Children and adolescents who are overweight and have hypertension need effective weight-management strategies to improve their health. (See the Obesity chapter.) Introducing medication to lower blood pressure is considered only when the recommended changes do not significantly improve blood pressure after 6 to 12 months, unless stage 2 hypertension is present. In the

setting of stage 2 hypertension, medication can be introduced along with dietary advice. If medication is prescribed, it is still important to adhere to the dietary and physical activity recommendations for primary hypertension.⁴

SODIUM AND SALT

The effect of dietary sodium on increased blood pressure is more pronounced in individuals who are “salt sensitive.” Because there is no simple way to screen for salt sensitivity, children and adolescents with primary hypertension or those with high-normal blood pressure should be advised to follow a moderate sodium-restricted diet.^{4,5}

Some dietary surveys have estimated sodium intake as high as 5,000 mg per day in children and adolescents. This intake far exceeds the estimated adequate daily intake for sodium needed to support growth and development during childhood and adolescence.⁷ A moderate sodium-restricted diet for children and adolescents is considered to be 1,500 to 2,500 mg per day.

To achieve this moderate intake of sodium, the following measures are advised:

- Do not add salt to food at the table.
- During cooking, omit added salt and other seasonings with sodium.
- Reduce intake of processed or packaged foods high in salt and other sodium compounds, including salted snacks (eg, chips, crackers, pretzels, popcorn, nuts); processed cheeses; condiments (eg, ketchup, mustard); cured meats (eg, bacon, sausage, hot dogs, lunch meats); soups; and most commercially prepared soups and main-course foods that are frozen, boxed, or canned.
- Limit intake of foods from fast-food restaurants because some items contain one-third or more of the recommended daily sodium intake.

In adults, the DASH (Dietary Approach to Stop Hypertension) eating plan is effective in lowering blood pressure.⁴ The DASH eating plan includes low-fat dairy products, fresh fruits and vegetables, and whole grains with avoidance of foods high in sugar, salt, and saturated fat. This

results in a diet that is relatively low in sodium, has appropriate calories, and is high in potassium. The DASH eating plan can also be effective in lowering blood pressure in adolescents with primary hypertension.⁸ Many of the strategies to implement a lower intake of sodium can also be used in the implementation of the DASH eating plan.

PHYSICAL ACTIVITY

Providing anticipatory guidance to children and adolescents with hypertension (particularly those who are sedentary and overweight) to become more active can be difficult. Helping families make regular physical activity a priority, enlisting the involvement of school physical education instructors, and using community recreational facilities all encourage children and adolescents to make physical activity an enjoyable part of their life.

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Iron-Deficiency Anemia

Iron-deficiency anemia is identified by abnormally small red blood cells, with decreased hemoglobin or hematocrit and a reduced capacity to deliver oxygen to body cells and tissues.¹

SIGNIFICANCE

Iron deficiency is the most prevalent form of nutrition deficiency in the United States. The risk of iron-deficiency anemia is highest during infancy and adolescence because of the increased iron requirements for rapid growth. In healthy full-term infants, iron stores are adequate until age 4 to 6 months. Iron requirements may exceed dietary iron intake after this time because of rapid rates of physical growth, placing older infants and young children at increased risk for iron deficiency. During the feeding transition from human milk or infant formula to solid foods, infants and young children may not consume adequate dietary sources of iron. Children from communities with a high concentration of families with low incomes and those with poor dietary habits are also at higher risk for iron deficiency. In addition, the onset of menarche and low dietary iron intake contribute to a higher risk for iron-deficiency anemia among adolescent females. Iron-deficiency anemia is more common among groups characterized by low income levels (compared with those characterized by higher income levels) and among African-American and Mexican-American children (compared with white children).¹

Iron-deficiency anemia has been associated with developmental delays and behavioral disturbances in young children.^{1,2} It has also been associated with impaired growth and development, fatigue, decreased resistance to infection, decreased physical performance, decreased levels of endurance, reduced attention span, decreased school performance, and increased susceptibility to lead poisoning.^{1,2}

RISK FACTORS

Increased demand for iron, low intake of iron, and/or greater loss of iron from the body are associated with a higher risk for iron-deficiency anemia. The following conditions are associated with an increased risk for developing iron-deficiency anemia:

- Periods of rapid growth
- Preterm or low-birth weight birth
- Low dietary intake of meat, fish, poultry, fortified grains, or foods rich in ascorbic acid
- Macrobiotic and vegan diets

- Inappropriate consumption of cow's milk (infants should not consume cow's milk; children should not consume more than 24 oz of cow's milk per day)
- Use of non-iron-fortified infant formula for more than 2 months
- Exclusive breastfeeding after age 6 months without the addition of iron-fortified supplemental foods in the infant's diet
- Meal-skipping, frequent dieting
- Pregnancy, especially multiple and closely spaced pregnancies
- Participation in endurance sports (eg, long-distance running, swimming, cycling)
- Intensive physical training
- Recent blood loss, recent pregnancy, heavy/lengthy menstrual periods
- Chronic use of aspirin or nonsteroidal anti-inflammatory drugs (eg, ibuprofen)
- Parasitic infections

Although no guidelines exist for screening of overweight and obese children and adolescents, research indicates that a greater number of these children and adolescents have iron deficiency than their normal-weight peers.³⁻⁶ Potential associations may include increased

iron needs, genetics, poor diet quality with inadequate consumption of iron-rich foods, and physical inactivity.^{3,4,6}

SCREENING

Recommendations for iron-deficiency anemia screening have been put forth by the Centers for Disease Control and Prevention (CDC),¹ the Institute of Medicine,⁷ and the American Academy of Pediatrics (AAP).^{8,9} While hemoglobin and hematocrit values, which are used to identify iron-deficiency anemia (Table 1) are consistent across the various recommendations, the recommended timing for screening infants and young children, as well as recommended screening tests, may differ. The distribution of hemoglobin and hematocrit values differs in children and adolescents and in males and females.

Hemoglobin is important to measure since it determines whether anemia is present; however, measuring hemoglobin alone may not be sufficient to identify iron-deficiency anemia, because hemoglobin has both low sensitivity and low specificity. The AAP recommends that the hemoglobin measure be accompanied by more

TABLE 1. MAXIMUM HEMOGLOBIN CONCENTRATION AND HEMATOCRIT VALUES FOR ANEMIA^a

Sex/Age, y ^b	Hemoglobin, <g/dL	Hematocrit, <%
Males and Females		
1-<2 ^c	11.0	32.9
2-<5	11.1	33.0
5-<8	11.5	34.5
8-<12	11.9	35.4
Males		
12-<15	12.5	37.3
15-<18	13.3	39.7
≥18	13.5	39.9
Females ^d		
12-<15	11.8	35.7
15-<18	12.0	35.9
≥18	12.0	35.7

^aSource: Centers for Disease Control and Prevention.¹

^bAge- and sex-specific cutoff values for anemia are based on the 5th percentile from the third National Health and Nutrition Examination Survey (NHANES III).

^cAlthough no data are available from NHANES III to determine the maximum hemoglobin concentration and hematocrit values for anemia among infants, the values listed for children ages 1 to <2 can be used for infants ages 6 to 12 months.

^dNonpregnant adolescents.

sensitive measures of iron status during screening if the infant's or child's (birth–3 years) hemoglobin is less than 11.0 mg/dL or if the infant or child is at high risk of iron deficiency or iron deficiency anemia.⁹ These additional measures are described in the Assessment section.

INFANTS AND CHILDREN AGES 9 TO 18 MONTHS

The AAP and CDC recommend screening infants during the first year of life.^{1,9} While the AAP recommends universal screening for iron deficiency and iron-deficiency anemia at about age 12 months,⁹ the CDC recommends screening infants at high risk for iron-deficiency anemia or those with known risk factors for iron-deficiency anemia between ages 9 to 12 months and again 6 months later (ages 15–18 months).¹

Infants and children considered at high risk for iron-deficiency anemia include¹

- Infants and children from families with low incomes
- Infants and children who are eligible for the Special Supplemental Nutrition Program for Women, Infants and Children (WIC)
- Infants and children who are migrants or recently arrived refugees
- Infants and children who are Mexican-American⁹

Infants and children who have known risk factors for iron-deficiency anemia include¹

- Infants born preterm or with low birth weight
- Infants fed non-iron-fortified infant formula for more than 2 months
- Infants fed cow's milk before age 12 months
- Infants who are breastfed infants and do not receive adequate iron from supplemental foods after age 6 months
- Children who consume more than 24 oz of cow's milk per day
- Children with special health care needs who use medications that interfere with iron absorption (eg, antacids, calcium, phosphorus, magnesium) or those with chronic infection; inflammatory disorders; restricted diets; or extensive blood loss from a wound, an accident, or surgery

CHILDREN AGES 2 TO 5

The AAP recommends the annual screening of children if any of the following risk factors are present⁸:

- Special health care needs
- Diet low in iron
- Vegetarian diet
- Low socioeconomic status
- Limited access to food

The CDC recommends the annual screening of children if any of the following risk factors are present¹:

- Diet low in iron
- Limited access to food because of poverty or neglect
- Special health care needs
- Low income
- Eligible for WIC
- Migrants or recently arrived refugees

CHILDREN AGES 5 TO 12 AND ADOLESCENT MALES AGES 12 TO 18

The AAP recommends screening children who are consuming a strict vegetarian diet without iron supplementation. Additionally, the AAP recommends screening adolescent males during their peak growth period at a routine physical examination.⁸

The CDC recommends screening children and adolescent males with known risk factors for iron-deficiency anemia (eg, low iron intake, special health care needs, previous diagnosis of iron-deficiency anemia).¹

ADOLESCENT FEMALES AGES 12 TO 21

The AAP recommends screening adolescent females during all routine physical examinations.⁸

The CDC recommends annually screening adolescent females with known risk factors for iron-deficiency anemia (eg, extensive menstrual or other blood loss, low iron intake, a previous diagnosis of iron-deficiency anemia). For those with no known risk factors, the CDC recommends screening every 5 to 10 years during routine physical examinations.¹

ASSESSMENT

If the infant's or child's (birth–3 years) hemoglobin level is less than 11.0 mg/dL or the infant or child is at high risk of iron deficiency or iron deficiency anemia, the AAP recommends any of the following sets of laboratory values for the assessment of iron-deficiency anemia:

- Hemoglobin and reticulocyte hemoglobin content (CHr)
- Hemoglobin, serum ferritin (SF), and C-reactive protein (CRP)

Hemoglobin is important to measure since it determines whether anemia is present; however, measuring hemoglobin alone may not be sufficient to identify iron-deficiency anemia, because hemoglobin has both low sensitivity and low specificity. The AAP recommends that the hemoglobin measure be accompanied by a more sensitive measure of iron status during screening.⁹ The other laboratory tests—transferrin receptor concentration (TfR1), CHr, and SF—provide information about iron status. Hemoglobin along with TfR1 is the preferred test for screening for iron-deficiency anemia. However, standard values for infants and children have not been established. Additionally, the equipment used to assess TfR1 is not readily

available in most areas. Reticulocyte hemoglobin content and TfR1 concentrations are not impacted by anemia of chronic disease, malignancy, or inflammation, thus would be preferable as biomarkers for iron status. Therefore, they are preferred over SF and CRP. A low CHr concentration is the strongest predictor of iron deficiency in children. Serum ferritin is affected by inflammation, infection, malignancy, and liver disease.¹⁰ Serum ferritin should therefore be assessed along with a measure of acute phase reactants when used to assess iron status.⁹

The CDC uses age-specific cutoff points for hemoglobin and hematocrit (hematologic tests) as criteria for diagnosis of iron-deficiency anemia, but acknowledges that biochemical tests, such as SF, would detect earlier changes in iron status.

High altitudes and cigarette smoking increase anemia cutpoints (Table 2). Altitudes above 3,000 feet raise the cutpoint for anemia because of lower oxygen partial pressure, a reduction in oxygen saturation of blood, and an increase in red cell production. Cigarette smoking also raises the cutpoint for anemia because carboxyhemoglobin formed from carbon monoxide during smoking has no oxygen-carrying capacity.

TABLE 2. ADJUSTMENT OF MAXIMUM HEMOGLOBIN CONCENTRATION AND HEMATOCRIT VALUES FOR IRON-DEFICIENCY ANEMIA^a

Altitude, ft	Hemoglobin Concentration, <g/dL	Hematocrit, <%
3,000–3,999	+0.2	+0.5
4,000–4,999	+0.3	+1.0
5,000–5,999	+0.5	+1.5
6,000–6,999	+0.7	+2.0
7,000–7,999	+1.0	+3.0
8,000–8,999	+1.3	+4.0
9,000–9,999	+1.6	+5.0
10,000–11,000	+2.0	+6.0
Cigarette smoking		
0.5–<1.0 pack per day	+0.3	+1.0
1.0–<2.0 packs per day	+0.5	+1.5
≥2.0 packs per day	+0.7	+2.0
Unknown level of smoking	+0.3b	+1.0

^aSource: Centers for Disease Control and Prevention.¹

^bIn place of the adjustments based on packs per day, a single hemoglobin concentration adjustment of 0.3 g/dL may be used for all smokers.

TREATMENT

Following the diagnosis of iron-deficiency anemia in an infant, child, or adolescent, families should receive information on treatment options. Treating iron-deficiency anemia involves both iron therapy and improving eating behaviors. After iron-deficiency anemia of dietary origin has been treated successfully, recurrence can be prevented with an improved diet.

IRON THERAPY

If low hemoglobin is confirmed, the following treatment is recommended:¹

- Infants and children younger than 5: 3 mg/kg of body weight of elemental iron drops per day
- Children ages 5 to 12: one 60-mg elemental iron tablet per day
- Adolescent males ages 12 to 18: two 60-mg elemental iron tablets per day
- Adolescent females ages 12 to 18: one to two 60-mg elemental iron tablets per day

Iron supplementation is given through the administration of multivitamins—either drops, chewable multivitamin-mineral tablets, or tablets. The AAP recommends liquid iron sulfate drops or multivitamin drops with iron for children ages 12 to 36 months and chewable iron or multivitamin tablets with iron for children ages 3 years and older when iron supplementation is necessary.⁹

Oral iron preparations are absorbed most effectively when taken between meals or at bedtime. If gastrointestinal intolerance (eg, nausea, cramping, diarrhea, constipation) occurs, iron supplements can be taken with meals. Tolerance may also be improved by using a lower dosage, gradually increasing the dosage, or using a different form (eg, ferrous gluconate). Since iron absorption occurs primarily in the duodenum, timed-release iron preparations may be less effectively absorbed. Iron preparations should not be taken within 1 hour of substances that may inhibit iron absorption (eg, dairy products, casein, antacids, calcium supplements, coffee, tea, bran, whole grains). To prevent accidental poisoning, iron supplements should be stored out of the reach of infants and children.

Once treatment for iron-deficiency anemia is begun, screening for anemia should be repeated in 4 weeks.¹ If after the initial 4 weeks of

treatment the anemia is not responsive to treatment, other laboratory tests, such as mean cell volume (MCV), red blood cell distribution width (RDW), and SF, should be obtained. Microcytic anemia is indicated by an MCV volume of less than 77 fL (femtoliters) in children ages 1 to 2, less than 79 fL in children ages 3 to 5, less than 80 fL in children ages 6 to 11, less than 82 fL in adolescents ages 12 to 15, and less than 85 fL in adolescents older than 15. However, a low MCV value alone cannot rule out anemia caused by lead poisoning, infection, chronic disease, or thalassemia.^{1,10} An RDW value greater than 14% indicates iron deficiency; however, this cut-off value is instrument specific, so it may not apply to all equipment.¹ The RDW is often used in conjunction with the MCV laboratory test. A low MCV value and an RDW value greater than 14% is an indicator of iron-deficiency anemia. An SF value of 15 µg/L or less in infants older than 6 months, children, and adolescents indicates depleted iron stores. Ferritin values may be falsely elevated when infection, inflammation, or liver disease is present.^{1,10} Serum transferrin-receptor concentration may be a more reliable indicator of iron stores because it is not influenced by chronic infection, inflammation, or disease.^{1,10} Hemoglobin or hematocrit should be rechecked 6 months after completion of treatment for iron-deficiency anemia.

DIETARY STRATEGIES

Dietary strategies can improve iron status and help prevent recurrence of iron-deficiency anemia. Iron status can be improved through increased consumption of lean meat, fish, and poultry, which contain heme iron, an effectively absorbed form of iron from hemoglobin and myoglobin.⁹ Meat, fish, and poultry also enhance absorption of the less bioavailable plant sources of iron (eg, fortified grains, dried peas and beans, spinach).

Sources of vitamin C (eg, citrus and vitamin C–fortified fruit juices, citrus fruit, strawberries, cantaloupe, green peppers, broccoli, cabbage) taken with meals increase the absorption of non-meat sources of iron by maintaining the iron in its reduced, more soluble form. The use of highly vitamin C–fortified breakfast cereals can also improve iron intake. Liver is not recommended because of its high cholesterol content and

potentially high level of environmental toxins. For those with iron-deficiency anemia, inhibitors of iron absorption, including dairy products, tea, bran, and coffee, should not be consumed in conjunction with iron-rich foods.^{1,11}

ANTICIPATORY GUIDANCE

Primary prevention of iron-deficiency anemia should be achieved through diet. The following general guidelines are based on AAP and CDC recommendations for preventing iron-deficiency anemia in infants, children, and adolescents.¹

INFANCY

- Breastfeed throughout the first year of life, with exclusive breastfeeding for the first 4 to 6 months (without supplementary liquid, formula, or food).^{1,9}
- When exclusive breastfeeding is stopped, provide a supplemental source of iron (approximately 1 mg/kg of body weight/day), preferably from supplementary foods.¹
- Use iron-fortified infant formula for infants who are not breastfed or who are partially breastfed.¹ Infants who are not breastfed should receive iron-fortified infant formula fortified with a maximum of 12 mg/L of elemental iron.⁹
- Encourage use of only breast milk or iron-fortified infant formula for any milk-based part of the diet, and discourage use of low-iron milk (eg, cow's, goat's, soy, rice) for infants.¹
- Provide iron-containing foods (eg, red meats, vegetables containing iron, and iron-fortified infant cereal) when exclusive breastfeeding is stopped.

- Supplement with oral iron (1 mg/kg of body weight/day) exclusively breastfed infants beginning at age 4 months and continued until iron-rich complementary foods have been introduced.⁹
- Supplement with oral iron (1 mg/kg of body weight/day) for partially breastfed infants (who receive more than one-half of their daily feeding from breast milk) beginning at age 4 months and continue until iron-rich complementary foods have been introduced.⁹
- Encourage one feeding per day of foods and beverages rich in vitamin C by age 6 months.
- Introduce pureed fruits, vegetables, and meats after age 6 months or when the infant is developmentally ready to consume such foods.^{1,13}

EARLY CHILDHOOD, MIDDLE CHILDHOOD, AND ADOLESCENCE

- Children ages 1 to 5 should consume no more than 24 oz of cow's, goat's, or soy milk per day.¹
- Include sources of iron-rich foods (eg, fortified breakfast cereals, meat, fish, poultry) and vitamin C-rich foods (eg, citrus and vitamin C-fortified fruit juices, citrus fruit, strawberries, cantaloupe, green peppers, broccoli, cabbage) to enhance iron absorption.
- Limit snacks that are low in nutrients.
- Avoid skipping meals or chronic dieting.
- Limit coffee, tea, and colas.

REFERRAL

Referral to a registered dietitian is helpful in cases of severe or prolonged iron-deficiency anemia. All infants, children, and pregnant or lactating adolescents who are eligible should be referred to WIC. (See Tool J: Nutrition Resources.)

TABLE 3. IRON NEEDS FOR INFANTS, CHILDREN, AND ADOLESCENTS^a

Age	Males, mg/day	Females, mg/day
Birth–6 months	0.27	0.27
7–12 months	11	11
1–3 years	7	7
4–8 years	10	10
9–13 years	8	8
14–18 years	11	15
19–21 years	8	18

^aAll values are recommended daily allowances except for infants from birth to age 6 months, which are based on adequate intake.¹²

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Nutrition and Sports

Whether children and adolescents are involved in competitive sports, strength training, or physical activity for fun and health, eating healthy foods and meeting nutritional needs is important. The healthy eating strategies discussed in this chapter can enhance performance in sports and physical activity while contributing to optimal growth, health, and physical and emotional development, and they are also integral components of weight management.

SIGNIFICANCE

Participating in physical activity during childhood and adolescence promotes fitness and is associated with a lower risk of overweight and obesity in adulthood.¹ There is strong evidence for the positive effect of physical activity during childhood and adolescence on bone health, and participating in physical activity positively affects academic performance, adiposity, blood pressure, cardiovascular health, lipoproteins, and mental health.²

Young athletes are vulnerable to misinformation about nutrition and to claims about unsafe practices that promise enhanced performance. Pressure from coaches and peers to achieve a competitive edge, as well as promotion of dietary supplements by prominent athletes, may encourage young athletes to experiment with such supplements and purported ergogenic aids (eg, protein beverages; weight-gain powders; amino acid, herbal, vitamin, and mineral supplements). Many ergogenic aids offer no benefits, and some are harmful. In a study conducted in 2006–2007, researchers found that up to 25% of dietary supplements bought in retail stores in the United States were contaminated with steroid-like substances, and up to 12% were contaminated with banned stimulants. Samples were obtained from various retail stores throughout the United States, as well as from popular online stores.³ An athlete who consumes some of these contaminants could fail a steroid screen and be suspended from competition.

Inappropriate use of dietary supplements, unsafe weight-control methods, and unhealthy eating practices can adversely affect strength and endurance, jeopardize health, negate the benefits of training, and result in suspension from sports; such use also runs counter to assumptions about fair play in sports. Research continues to support recommendations to improve performance through a combination of safe training and healthy eating practices, not through ingesting dietary supplements and ergogenic aids.

NUTRITIONAL ADEQUACY

Children and adolescents who compete in sports can achieve an adequate, balanced intake of nutrients by following the *Dietary Guidelines for Americans*.⁴ The nutrient needs of young athletes are similar to those of non-competing children and adolescents, except that young athletes need to consume more energy (ie, calories), more water and, in some cases, more protein.

ENERGY

Physical activity increases the body's need for energy. The amount of additional energy the body requires depends on the type, frequency, intensity, and duration of the activity. Young athletes may need 500 to 1,000 additional calories per day; growth, weight, weight change with increases in training, symptoms of fatigue, athletic performance, and appetite help indicate whether energy intake is sufficient. The Dietary Reference Intake (DRI) for energy and the estimated energy requirements (EERs) are based on age, sex, weight, height, energy expenditure, requirements for growth, and physical activity level.⁵ Table 1 presents examples of EERs based on age, reference weights and heights, and physical activity levels. Estimated energy requirements

for children and adolescents whose weights or heights are higher or lower than the reference weights and heights should be adjusted accordingly.

CARBOHYDRATES

To perform optimally, children and adolescents who compete in sports need to consume a diet high in carbohydrates: grains, whole-wheat bread and cereal, pasta, potatoes, fruits, vegetables, and low-fat dairy products. Moderate amounts of sugar may also help to meet carbohydrate needs.⁷ Inadequate carbohydrate intake may be associated with fatigue, weight loss or inability to gain weight, and decreased performance. For athletes who train intensively, for example those competing at the national or international levels, the recommended carbohydrate intake is 60% to 70% of total calories consumed; for athletes who train more moderately, 55% to 65% is probably preferable. Table 2 provides daily ranges for carbohydrate consumption based on weight and activity level.⁸ The amount of carbohydrates required depends on the athlete's sex, weight, energy expenditure, level of physical activity, and type of sport performed, as well as on environmental factors.⁹

TABLE 1. EXAMPLES OF ESTIMATED ENERGY REQUIREMENTS FOR MALE AND FEMALE CHILDREN AND ADOLESCENTS AGES 8 TO 18^a

Age		Reference Weight, kg (lbs)	Reference Height, m (in)	Low Active PAL ^b	Active PAL ^b	Very Active PAL ^b
8	Male	25.6 (56.4)	1.28 (50.4)	1,692	1,931	2,225
	Female	25.6 (56.4)	1.28 (50.4)	1,593	1,810	2,173
10	Male	31.9 (70.3)	1.39 (54.7)	1,875	2,149	2,486
	Female	32.9 (72.5)	1.38 (54.3)	1,729	1,972	2,376
12	Male	40.5 (89.2)	1.49 (58.7)	2,113	2,428	2,817
	Female	41.6 (91.6)	1.51 (59.4)	1,909	2,183	2,640
14	Male	51.0 (112.3)	1.64 (64.6)	2,459	2,829	3,283
	Female	49.4 (108.8)	1.60 (63.0)	2,036	2,334	2,831
16	Male	60.9 (134.1)	1.74 (68.5)	2,736	3,152	3,663
	Female	53.9 (118.7)	1.63 (64.2)	2,059	2,368	2,883
18	Male	67.2 (148.0)	1.76 (69.3)	2,823	3,263	3,804
	Female	56.2 (123.8)	1.63 (64.2)	2,024	2,336	2,858

^aAdapted with permission from: National Academies Press.⁵

^bPAL indicates physical activity level; low active PAL, less than 1 hour/day of physical activity; active PAL, about 1 hour/day of physical activity; very active PAL, more than 1 hour/day of physical activity.⁶

TABLE 2. DAILY RANGES FOR CARBOHYDRATE CONSUMPTION BASED ON PHYSICAL ACTIVITY LEVEL^a

Intensity of Activity	Carbohydrate (g/kg/day)
None or light training	3–5 g/kg/day
Moderate or heavy training	5–8 g/kg/day
Pre-event (24–48 hours)	8–9 g/kg/day
Post-event (within 2–3 hours)	1.5 g/kg within the first hour; then 1.5 g/kg within the next 2–3 hours

^aSource: American Dietetic Association.⁹

PROTEIN

The protein requirements of most young athletes can be met by consuming approximately 1 g protein per kilogram of body weight per day. Athletes participating in intense endurance sports or strength training may require 1.5 to 2 g protein per kilogram of body weight per day;⁹ however, most children and adolescents in the United States consume 1.5 to 3 times their DRIs for protein,^{5,9} so it is likely that protein needs can be met by eating a variety of nutritious foods without adding protein supplements. However, protein intake should be monitored for young athletes who are restricting food intake.

Higher consumption of proteins and the use of protein or amino acid supplements (misleadingly promoted as “safe” alternatives to steroids) are not beneficial and also increase urinary excretion of calcium. Protein intake beyond the amount needed also leads to extra energy intake and fat storage. Athletes who eat increased amounts of protein or take amino acid supplements may view these as substitutes for other foods and thus neglect important nutrients.

VITAMINS AND MINERALS

A balanced variety of foods that meet the body’s energy needs also meet the requirement for sufficient vitamins and minerals. Nutrients reported most often in less than adequate amounts for children and adolescents include iron; calcium; and vitamins A, C, E, and B6.^{10,11}

Iron is particularly important for young athletes because there are increased needs for growth, expansion of red blood cell volume, and addition of lean body mass. Menstruating females may be particularly susceptible to iron-deficiency anemia, which can lead to poor stamina, poor performance, and decreased ability to learn.

Prevention should focus on regular consumption of adequate sources of iron that are acceptable to the child or adolescent. The best sources of iron are meat, fortified grains, and dried beans. The DRI for iron for males ages 14 to 18 is 11 mg/day and for females ages 14 to 18 is 15 mg/day.¹²

Adolescents’ intake of calcium and vitamins A, C, and B6 may be inadequate because adolescents often avoid fruits, vegetables, and dairy products. Calcium is especially critical for adolescents because the DRI for calcium increases to 1,300 mg/day for children and adolescents ages 9 and older, up from 800 mg/day for children ages 4 to 8.¹³ If young athletes do not consume sufficient quantities of dairy products, (ie, 4 servings per day), they should take a calcium supplement, such as calcium carbonate.⁸ Inadequate calcium consumption may place female athletes at risk for stress fractures and osteoporosis.¹⁰

PREGAME AND POSTGAME MEALS

Consuming a light meal high in complex carbohydrates (eg, rice, pasta, bread) and ample caffeine-free beverages (eg, fruit juice, water) is recommended 3 to 4 hours before an event to prevent hunger, provide energy, ensure gastric emptying, and prevent respiratory and cardiac stress. During physical activities involving several events, energy can be obtained by consuming sports drinks or unsweetened fruit juice diluted to one-half strength with water up to 1 hour before physical activity. If events are 1 to 3 hours apart, carbohydrate snacks (eg, cereal bars, sports bars, crackers, fruit, whole-wheat bread, bagels) or liquid meals are recommended. After physical activity, it is important to replace muscle and liver glycogen stores by consuming carbohydrates within 2 hours. Drinking beverages containing carbohydrates should be encouraged if foods are

not well tolerated or not available within 2 hours after physical activity. See Table 3 for suggested meal and snack timing for athletes.

FLUIDS AND ELECTROLYTES

Adequate fluid intake and prevention of dehydration are critical for effective energy metabolism, performance, and body cooling. The risk of dehydration becomes greater with increased heat, humidity, intensity or duration of physical activity, body surface area, and sweating. Children are at greater risk for dehydration and heat-related illness than adolescents or adults because children generate more heat relative to their body weight, sweat less, take longer to acclimatize, and absorb more heat from the environment owing to the higher ratio of their skin surface area relative to their body weight compared with adults.¹⁴

Inadequate fluid intake can result in dehydration and heat-related illness. To ensure adequate hydration in children and adolescents, note the following key principles¹⁴:

- Adequate fluid intake can prevent dehydration and serious problems, but thirst is not an adequate indication of the body's need for fluids.
- Drinking 16 oz of water 1 to 2 hours before the event is recommended followed by 12 oz of water 15 minutes before the event and 4 to 8 oz of water every 15 to 20 minutes during the event.
- During hot or humid weather, for strenuous physical activity or events lasting more than 60 minutes, muscle glycogen can be conserved and fatigue reduced by consuming drinks containing 4% to 8% carbohydrates (10–18 g carbohydrates per 8 oz). Examples include (1) unsweetened fruit juice diluted with an equal amount of water and (2) sports drinks. Newer formulated sports drinks provide a lower carbohydrate content of 2% to 3%. These drinks are adequate for hydration but do not provide extra carbohydrates for energy.
- Cool drinks, including water (40°F–50°F), are absorbed most quickly.
- Water can be more palatable for some children and adolescents if flavoring (eg, lemon slices) is added.
- After physical activity, drinking 16 oz of fluid per pound of weight lost will restore water balance and allow optimal performance in subsequent physical activity sessions.
- Undiluted fruit juice, carbonated or caffeine-containing beverages (including soft drinks), and fruit punches should not be consumed immediately before or during physical activity because they may cause cramping or diarrhea.
- During hot weather, closely monitor children and adolescents who use exercise equipment (eg, helmets, padding). These kinds of equipment can lead to greater heat generation and prevent sweat from evaporating, thus increasing body temperature.

TABLE 3. SUGGESTED MEAL AND SNACK TIMING FOR ATHLETES

Meal/Snack	Timing	Examples
Snack (15–20 g carbohydrates, <5% fat)	½–1 hour before event	Pretzels and fluids (eg, sports drink, water, lemonade)
Light meal (30–40 g carbohydrates, 5%–15% fat)	2–4 hours before event	Turkey sandwich, pretzels, fruit, fluids (eg, sports drink, water, lemonade). Limit fiber to avoid bloating.
Heavy meal (50–60 g carbohydrates, 15%–25% fat)	4–5 hours before event (may need a snack later)	Baked chicken, potatoes, fruit, and bread, or peanut butter sandwich, baked chips, and fruit plus fluids (eg, sports drink, water, lemonade). Limit fiber.

The American College of Sports Medicine provides recommendations for prevention and intervention of heat illness. This statement is based on nonrandomized trials and observational studies and panel consensus judgment.¹⁴ Table 4 presents a summary of the recommendations from this consensus statement.

Heat-related illness can be critical and sometimes life-threatening. It is important for health professionals, coaches, parents, and adolescents to be able to recognize the signs and symptoms of heat illness and the recommendations for treating heat-related events. Table 5 reviews the 3 types of heat-related illness.

TABLE 4. HYDRATION RECOMMENDATIONS FOR THE PREVENTION AND INTERVENTION OF HEAT ILLNESS^a

Time	Rehydration Amounts
1–2 hours before physical activity	12–22 oz cool water (50°F–60°F) but always lower than the ambient temperature
10–15 minutes before physical activity	10–20 oz cool water (50°F–60°F)
During physical activity	4–6 oz cool water every 15–20 minutes
After physical activity	2–3 cups (16–24 oz) cool fluids (50°F–60°F) for every pound of weight lost

^aSource: American College of Sports Medicine.¹⁴

TABLE 5. HEAT-RELATED ILLNESS: SIGNS, SYMPTOMS, AND TREATMENT^a

Illness	Signs and Symptoms	Treatment
Heat cramps	Disabling muscular cramps Thirst Chills Rapid heart rate Normal body temperature Alertness Normal blood pressure Nausea	Give child or adolescent 4–8 oz of cold water every 10–15 minutes. Make sure child or adolescent avoids beverages that contain caffeine. Move child or adolescent to a cool place. Remove as much clothing and equipment as possible. Provide passive stretching. Apply ice massage to cramping muscles.
Heat exhaustion	Sweating Dizziness Headache Confusion Lightheadedness Clammy skin Flushed face Shallow breathing Nausea Body temperature of 100.4°F–104°F	Give child or adolescent 16 oz of cold water for each pound of weight lost. Move child or adolescent to a cool place. Remove as much clothing and equipment as possible. Cool child or adolescent (eg, with ice packs, ice bags, immersion in ice water).
Heat stroke	Shock Collapse Body temperature >104°F Delirium Hallucinations Loss of consciousness Seizures Inability to walk	Call for emergency medical treatment. Cool child or adolescent (eg, with ice packs, ice bags, immersion in ice water). Give intravenous fluids.

^aSource: Maughan.¹⁵

SPECIAL CONSIDERATIONS

ANEMIA

Strenuous physical activity or intensive training may be associated with iron-deficiency anemia. Contributing factors include decreased iron absorption, marginal iron intake, hemodilution (leading to a pseudoanemia but with no reduction in oxygen-delivering capacity), increased destruction of erythrocytes in circulation, and foot strike hemolysis.⁷ Iron-deficiency anemia is not a contraindication to continued training; however, the etiology of the anemia should be evaluated, treatment initiated, and a follow-up plan developed by a health professional before clearing the athlete without restriction for sports. (See the Iron-Deficiency Anemia chapter.)

Young female distance runners are most at risk for iron-deficiency anemia, but there are no recommendations for routine screening for iron status. However, for young female athletes whose body weight is low normal to below normal or those at risk for iron-deficiency anemia because of inadequate intake, an empiric trial of iron supplementation (eg, 325 mg ferrous sulfate in the form of 1 to 2 tablets per day with orange juice or another source of vitamin C) is reasonable as an attempt to prevent reduced iron stores. Otherwise, a biochemical assessment of iron status can be considered.

WEIGHT STATUS

Losing excess body fat is a long-term process involving healthy food choices as well as physical activity. For young athletes, this process should be initiated several months before the start of the athletic season. Severe energy restriction and weight loss of more than 2 pounds per week can result in the loss of muscle mass and compromised growth and development. Weight maintenance and increased physical activity, rather than weight loss, are appropriate goals for athletes who are still growing. Loss of body fat can be facilitated through physical activity (eg, power walking, cycling) at 60% to 80% of maximum aerobic capacity for 60 minutes 5 to 6 times per week.

Rapid weight-loss (eg, severe food restriction, dehydration, purging, excessive exercise) and weight-management techniques practiced

by some athletes (eg, wrestlers, dancers, gymnast) can be dangerous. In addition to decreased muscle strength and endurance, side effects may include hypoglycemia, depletion of electrolytes and glycogen stores, and nutrient deficiencies. Chronic energy restriction combined with medical complications may suggest the presence of eating disorders, which, if persistent, can compromise growth and development. Sufficient time should be allotted for gradual and appropriate weight loss. For athletes who need to lose weight, losing 1 to 2 pounds per week is recommended.

Adolescents who wish to increase muscle mass should be advised to combine strength training with a balanced intake of healthy foods providing an additional 500 to 1,000 calories per day. This should result in a weight gain of 1 to 2 pounds per week. Foods chosen should be low in fat, cholesterol, and sugar and high in complex carbohydrates.

STRENGTH TRAINING

Properly prescribed and supervised strength training as part of a total fitness program can improve body composition, increase muscular strength and endurance, and improve overall fitness and performance in sports and recreational activities. Strength training can increase muscle size in adolescents. Prepubertal children who strength train increase strength via increased recruitment of muscle fibers by peripheral nerves, and not by increased muscle bulk. Strength training in children and adolescents is safe, but to prevent injury of the long bones and back, children should not lift maximum or near-maximum weights. Weights that can be lifted for 6 repetitions or more are appropriate.¹⁶

EATING DISORDERS

Restricted food intake, binge-eating, purging, and unhealthy weight-loss practices can occur among young athletes in all sports, but they are more common in weight-related activities (eg, wrestling, running) and in “appearance” sports (eg, gymnastics, ballet, figure skating). Eating disorders may be associated with electrolyte imbalances, nutrient deficiencies, amenorrhea, and impaired growth and development. These medical complications may be life-threatening in extreme cases. (See the Eating Disorders chapter.)

An issue of major concern in female athletes is the interrelationship between eating disorders, amenorrhea, and osteoporosis, which has been labeled the “female athlete triad.” Some female athletes develop eating behaviors that can lead to weight loss, amenorrhea, and negative consequences for bone health (ie, premature bone loss, decreased bone density, increased risk of stress fractures). It is important to identify and treat this condition early, because bone loss resulting from malnutrition may be irreversible despite weight gain, estrogen replacement, calcium supplementation, and resumption of menstrual periods.

SUPPLEMENTS

The American Academy of Pediatrics strongly discourages the use of performance-enhancing substances for athletic or other purposes.¹⁷ Other organizations, including the National Federation of State High School Associations and the National Collegiate Athletic Association, have put forth similar recommendations. Additionally, several states have banned the sale or distribution of performance-enhancing substances to children and adolescents, and other states have proposed such a ban.

Performance-enhancing substances may pose a significant health risk to children and adolescents. Unfortunately, a great deal of misinformation exists about supplements and their contribution to athletic performance. Parents, coaches, and school and sports organizations need to stress the importance of eating nutritious foods and of seeking accurate information from appropriate professionals (eg, sport medicine physicians, sports nutrition dietitians) so that young athletes and their parents can make informed choices.

One popular supplement, creatine, may promote increased muscle mass when combined with strength training and may result in improved short-duration, high-intensity physical activity. However, it has not been established that creatine consumption translates into improved performance beyond that associated with training alone, without creatine consumption. Side effects of creatine include nausea and muscle cramps. Creatine is sometimes contaminated with

stimulants and steroid-like substances. There is insufficient information on the long-term risks of using creatine, and it is not recommended for young athletes.

SCREENING AND ASSESSMENT

The nutritional adequacy of typical eating practices as well as specialized training diets can be evaluated using the *Dietary Guidelines for Americans*.⁴ To screen and assess children and adolescents for adequate nutrition, it is important to determine the following:

- Intake of calcium and iron (from foods)
- Pregame and postgame eating practices
- Fluid intake before, during, and after competition
- Use of all dietary supplements, including vitamin and mineral supplements
- Weight-control practices, including restrictive eating and binge-eating/purging activity
- Use of purported ergogenic aids (eg, caffeine, steroids, amphetamines, creatine, chromium picolinate)
- Height, weight, and body mass index (which should be measured annually and evaluated in relation to age and gender growth curves)
- Menstrual history
- Type, frequency, intensity, and duration of physical activity to help determine energy needs
- For wrestlers, desired weight classification for competition and training activities (urine-specific gravity measurements may be indicated if dehydration before weight certification is suspected)

ANTICIPATORY GUIDANCE

Children, adolescents, parents, and coaches should receive information about sound nutrition practices for participants in sports and recreational physical activities. Questions about nutrition and physical activity can be best answered by a registered dietitian with expertise in sports nutrition. The following general guidance may be helpful for health professionals when sharing information on nutrition and physical activity with children, adolescents, and their parents and coaches.

CHILDREN AND ADOLESCENTS

- Discuss the risks of dehydration and the recommendations for fluid intake and fluid replacement needs after physical activity. For players involved in practices that are associated with increased risk of heat injury (eg, daily summer football practices), explain that it may be helpful to weigh players daily to monitor otherwise underappreciated fluid losses (2%–3% fluid losses), which are cumulative over a series of days.
- Advise children and adolescents to consume complex carbohydrates at each meal (eg, rice, pasta, bread, bagels, corn, potatoes, sweet potatoes, tortillas, cereal).⁴
- Tell children and adolescents to maintain a diet in which fat intake is no less than 25% and no more than 35% of total energy.
- Caution against high protein intake (ie, >2 g protein per kilogram of body weight per day) and against the use of protein or amino acid supplements.
- Discuss the dangers of using steroids and amphetamines (including the risk of contaminants, since these ergogenic aids are not regulated by the Food and Drug Administration) and the ineffectiveness of other ergogenic aids and dietary supplements.

- Caution against rapid weight-loss techniques, and explain their adverse effects on health and performance.
- Discuss pregame and postgame meals and recommended snacks, fast foods, and convenience store foods when traveling (eg, low-fat yogurt; reduced-fat [2%], low-fat [1%], or fat-free [skim] milk; yogurt cones and shakes; bananas; string cheese; grilled chicken; submarine sandwiches; light tacos and burritos; thick-crust cheese or vegetable pizza; muffins; bagels; trail mix).
- Demonstrate how to monitor pulse rate and, for those trying to lose fat mass, encourage aerobic physical activity at 60% to 80% of maximum heart rate while training.

PARENTS AND COACHES

- Enlist parental and coaching support in making healthy foods available. One place to start is the parents who prepare team pregame and postgame meals and snacks. Encourage parents to purchase or prepare healthy meals and snacks (Table 6).
- Advise parents to discourage unhealthy weight-loss practices or supplement use.

TABLE 6. SUGGESTIONS FOR HEALTHY MEALS AND SNACKS

Breakfast		Recommendations
Bran muffin Low-fat milk Fresh fruit	English muffin 1 egg Orange juice Low-fat yogurt	For a meal high in carbohydrates, select foods such as pancakes, waffles, French toast, bagels, muffins, and juice. When traveling, pack juice, dried fruit, fresh fruit, and bagels. Avoid foods high in fat (eg, bacon, sausage).
Lunch		
Turkey sandwich Low-fat yogurt Baked chips	Baked chicken Baked potato Fresh or canned fruit	Avoid high-fat meats and fried foods (eg, fish, chicken, or french fries).
Dinner		
Spaghetti with marinara sauce and parmesan cheese Bread sticks Fruit juice	Thick-crust cheese or vegetarian pizza Salad Fruit juice	When traveling, select foods such as pasta, baked potatoes, rice, breads, and salads. Order thick-crust pizza with vegetable toppings (eg, green peppers, tomatoes, mushrooms) instead of meat (eg, sausage, pepperoni).
Snacks (depends on timing of event)		
Pretzels Juice or sports drinks	Fruit Bagel or English muffin with jam	Avoid foods high in fat and high in protein. Avoid food products with simple carbohydrates (eg, candy, soft drinks).

REFERRAL

Referral to a registered dietitian is recommended for young athletes, coaches, or parents who have questions about healthy eating, supplements, or preventing heat illness. A referral is also recommended for young athletes who have any of the following conditions: eating disorders, unhealthy eating practices, strict vegetarian eating practices, obesity, underweight, or iron-deficiency anemia. (See Tool J: Nutrition Resources.)

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The Importance of Drinking Sufficient Fluids in Hot Weather

The physician explains that young children are at higher risk than adolescents or adults for dehydration and heat stroke because their bodies generate more heat and are less effective at getting rid of it compared with adults.

Roberto Garza is a 10-year-old boy who plays baseball in a community league coached by parents. He lives in an area where the summer weather is hot and humid, and practice is scheduled in the afternoon, when the temperature is quite hot. Roberto often complains of being thirsty during practice, and his father is concerned because the coaches don't schedule water breaks.

During a routine sports physical, Mr Garza discusses his concerns with Roberto's physician, Dr Rahman. The physician explains that children are at higher risk than adolescents or adults for dehydration and heat stroke because their bodies generate more heat. "Children need to drink additional fluids in hot weather to prevent dehydration and other serious problems," advises Dr Rahman. "Thirst is not an adequate indication of the body's need for fluids because physical activity

can sometimes mask children's sense of thirst, making them even more vulnerable to dehydration."



Dr Rahman gives Mr Garza a pamphlet that discusses the importance of replacing fluids during physical activity and asks him to share the information with Roberto's coaches.



Dr Rahman gives Mr Garza a pamphlet that discusses the importance of replacing fluids during physical activity and asks him to share the information with Roberto's coaches. The pamphlet states that children should drink 4 to 8 oz of water or other fluids every 15 to 20 minutes during physical activity, and they should be allowed water breaks as needed.

The pamphlet also advises parents and coaches to monitor each child's weight before and after physical activity. Any weight that is lost during physical activity is probably due to loss of body water and should be replaced after activities by drinking fluids at the rate of 16 oz of water for each pound lost.

Mr Garza shares the pamphlet with the coaches; as a result, the children are allowed both scheduled and unscheduled water breaks. In addition, the team manager has started to monitor the baseball players' fluid intake to be sure they are drinking enough.



Obesity

BACKGROUND

Based on measured heights and weights from nationally representative samples of children and adolescents assessed during the National Health and Nutrition Examination Surveys (NHANES) (1976–1980 and 2003–2008), obesity prevalence has risen in children aged 2 to 5 years, from 5.0% to 10.4%; in children aged 6 to 11 years, from 6.5% to 19.6%; and in adolescents aged 12 to 19 years, from 5.0% to 18.1%.¹ The obesity epidemic has disproportionately affected some racial-ethnic and economic groups.² In 2007–2008, the prevalence was particularly high among 2- to 19-year-old African-American females (22.7%) and among 2- to 19-year-old Hispanic males, including Mexican-American males (24.4%).¹ Prevalence has also increased among Native American and Asian-American children and adolescents. Poverty has been associated with higher obesity prevalence among adolescents; however, subgroups have differed. Health professionals are faced with addressing this problem in a steadily increasing number of children and adolescents.

The consequences of this epidemic are not simply cosmetic. A child or adolescent who is obese often remains obese into adulthood, with higher degrees of excess weight associated with increasing risk of persistence.³ Obesity is associated with many chronic health conditions, including diabetes mellitus, hypertension, dyslipidemia, nonalcoholic steatohepatitis, and cardiovascular disease.⁴ With increasing number of obese children and adolescents, these chronic conditions, previously identified only in adults, are present in adolescents and even among younger children. These health issues among children and adolescents lead to increased health care costs, and the future costs of these chronic conditions will be heavy indeed. The overweight and obese child or adolescent experiences stigmatization and poor quality of life.⁵

DEFINITIONS AND TERMINOLOGY

Body mass index (BMI), a measure of body weight adjusted for height, is a useful tool to assess body fat. Although BMI does not directly measure body fat, it can be used as a screening tool because it correlates with body fat and health risks and is clinically feasible. Body mass index is defined as weight (kilograms) divided by the square of height (meters): $\text{wt (kg)}/\text{ht (m)}^2$. In children and adolescents, the distribution of BMI changes with age, just as weight and height distributions change. As a result, while absolute BMI is appropriate to categorize body weight in adults, percentiles specific for age and gender from reference populations define underweight, healthy weight, overweight, and obesity in children and adolescents.⁶

Standard reference curves are derived from data collected before obesity prevalence began to rise. Using these reference curves, a BMI at the 95th percentile or greater defines obesity.⁶ Almost all children and adolescents with BMI in this range are likely to have excess body fat and associated health risks. A BMI at the 85th percentile to 94th percentile defines overweight.⁶ Children and adolescents with BMI in this range often have excess body fat and health risks, although for some the BMI category will reflect high lean body mass rather than fat. These definitions are most useful to define adiposity risk for populations, but for individual children and adolescents, health professionals need to review growth pattern, family risks, and medical conditions to assess risk and determine how to approach the child or adolescent and family. The use of 2 cutpoints, and 85th percentile and the 95th percentile BMI, captures varying risk levels and minimizes both over- and underdiagnosis.

Several other definitions are important. *Under 2 years:* The Centers for Disease Control and Prevention (CDC) growth charts provide weight-for-length norms rather than BMI norms in this age group. Weight for length greater than the 95th percentile defines overweight with no specific cutpoint for obesity. *Late adolescence:* The adult cutpoint for overweight (BMI = 25 kg/m²) can be used to define overweight in late adolescence even when the 85th percentile is defined by a higher absolute BMI. For example, a female adolescent of 17 years, 4 months with a BMI of 25.2 is at the 84th percentile. Even though her BMI is slightly below the 85th percentile, the BMI is in the overweight category because it is above the adult cutpoint for overweight of 25 kg/m². Similarly, the adult definition of obesity (BMI ≥30 kg/m²) can be used in late adolescence when this value is lower than the 95th percentile.

Severe obesity is also increasing in prevalence among children and adolescents, and they are at high risk for multiple cardiovascular disease risk factors and greater health risk.^{7,8} There is not consensus on a definition of severe obesity. The expert committee suggested use of 99th percentile based on cutpoints defined by Freedman and colleagues⁷ from NHANES data, but the sample of children and adolescents with BMI at this level was small, and so more valid cutpoints may

soon supersede this information. However, children and adolescents with BMI at or above this level have higher health risk and therefore intervention is more urgent. Health professionals should ensure that best efforts are made to provide treatment to children and adolescents whose BMI for age and gender is above the 97th percentile, which is the highest curve available on the growth charts.

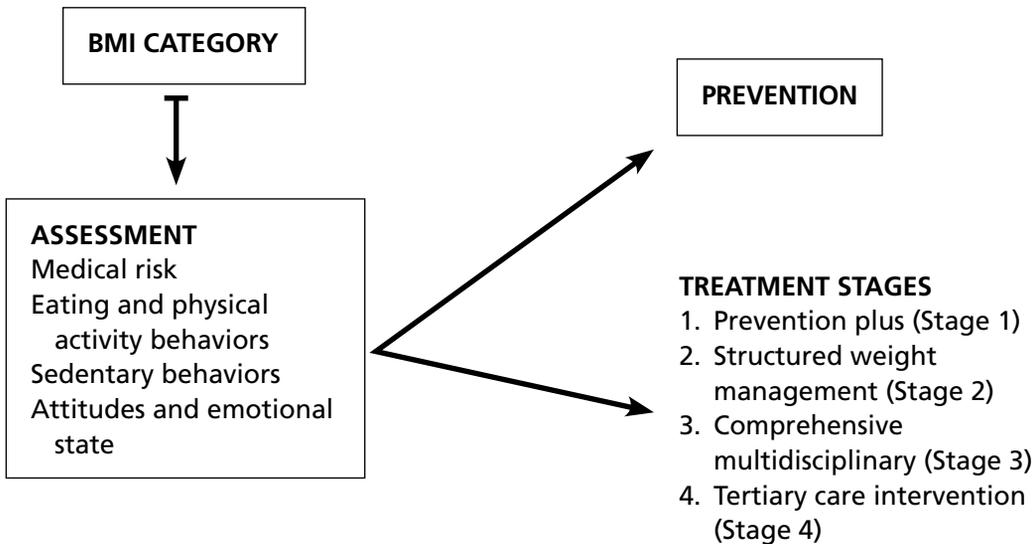
SCREENING AND ASSESSMENT

UNIVERSAL ASSESSMENT OF OBESITY RISK^{6,9}

Screening for obesity risk, an ongoing process, starts with BMI evaluation (or weight for length if child is <2 years of age), and then incorporates evaluation of medical conditions and risks, current behaviors, and family attitudes and psychosocial situation. Based on this information, health professionals can provide obesity prevention (teaching or reinforcing behaviors that will promote sustained healthy weight, such as increasing fruit and vegetable intake and physical activity, decreasing television viewing, and decreasing sugar-sweetened beverages and high-calorie foods) or obesity treatment (guidance to improve weight) (Figure 1). In general, children and adolescents with BMI for age and gender below the 85th percentile will benefit from prevention anticipatory guidance, which will guide them toward healthier behaviors or reinforce current healthy behaviors. This guidance should be framed as growing healthy bodies rather than achieving a specific weight. Children and adolescents whose BMI is in the overweight category require special attention. Some children and adolescents may have healthy body weight but others may have excess fat and health risk and will benefit from attention to weight control. A “wait-and-see” approach may result in a missed opportunity to prevent progression. Most children and adolescents whose BMI is in the obese category will benefit from intervention to control weight.

1. *BMI calculation and plotting on the appropriate growth curve at least once a year to identify current category.* Underweight (<5th percentile), healthy weight (5th–84th percentile), overweight (85th–94th percentile), obese (≥95th). Calculators, wheels, tables, and nomograms are

FIGURE 1. UNIVERSAL ASSESSMENT OF OBESITY RISK



some of the tools used to calculate BMI, which then is plotted on a growth chart, available online from the CDC.

2. *Medical assessment.* Includes family history in first- and second-degree relatives (siblings, parents, aunts, uncles, and grandparents) of diabetes mellitus and cardiovascular disease risk factors like hypertension and dyslipidemia. In addition, a medical professional should perform a medical history and physical examination for current obesity-related conditions. In the case of severe obesity, a medical professional can evaluate for rare cases of underlying syndromes. Depending on BMI category, age, and family history, laboratory evaluation may be needed for several obesity-related conditions that often have no signs or symptoms, including dyslipidemia, diabetes, and nonalcoholic fatty liver disease.
3. *Dietary, physical activity, and sedentary behavior assessment.* A brief assessment of foods and beverages typically consumed and the pattern of consumption can uncover modifiable behaviors associated with excess caloric intake. Sugar-sweetened beverages, fruit and vegetable servings, and meals prepared outside the home are often important areas to address initially. A dietitian can do a thorough evaluation when detail is needed or when initial obvious excesses have been addressed. Assessment of age-appropriate vigorous activity, both

structured and unstructured, and routine activity, like walking to school or doing chores, can determine approximate amount of time spent being physically active, again with the goal of identifying opportunities for increased activity. Number of hours of television watching is associated with increased risk of obesity, and reduction in these hours improves weight control. Therefore, asking about hours of television viewing and other “screen time” (eg, computers, video games) will uncover a very important opportunity to modify behavior for improved energy balance.

4. *Attitude and emotional state.* Families may not recognize excess weight or the risk of obesity development. Or they may be unwilling or unable to make behavior changes to improve eating and physical activity. Prior to providing anticipatory guidance about new behaviors, health professionals should assess attitude and capacity for change.

PREVENTION

The target of obesity prevention should begin at birth or before.¹⁰ Lifestyle behaviors to prevent obesity, rather than intervention to improve weight status, should be the aim of anticipatory guidance for children and adolescents with healthy BMI for age and gender (5th–84th percentile), and some children and adolescents with

BMI in the overweight category (85th–94th percentile), depending on their growth pattern and risk factors. Health professionals should be aware of the increased risk of obesity in children and adolescents with parents who are obese and those whose mothers had diabetes mellitus during the child's gestation.

Although defining the contribution of a specific behavior over time to obesity prevention is difficult, the following specific eating and activity behaviors have some scientific support for promotion of energy and nutritional balance:

- Limited sugar-sweetened beverages.
- Recommended quantities of fruits and vegetables.
- Limited television and other screen time to not more than 2 hours per day, with no television viewing before age 2 years. Televisions and other screens should not be in the child's or adolescent's primary sleeping room.
- Breakfast daily.
- Limited eating at restaurants, particularly fast-food restaurants.
- Meals together as a family as much as possible.
- Appropriate portion size, which may differ from the serving size on the food label.
- A diet with foods high in calcium.
- A diet with foods high in fiber, including whole grains.
- A diet with foods balanced in macronutrients (calories from fat, carbohydrate, and protein in proportions for age recommended by the Dietary Reference Intakes).
- Exclusive breastfeeding to age 6 months and maintain breastfeeding after introduction of solids to age 12 months and beyond.
- Moderate to vigorous age-appropriate physical activity for at least 60 minutes each day.
- Limited consumption of high-calorie, especially low-nutrient, foods.

The complexity of obesity prevention lies less in the identification of target health behaviors and much more in the process of influencing families to change behaviors when habits, culture, and environment promote less physical activity and more energy intake. Health professionals can adopt specific techniques of interaction with families and create office systems that support ongoing commitment to obesity prevention. Although limited research is available for use in clinical

practice, the approaches described below may be useful guides for counseling overweight and obese children, adolescents, and their families.

Language. Health professionals should convey support and empathy. When they identify a problem, they should choose words carefully, avoiding “fatness” and “obesity,” which many perceive as derogatory, and using neutral terms, such as “weight,” “excess weight,” and “BMI.”

Cultural and economic awareness. Cultural differences in perceptions of what constitutes an attractive or healthy weight, the importance of physical activity, desirable foods, and other attitudes may influence a family's motivation to address weight. Community environments, such as lack of safe recreation areas, may be barriers to change. Health professionals should become knowledgeable about the values or circumstances that may be common in the population they serve, especially if that population differs from their own. In addition, a health professional's knowledge of a family's personal values and circumstances may be most helpful in tailoring recommendations.

Effective parenting. Because parents and other caregivers help the child or adolescent develop healthy habits, health professionals can teach and motivate parents to use their authority and to be good role models. In young children, health professionals will focus the discussion on parenting behavior. In adolescents, health professionals should discuss health behaviors directly with them but also encourage parents to make the home environment as healthy as possible.

Stages of change (readiness to change). Before a person is ready to change a behavior, he or she needs to be aware of a problem, then plan to address it, and finally actually begin the new behavior. A health professional can help children, adolescents, and their families move along these stages rather than prescribe a new behavior to those who are not ready. (See Tool F: Stages of Change—A Model for Nutrition Counseling.)

Motivational interviewing. This technique uses nonjudgmental questions and reflective listening to uncover a child's, adolescent's, or parent's beliefs and values. The health professional can evoke motivation rather than try to impose it and then help them formulate a plan that is consistent with their own values. This approach avoids the

defensiveness created by a more directive style. Although not statistically significant, a pilot study demonstrated feasibility and a tendency toward reduced BMI change with this technique.¹¹

Cognitive behavioral techniques. Health professionals can encourage goal setting, monitoring behaviors targeted for change, and use of positive reinforcement. Initial goals should be easily achievable, like engaging in 15 minutes of physical activity or having only one serving (generally ≤ 8 ounces) of a sugar-sweetened beverage each day. Parents should reinforce behavior goals rather than weight change, and reinforcement should be verbal praise or an extra privilege, but not food. Health professionals and parents should expect imperfect adherence and should focus on successes, not failures.

THE ROLE OF HEALTH PROFESSIONALS

The health professional's office system can enhance efforts to address obesity prevention consistently through the following practices:

- Routine documentation of BMI for age and gender. This practice will improve timely recognition of early mild obesity that may be more amenable to intervention.
- Establishment of procedures to deliver obesity prevention messages to all children and adolescents. When the child's or adolescent's individual risk of obesity is low, these messages can promote appropriate general health or wellness rather than weight control. Simple, memorable guidelines, presented early and repeated regularly and supported with posters and handouts, can be delivered efficiently in the office and are likely to be effective teaching tools.
- Establishment of procedures to address children and adolescents who are overweight (85th–94th percentile BMI) and obese (≥ 95 th percentile BMI). For instance, when a child or adolescent is overweight, a health professional may plan to review family history, child's or adolescent's blood pressure and cholesterol, and BMI percentile over time, then assess health risk based on that information. Offices should flag charts of overweight and obese children and adolescents so that

all health professionals at all visits are aware and can monitor growth, risk factors, and social-emotional issues.

- Involvement and training of interdisciplinary teams, including nurses, physicians, and administrative staff, in their respective responsibilities and skills.
- Chart audits to establish baseline practices, help set goals for practice improvement, and then measure the improvement over time.

TREATMENT

The primary goal of obesity treatment is improvement of long-term physical and psychosocial health through permanent healthy lifestyle habits and changes to the environment where the child or adolescent lives.¹² For some children and adolescents, implementation of these habits alone will lead to improved weight (weight loss or weight maintenance during linear growth), but other children and adolescents may need additional focused efforts to achieve negative energy balance. Others may need additional help with behavior modification strategies to develop and sustain healthy habits. Emotional health (good self-esteem and an appropriate attitude toward food and body) is also an important outcome. To achieve these goals, it has been recommended that health professionals present a staged approach with 4 treatment stages of increasing intensity.¹² Patients can begin at the least intense stage and advance depending on response to treatment, age, degree of obesity, health risks, and motivation.

Table 1 presents the 4 stages and includes both the intervention strategies (what behavior changes to recommend) and the process for providing the intervention (how to offer an intervention to a family, in terms of location, staffing, and support.)

Stage 1: Prevention Plus. As a first step, overweight and obese children or adolescents and their families can focus on basic healthy lifestyle eating and activity habits that form the obesity prevention strategies. However, the outcome is improved BMI status rather than maintained healthy BMI, and the health professional offers more frequent monitoring to motivated patients and families.

TABLE 1. STAGED APPROACH FOR TREATMENT OF CHILDHOOD AND ADOLESCENT OBESITY^a

Stage	What: Recommended Behaviors for Child/Adolescent and Family	How: Setting and Staff for Intervention	When
Stage 1: Prevention Plus	<p>5+ fruits and vegetables</p> <p><2 hours/day screen time</p> <p>≥1 hour/day physical activity</p> <p>Reduce/eliminate sugar-sweetened beverages</p> <p>Eating behaviors (eg, 3 meals a day, family meals, limit eating out)</p> <p>Family-based change</p>	<p>Office-based</p> <p>Trained office support (eg, physician, pediatric nurse practitioner, nurse, physician assistant)</p> <p>Scheduled follow-up visits</p>	<p>Frequency of visits based on readiness to change/behavioral counseling</p> <p>Reevaluate in 3–6 months</p> <p>Advance to next level depending on response and interest</p>
Stage 2: Structured Weight Management	<p>Develop plan for family and/or adolescent to include</p> <p>More structure (timing and content) of daily meals and snacks</p> <p>Balanced macronutrient diet</p> <p>Reduced screen time to <1 hour/day</p> <p>Increased time spent in physical activity</p> <p>Monitoring taught to improve success (eg, logs of screen time, physical activity, dietary intake, or dietary patterns)</p>	<p>Office-based (registered dietitian, physician, nurse) trained in Assessment techniques</p> <p>Motivational interviewing/behavioral counseling</p> <p>Teaching parenting skills and managing family conflict</p> <p>Food planning</p> <p>Physical activity counseling</p> <p>Support from referrals</p>	<p>Monthly visits tailored to child/adolescent and family</p> <p>Advance if needed or if no improvement after 3–6 months (improvement = weight maintenance or BMI deflection downward)</p>
Stage 3: Comprehensive Multidisciplinary Intervention	<p>Structured behavioral program (eg, food monitoring, goal-setting contingency management)</p> <p>Improved home food environment</p> <p>Structured dietary and physical activity interventions designed to result in negative energy balance</p> <p>Strong parental/family involvement especially age <12 years</p>	<p>Multidisciplinary team (includes dietitian and counselor or behavioralist, with medical oversight)</p> <p>Dedicated pediatric weight management program or dietitian and behavioral counselor plus structured activity program</p>	<p>Weekly for 8–12 weeks, then monthly</p> <p>If no improvement after 6 months (improvement = weight loss or BMI deflection downward)</p> <p>Ages 2–5 years remain in stage 3 with continued support</p> <p>Ages 6–11 years if >99th percentile^b and a comorbidity, consider stage 4</p> <p>Ages 12–18 years if >99th percentile^b with a comorbidity or with >6 months of no weight loss in stage 3, consider stage 4</p>
Stage 4: Tertiary Care Intervention	<p>Continued diet and activity behavioral counseling plus consider more aggressive approaches, such as medication, surgery, or meal replacement</p>	<p>Pediatric weight management center operating under established protocols</p> <p>Multidisciplinary team</p>	<p>According to protocol</p>

Abbreviations: BMI, body mass index; NHANES, National Health and Nutrition Examination Surveys.

^aAdapted, with permission, from: Barlow et al.⁶

^bThere is not consensus on a definition of severe obesity. The expert committee suggested use of 99th percentile based on cutpoints defined by Freedman et al⁷ from NHANES data. These cutpoints may be imprecise, but children and adolescents with BMI at or above this level have higher medical risk and therefore intervention is more urgent.

Stage 2: Structured Weight Management. This level of obesity treatment is distinguished from Prevention Plus less by differences in the targeted behaviors and more by the support and structure provided to the child or adolescent to achieve those behaviors.

Stage 3: Comprehensive Multidisciplinary Intervention. This approach increases the intensity of behavior changes, frequency of visits, and specialists involved to maximize support for behavior change. Generally, this type of program will exceed the capacity of a primary care office to offer within the typical visit structure. However, an office or several offices could organize specialists to offer this kind of a program.

Stage 4: Tertiary Care Intervention. The intensive interventions in this category, such as medications, surgery, and meal replacements, may be considered for some severely obese adolescents. These interventions move beyond the goal of balanced, healthy eating and activity habits that are the core of the other stages. Candidates for consideration will have attempted weight control in the Comprehensive Multidisciplinary Intervention stage, have the maturity to understand possible risks, and be willing to maintain physical activity and, if consistent with

the additional intervention, a healthy diet with appropriate behavior monitoring. However, lack of success with the Comprehensive Multidisciplinary Intervention is not by itself an indication to move to this level of treatment.

The metric for improved weight is BMI percentile, generally to below the 85th percentile, although some children and adolescents will be healthy in the overweight category (85th–94th percentile). Although improvement in BMI percentile is the goal, serial weights can reflect energy balance in the short term. Weight maintenance leads to reduction in absolute BMI because of ongoing linear growth, and even slow weight gain can result in lower BMI percentile because BMI for a given percentile curve rises with age. In general, younger and more mildly obese children should change weight more gradually than older, severely obese adolescents. Table 2 summarizes recommendations for weight change targets for children and adolescents in obesity treatment.

Ages 2 years and younger: Caloric restrictions designed to reduce weight are not recommended in this age group. However, health professionals should discuss the potential long-term risk and encourage parents to establish obesity prevention strategies.

TABLE 2. WEIGHT TARGETS FOR CHILDREN AND ADOLESCENTS TREATED FOR OBESITY^{a,b}

Ages, y	BMI 5th–84th Percentile	BMI 85th–94th Percentile	BMI 95th–98th Percentile	BMI ≥99th Percentile ^c
2–5	Maintain growth velocity.	Weight maintenance or BMI trending downward	Weight maintenance or BMI trending downward	Very high BMI (rare) if BMI >21 gradual weight loss of not >1 lb/month until BMI <98th percentile ^d
6–11	Maintain growth velocity.	Weight maintenance or BMI trending downward	Gradual weight loss not more than 1 lb/month ^d	Weight loss maximum of an average of 2 lbs per week ^d
12–18	Maintain growth velocity until linear growth complete.	Weight maintenance or BMI trending downward	Weight loss of a maximum of an average of 2 lbs per week ^d	Weight loss maximum of an average of 2 lbs per week ^d

Abbreviations: BMI, body mass index, NHANES, National Health and Nutrition Examination Surveys.

^aAdapted, with permission, from: Barlow et al.⁶

^bThese targets apply to children and adolescents who need to improve weight. Some children and adolescents who are in (or just above) the 85th percentile to 94th percentile category are unlikely to have excess body fat and should receive usual obesity prevention counseling without a goal of lower BMI percentile.

^cThere is not consensus on a definition of severe obesity. The expert committee suggested use of the 99th percentile based on cutpoints defined by Freedman et al⁷ using NHANES data. These cutpoints may be imprecise, but children and adolescents with BMI at or above this level have higher medical risk and therefore intervention is more urgent.

^dExcessive weight loss should be evaluated for high-risk behaviors.

CONCLUSION

Health professionals have the potential to improve outcomes by early identification, helping individual families create the best possible home environment, encouraging parents to be good role models for healthy eating and physical activity, and providing more structured guidance to overweight and obese children and adolescents and their families.

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Oral Health

Good oral health can be defined as having a functionally sound mouth and jaw that are free of disease. Maintaining good oral health requires a healthy body and healthy behaviors, including eating habits. Nutrition and oral health go hand in hand; adequate nutrition is necessary for the development, maintenance, and integrity of oral tissues, and the ability to chew is important for maintaining healthy eating habits and sound nutrition status.¹ Both maintaining healthy eating and sound nutrition status play important roles in helping to prevent oral diseases, including dental caries (tooth decay) and periodontal diseases—the 2 types of oral infections that account for most tooth loss.²

Although mastication can cause the release of low levels of mercury vapor from dental amalgam filling material, the US Food and Drug Administration concluded that dental amalgam does not cause adverse health effects in humans including sensitive subpopulations (ie, infants, children, pregnant women). These conclusions were based on published peer-reviewed literature and reviews by the Agency for Toxic Substances and Disease Registry and the Environmental Protection Agency.³

SIGNIFICANCE

Dental caries and periodontal diseases are among the most common diseases affecting children and adolescents. The report, *Oral Health in America: A Report of the Surgeon General*, states that approximately 52% of children ages 5 to 9 are affected by dental caries, and the disease becomes even more prevalent as children get older.⁴ More than 70% of children older than age 7 are affected by gingivitis.^{5,6} Untreated gingivitis can progress to periodontitis, a serious infection that results in irreversible destruction of the tissues of the periodontium, and eventually may cause tooth loss. Both dental caries and periodontal diseases are preventable and can be addressed through oral health and nutrition education.

Foods that promote dental caries and plaque formation include those high in sucrose, fructose, and glucose, such as candy, cookies, cake, sweetened beverages, and dried fruit. Such items are cariogenic because they contain fermentable carbohydrates. These sugars are metabolized by oral bacteria, producing acids that cause a decrease in dental plaque pH. A drop in plaque pH below 5.5 causes demineralization or loss of the tooth's mineral structure.⁷ Caries activity is strongly influenced by the retentiveness and frequent consumption (ie, more than 4 times a day) of fermentable carbohydrates. Consuming foods such as plain milk, cheese, meats, legumes, and raw vegetables can reduce the risk of caries, and their consumption fosters systemic health as well.^{7,8}

Complex carbohydrates such as whole grains deter plaque formation and stimulate salivary flow, which facilitates dental and periodontal health. Maintaining a healthy periodontium requires a healthy immune system supported by a healthy diet. Nutrient

deficiencies have been shown to result in decreased resistance to periodontal infections, weakened periodontal structures, and diminished wound healing.⁹

SCREENING AND ASSESSMENT

A generation ago, the role of nutrition in oral health was thought to be limited to the relationship between simple sugars and dental caries. Anticipatory guidance for dental caries prevention meant advising individuals to decrease the frequency of simple sugar consumption. Today, nutrition screening and assessment in the context of oral health focuses on risk assessment and referral to a registered dietitian for infants, children, and adolescents who present with significant dietary inadequacies.

Risk assessment allows the oral health professional to tailor health supervision to the infant’s, child’s, or adolescent’s level of risk for specific diseases, conditions, and injuries. The

assessment consists of (1) an interview to identify risk and protective factors for oral disease and (2) an analysis of these factors to establish a health supervision plan that includes age-appropriate anticipatory guidance and recommendations on the type and frequency of visits needed.

*Bright Futures in Practice: Oral Health*¹⁰ discusses risk assessment and provides guidelines on risk factors for infants, children, and adolescents and on factors that are most common at a particular age. A pediatric dental nutrition risk assessment tool can be very helpful to the oral health professional in identifying specific oral health and dietary risk factors (Figure 1). The oral health professional should address the risk factors with the child’s parent/caregiver and provide appropriate oral health and nutrition education. Nutritional counseling should be provided for those patients at high risk.¹¹ The child or adolescent should be referred to a registered dietitian if notable deficiencies are evident.

FIGURE 1. DENTAL NUTRITION RISK ASSESSMENT^a

Questions for a child’s parent/caregiver

Has your child ever had any cavities or fillings?
 Enter 1 for yes _____
 Enter 0 for no _____

Have any of the child’s brothers or sisters ever had cavities or fillings?
 Enter 1 for yes _____
 Enter 0 for no _____

How often does your child brush his/her teeth?
 Enter 0 for at least twice a day _____
 Enter 1 for once a day _____
 Enter 2 for never or less than once a day _____

Does your child use fluoride toothpaste?
 Enter 0 for yes _____
 Enter 1 for no _____

How often does your child floss?
 Enter 0 for every day or most days _____
 Enter 1 for at least once a week, but not daily _____
 Enter 2 for never/rarely (less than once a week) _____

Does your child take any sugar-containing medications or vitamins on a regular basis?
 Enter 0 for yes _____
 Enter 1 for no _____

How many snacks does your child eat per day?
 Enter 0 for 0, 1, or 2 snacks _____
 Enter 1 for 3 snacks _____
 Enter 2 for more than 3 snacks _____
 Enter 3 for constant snacking _____

Which best describes when your child eats sweets?
 Enter 0 for with meals _____
 Enter 1 for at the end of meals _____
 Enter 2 for with or as snacks _____
 Enter 3 for never _____

FIGURE 1. DENTAL NUTRITION RISK ASSESSMENT^a, continued

How often does your child snack before bedtime?	_____
Enter 0 for never	_____
Enter 1 for occasionally	_____
Enter 2 for often	_____
How often does your child eat slowly dissolving candies and/or lozenges?	_____
Enter 0 for never/rarely	_____
Enter 1 for often	_____
Enter 2 for once a day	_____
Enter 3 for more than once a day	_____
Does your child chew sugar-free gum?	_____
Enter 0 for yes	_____
Enter 1 for no	_____
How often does your child drink fruit juice, soda, or other carbonated beverages?	_____
Enter 0 for never/rarely	_____
Enter 1 for often, but not every day	_____
Enter 2 for daily, one or more consumed fast	_____
Enter 3 for daily, one or more sipped slowly	_____
If end score was	_____
9 or higher: Very high risk. Needs nutrition counseling	
4–8: Moderate risk. Will probably benefit from instructions and handout.	
0–3: Low risk. Will probably benefit from review of basic instructions and handout.	

^aSource: Harper and Faine.¹¹

ANTICIPATORY GUIDANCE

For children with dental caries, anticipatory guidance should address the frequency, consistency, and amount of cariogenic foods consumed. Children and adolescents with dental caries should be advised to (a) choose nutrient-dense foods (ie, those with many vitamins, minerals, fiber, and other nutrients, but that are lower in calories than other foods of comparable nutritional value) that deter plaque formation and stimulate salivary flow, (b) eat snacks in moderation, (c) consume cariogenic foods with meals only, (d) decrease frequency of sugar consumption, and (e) consume less than 10% of daily calories from sugar.^{7,12}

Dietary recommendations for children and adolescents with periodontal disease (eg, gingivitis, periodontitis) are less specific than are dietary recommendations for those with dental caries, because periodontal diseases are more complex and can take years to emerge. Anticipatory guidance for children and adolescents with periodontal diseases should stress eating foods that maintain the integrity of the gums and bones, support immunity and healing, and minimize plaque accumulation.^{9,13} Such foods would include low-sugar, fibrous, and nutrient-

dense items, such as orange slices, carrot sticks, cheese and whole-grain crackers, and milk and unsweetened whole-grain cereals.

Although these recommendations apply to all infants, children, and adolescents, some recommendations are age-specific. Health professionals can use the following information to provide anticipatory guidance to infants, children, adolescents, and their parents.

PRENATAL

Good maternal nutrition during pregnancy supports normal enamel development in the infant's primary teeth as well as salivary gland development and function. Although the effects of marginal deficiencies are unknown, extreme nutrient deficiencies in the pregnant woman can lead to malformed teeth and altered salivary flow in the infant.^{1,14} Ingesting fluoride during pregnancy does not protect the fetus against future dental caries,¹⁵ but fluoride use and good oral hygiene can reduce a pregnant woman's levels of caries-causing bacteria.¹⁶

To reduce the infant's risk of inoculation with cariogenic bacteria, health professionals should advise parents not to share food or utensils with the infant and not to clean pacifiers by

placing the pacifiers in their own mouths, since cariogenic bacteria are often transmitted via these routes.¹⁷ Health professionals should also encourage parents to receive regular preventive oral health care, since active dental caries harbor high levels of cariogenic bacteria.¹⁸

INFANCY AND EARLY CHILDHOOD

When infants are 6 months old, the adequacy and method of fluoride intake should be addressed.¹⁹ Systemic fluoride—which is ingested through fluoridated water or fluoride supplements—becomes very important because of its long-term benefits. The amount of fluoride the infant is ingesting needs to be determined via assessment of the water source (community water, bottled water, or well water) and the feeding method (breastfeeding or bottle-feeding). The local health department can determine the amount of fluoride in community water and a laboratory test can determine the amount of fluoride in well water. If parents use infant formula that is reconstituted from powder or concentrate and the child is taking a fluoride supplement, the formula should be mixed with non-fluoridated water to avoid overexposing developing teeth to fluoride. The child's dentist should determine the appropriate combination of fluoride therapies.

Dental caries can occur at any age after the teeth erupt. Particularly damaging forms can begin early, when developing primary teeth are especially vulnerable. This type of dental caries is known as early childhood caries (ECC). Early childhood caries is defined as the presence of one or more decayed (non-cavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child between birth and 71 months of age.¹⁸

The etiology of ECC is multifactorial. Important contributing factors include excessive and inappropriate use of a bottle containing cariogenic liquids and transitional methods of feeding (eg, sippy cup to cup).²⁰ To reduce the risk of ECC, infants and children should not be put to bed with a bottle or be allowed to drink from a bottle at will during the day. Sucking on a bottle containing beverages high in sugar (eg, fruit drinks, soda, fruit juice) for a prolonged period can contribute to dental caries.

Frequent consumption (ie, more than 4 times a day) of sugar or sweetened foods is associated with the development of dental caries in the first 3 years of life and can be a predictor of caries activity in later years.¹²

For children in child care programs, nutrition-related oral health issues include frequent consumption of fermentable carbohydrates as well as the fluoride level in their drinking water. Nutrition safety concerns include fluoride toxicity (poisoning and fluorosis);²¹ food allergies (eg, peanut allergies);²² and the potential for choking on foods such as peanuts, peas, beans, grapes, and hotdogs.²³

MIDDLE CHILDHOOD AND ADOLESCENCE

Children's and adolescents' access to snacks containing fermentable carbohydrates, their snacking patterns, their freedom to choose foods outside the home, and their increasing energy needs are nutrition-related oral health issues. Children's and adolescents' consumption of their school's drinking water and bottled or processed water needs to be considered when evaluating the adequacy of their fluoride ingestion.

The type and frequency of snacks that children and adolescents consume remain a concern. Dietary fads such as sport drinks, so-called functional drinks (eg, energy drinks and vitamin waters), and fruit drinks can compromise nutrition and oral health status (ie, decalcify teeth).

Carbonated beverages also present a risk, owing to their high sugar content and acidic pH. On average, the sugar content of a can of non-diet soda is 40 g (10 teaspoons). It is recommended that children and adolescents consume less than 40 g of sucrose per day to decrease the risk of caries.⁷ Beverages represent a significant concern, since many children and adolescents consume multiple servings per day.²⁴ Carbonated beverages and sport drinks also contribute to dental erosion (loss of tooth structure from demineralization) owing to their acidic pH levels, which range from 2.92 to 4.61.²⁵ Such levels are well below the decalcification point of 5.5. Erosion can occur even in a caries-free oral cavity, simply as a result of the high acidity of a food. In addition, low-nutrient beverages often displace milk in children's or adolescents' diets, increasing

the risk for calcium and vitamin D deficiencies. Such deficiencies can have long-term detrimental effects.^{23,24}

Purging types of eating disorders, such as bulimia nervosa, can also expose the oral tissues to an acidic pH. Vomiting is a common form of purging that can cause dental erosion because of the frequent exposure of teeth to acidic gastric contents. Dental erosion in children or adolescents with eating disorders can be severe, contributing to tooth sensitivity, tooth loss, or both.²⁶ Due to the serious oral and systemic health risks associated with eating disorders, early intervention and treatment is imperative.²⁷ (See the Eating Disorders chapter.)

INFANTS, CHILDREN, AND ADOLESCENTS WITH SPECIAL HEALTH CARE NEEDS

Many diseases and conditions can affect the nutrition and oral health status of infants, children, and adolescents with special health care needs. Owing to an increased risk for oral diseases, it is especially important that they receive regular oral health care. Following are some oral health implications associated with specific nutrition-related physical conditions:

- Infants born preterm with a low-birth weight can exhibit oral and dental malformations.²⁸
- Children and adolescents with special health care needs can require diets high in carbohydrates, which may increase the risk for dental caries. The frequency of carbohydrate feeding may also accelerate the development of dental caries.
- Children and adolescents who are fed through gastrostomy tubes can still develop calcified deposits on their teeth, which may lead to chronic inflammation in the mouth.²⁹
- Children and adolescents with gastric reflux can have enamel erosion similar to that seen with bulimia nervosa.³⁰
- Children and adolescents who have difficulty chewing and swallowing may leave more food on their teeth, which can increase plaque formation and the risk of decalcification.
- Children and adolescents with celiac disease may be at increased risk for tooth malformation.³¹
- Children and adolescents undergoing radiation and chemotherapy are at increased risk for oral disease.³²

- Children with special needs (ie, cerebral palsy, attention-deficit/hyperactivity disorder, and Down syndrome) are at increased risk for bruxism. Chronic wearing of the crowns of the teeth can cause difficulty chewing certain foods, which can increase a child's risk for malnutrition.^{1,33–36}
- Children with special health care needs often suffer from malocclusion, which can cause difficulty chewing raw, fibrous foods. Chronic consumption of a soft diet can cause malnutrition, since it may be inadequate in calories, nutrients, and fiber.^{1,37}
- Gingival overgrowth is a common side effect of certain medications (eg, dilantin, cyclosporine, and calcium channel blockers). Gingival overgrowth can cause difficulty chewing, resulting in insufficient intake of calories, nutrients, and fiber.¹⁸
- Long-term use of bottles or sippy cups filled with high-sugar beverages increase a child's risk of dental caries.¹⁸
- Frequent use of syrup-based medicine represents a primary risk factor for ECC.³⁵
- Certain drug treatments (eg, psychotropic medications) can cause xerostomia (dry mouth), which increases the risk for dental caries.^{1,35}
- High-sugar foods and/or beverages used to calm or soothe a child increase a child's risk of dental caries.³⁸

OTHER SPECIAL CONSIDERATIONS

VITAMIN DEFICIENCIES

Protein and calorie malnutrition and deficiencies in calcium and phosphorus and vitamins A, C, and D contribute to defects in enamel formation.^{14,39} Salivary gland hypofunction and altered salivary composition are associated with malnutrition as well, and they increase the risk for dental caries.¹⁴ Malnutrition also depresses the body's immune response, increasing the risk for periodontal infection,⁹ and select nutrient deficiencies (ie, vitamin C) increase the permeability of the sulcular epithelium, which further increases the risk of infection.^{9,40} Deficiencies of select B vitamins (ie, B₁, B₂, B₆, B₁₂, biotin, folate, niacin) lead to inflammation in the mouth, corners of the lips, and tongue. Vitamin C deficiency

causes scurvy and, if untreated, leads to a breakdown of the gums and bones and eventual death. Rectifying these deficiencies will reverse damage done to soft tissues and prevent further damage to teeth.^{39,40}

FLUORIDE

Although many community water supplies are still not fluoridated, the relatively widespread availability of fluoridated water is primarily responsible for the reduced prevalence of dental caries among children and adolescents during the last several generations.⁴¹ Fluoride increases the resistance of teeth to demineralization, encourages the healing of nascent caries, and reduces plaque formation.¹⁸

Infants, children, and adolescents can receive fluoride systemically, topically, or both ways. Systemic fluorides include fluoridated water and fluoride supplements (drops, liquids, and tablets). Children who drink fluoridated water benefit because fluoride is incorporated into their developing teeth. Although the contribution of systemic fluoride in developing teeth is believed to play a minor role in caries prevention, it does provide a topical effect for children and adolescents whose teeth are fully erupted. Topical fluorides (those applied to the surfaces of the teeth) are most effective when delivered at low doses many times a day. Topical fluorides include fluoridated water, over-the-counter fluoride rinses, professionally applied fluoride treatments, and fluoride-containing toothpaste.⁴² Almost all

toothpaste manufactured in the United States provides topical fluoride. Toothpastes with the American Dental Association seal of acceptance ensure an optimal level of fluoride.⁴³ Children younger than 6 years should be supervised when brushing to help reduce the risk of swallowing toothpaste. Fluoridated mouth rinse should not be used by children younger than 6 years due to the risk of swallowing.⁴⁴ Fluoridated water and toothpaste are recommended for all children irrespective of their caries risk and are considered a therapeutic baseline for children.

An oral health professional or physician should determine the appropriate fluoride program for each infant, child, or adolescent based on age, history of and susceptibility to dental caries, and current fluoride level.⁴² It is not sufficient for health professionals to ask families whether they live in a community where the water is fluoridated; rather, it is more appropriate to ask about the source of their drinking and cooking water. If the water is bottled or processed, it must be assessed to determine its fluoride level. Many children and adolescents spend a great deal of time outside the home and drink water that comes from a variety of sources. Fluoride supplements should be prescribed only for children and adolescents who are at high risk of developing dental caries and whose primary source of drinking water is deficient in fluoride.⁴⁵ Table 1 indicates the recommended dosage of system fluoride supplement relative to the fluoride level in drinking water and the child’s or adolescent’s age.

TABLE 1. SYSTEMIC FLUORIDE SUPPLEMENTS: RECOMMENDED DOSAGE^a

Age	Fluoride Ion Level in Drinking Water ^b		
	<0.3 ppm	0.3–0.6 ppm	>0.6 ppm
Newborn–6 months	None	None	None
6 months–3 years	0.25 mg/day ^c	None	None
3–6 years	0.50 mg/day	0.25 mg/day	None
6–16 years	1.0 mg/day	0.50 mg/day	None

^a Source: American Dental Association.⁴⁶

^b 1.0 ppm = 1 mg/L.

^c 2.2 mg of sodium fluoride contains 1 mg of fluoride ion.

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Pediatric Undernutrition

Pediatric undernutrition (sometimes also referred to as failure to thrive) is typically diagnosed in the first 2 years of life. Health professionals can often identify pediatric undernutrition by the time a child is 1 year old. By carefully monitoring the child's growth on a standard growth chart,¹ health professionals can recognize the condition when a child's weight for age, length for age, weight for length, or weight for height decreases across percentiles or falls below the fifth percentile, a z-score of -2, or when the child's weight does not increase after a few months.² Some children have normal growth parameters but a declining overall growth pattern. All of these children warrant further assessment for pediatric undernutrition.

SIGNIFICANCE

Pediatric undernutrition may impair a child's growth and development. The condition is also associated with diminished immunologic resistance and decreased physical activity. In addition, it can lead to long-term problems with cognitive development, academic performance, and socio-affective competence.² These effects are of greater concern if undernutrition is severe or if it occurs during infancy, when brain growth is most rapid. However, undernourished infants and children can benefit at any age from interventions that include improved nutrition.

ASSESSMENT

Pediatric undernutrition is caused by nutritional inadequacy. It occurs when infants or children either are not offered foods that contain adequate energy and nutrients, do not take these foods when offered, or do not retain the energy and nutrients that these foods contain. The condition often originates from a combination of biological, developmental, behavioral, economic, cultural, and psychosocial factors. When assessing children for pediatric undernutrition, it is important for health professionals to consider multiple factors. This requires working closely with families and may mean devoting extra time to understanding the causes of the problem.

BIOLOGICAL AND DEVELOPMENTAL FACTORS

Several biological and developmental factors may contribute to pediatric undernutrition. Health professionals should be aware of these when assessing an infant or young child.

Infants born prematurely, especially those born small for gestational age, are likely to remain short in stature and to weigh less than their peers as they get older. These children may have special nutritional requirements that need to be met to ensure that they grow and develop at their full potential. Special growth charts are available to monitor the growth of children born prematurely.

A diagnosis of inadequate growth may derive from familial patterns of normal growth (eg, parents who are short or thin, or who experienced delayed growth and sexual maturation).³ Inadequate growth may also result from common medical conditions (eg, otitis media, diarrhea, gastroesophageal reflux) or from a variety of uncommon medical conditions (eg, cystic fibrosis, congenital heart disease), most of which can be identified during a careful medical history and physical examination. In children with chronic diarrhea, it is helpful to obtain a dietary history, including the volume of fruit juice consumed. Some cases of pediatric undernutrition have been associated with excessive intake of juice.⁴ Some infants and children are difficult to feed and may not eat sufficient quantities of nutritious foods, even though food is offered to them in an appropriate manner. This situation can be challenging, frustrating, and worrisome for parents. The child's difficulties may be manifested by gagging, excessive drooling, coughing, choking, and other symptoms and may require help from an occupational therapist or speech-language pathologist.⁵ In addition to undernutrition, some children have delays in speech and language or other aspects of development and should be referred to early intervention programs.

NUTRITIONAL FACTORS

Food choices, feeding practices, or both may contribute to pediatric undernutrition. Therefore, assessment of these choices and practices is integral to assessing pediatric undernutrition. The

assessment includes gathering information about the mother's diet, whether the infant is breast-fed or formula fed, the infant's or child's feeding schedule, formula preparation, parents' knowledge and health beliefs, and food availability.

Asking parents to keep a 3-day food record or obtaining a 24-hour food recall can help health professionals determine whether the child's food intake contains sufficient energy, protein, and fat to sustain growth and development.⁴ Such food records can also help health professionals learn about the frequency and regularity of the infant's or child's feedings.

BEHAVIORAL FACTORS

It is important to obtain information from parents about the location of feedings, mealtime atmosphere, whether there are multiple caregivers, and how responsive parents and caregivers are to the needs and cues of the infant or child. Asking parents to describe a typical day may provide a good introduction to those issues.

It is often very helpful for health professionals to observe parents' interaction with the infant or child during feedings. Home visits by a registered dietitian, nurse, or other health professional are even more helpful and can help improve understanding of the family's lifestyle and enhance health professionals' ability to advise parents.³

Common problems with food choices and feeding practices include the following:

- Over-diluting infant formula
- Adding large quantities of cereal or other foods to the bottle
- Providing foods that are not appropriate textures for the infant's or child's age and developmental stage
- Providing 2% rather than whole milk for children younger than age 2
- Providing excessive amounts of fluids that have little nutritional value (eg, fruit-flavored drinks, sweetened beverages)
- Feeding infrequently or inconsistently
- Not providing a high chair
- Feeding in the presence of distractions or in a chaotic household with multiple caregivers

Toddlers seeking autonomy may refuse to be fed but may eat well if parents provide the food and let the child do the eating. For more information about appropriate feeding and eating behaviors, see the Infancy and Early Childhood chapters.

ECONOMIC FACTORS

Pediatric undernutrition can result when families do not have enough money and other resources (eg, transportation) to obtain sufficient food.³ Health professionals can refer parents to federal food assistance and nutrition programs that can provide a substantial part of an infant's or child's daily nutrition requirements. (See Tool K: Federal Nutrition Assistance Programs.) Food shelves and pantries, churches and other places of worship, and businesses can be additional sources of food and support.

CULTURAL FACTORS

When health professionals are interviewing and counseling parents of an infant or child with pediatric undernutrition, they must keep in mind that cultural beliefs affect many aspects of infant and early childhood nutrition (eg, breastfeeding and weaning, expectations about the child's weight, food preferences, and responding to the child's independence and need to self-feed). Health professionals need to listen attentively, become aware of their own assumptions, and be open to the practices of those from cultures other than their own. They can also improve their ability to advise parents by being sensitive to cultural differences in professional-parent relationships, learning to negotiate culturally based disagreements, and learning new languages or using interpreters.⁶ (For further information about culture and food choices, see the Cultural Awareness in Nutrition Services chapter.)

PSYCHOSOCIAL FACTORS

Psychological issues, maternal depression, family stressors, or a disturbance in the parent-child relationship may affect a child's nutrition. In addition, parents whose child is not growing as expected may experience high levels of anxiety, and the health professional may find it hard to work with the family. In these instances,

consultation with a mental health professional may be important. If parents fail to follow through with recommendations and the health professional suspects neglect, it may be necessary to contact child protective services.

TREATMENT AND MANAGEMENT

Nutritional treatment for pediatric undernutrition includes making appropriate adjustments to the infant's or child's feeding or eating practices to achieve optimal nutrition. This may include increasing the energy density of the foods that the infant or child receives, with the amount of energy continuing to increase until appropriate growth is achieved. A multivitamin and a zinc supplement may also be recommended. Iron deficiency should be treated if present. (See the Iron-Deficiency Anemia chapter.)

Topics for anticipatory guidance with parents may include

- Normal growth and development
- Formula preparation
- Feeding techniques
- Establishing a schedule for feeding
- Limiting sweetened beverages and fruit juice
- Developing realistic and achievable goals
- Addressing any behavioral issues related to feeding
- Toddlers' wish for autonomy

Suggestions for parents include decreasing distractions during feeding, having the infant or child sit in a designated place for feedings, offering approximately 3 meals and 2 snacks a day, and increasing the energy density of the foods offered.

Goals of treatment and management of pediatric undernutrition include

- Achieving food choices appropriate for the child's age and developmental stage
- Achieving appropriate feeding or eating behavior for the child and the parents so that all of them enjoy meals
- Improving growth, so that infants rise across percentiles (catch-up growth) and toddlers at least parallel the growth chart upward
- Achieving normal social-emotional, language, and cognitive development

Medical and nutritional follow-up include obtaining and monitoring growth measurements, assessing catch-up growth adequacy, modifying

the nutrition care plan as needed, and reinforcing anticipatory guidance provided to parents. Any underlying medical issues need further treatment and follow-up as well.

Because multiple factors can come into play with pediatric undernutrition, several professionals, including dietitians, nurses, physicians, mental health and other health professionals, child care providers, and child development specialists may need to work as a team in assessing and treating the child.⁴ These professionals must work closely with one another and with the family to gather and share information, plan effective interventions, identify areas where more help is needed, and work to coordinate services. Coordination among multiple agencies may be a challenge.

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Vegetarian Eating Practices

Vegetarian eating practices are chosen for religious, health, environmental, cultural, and ethical reasons. Infants and children on vegetarian diets are following their parents' eating practices, but adolescents may choose vegetarianism independently of family members.

Adolescence is a time of experimentation, and as adolescents experience cognitive changes and broaden their perspectives, they often become concerned about social and environmental issues. Adolescents tend to be attracted to vegetarian eating practices, especially during middle or late adolescence, because of their concerns about animal welfare, ecology, the environment, or personal health. Concerns about body weight also motivate some adolescents to adopt a vegetarian diet, since this is a socially acceptable way to reduce dietary fat. Vegetarian eating is often seen in adolescents with anorexia nervosa, who adopt the diet in an attempt to hide their unnecessary restrictions on food intake.

Vegetarian diets usually include at least a few foods of animal origin, most commonly milk, milk products, and eggs. Vegan diets exclude the use of animal foods of any type. Table 1 describes the different types of vegetarian eating practices.

POTENTIAL BENEFITS

Vegetarian diets often provide more fruits, vegetables, and fiber, as well as less fat and cholesterol, than mixed diets. Children and adolescents who are vegetarians may also have lower levels of blood cholesterol and body fat than nonvegetarians.

POTENTIAL RISKS

Vegetarian diets that include milk, milk products, and eggs are generally high in essential nutrients and are unlikely to pose health risks. Strict adherence to a vegan diet (which excludes all foods of animal origin) may place infants, children, and adolescents at nutrition risk. Unless specially fortified foods or supplements are added, the vegan diet lacks vitamins B₁₂ and D.

Animal foods are particularly rich sources of certain nutrients needed for growth: protein, iron, calcium, zinc, vitamin B₁₂, vitamin A, and vitamin D. If animal foods are eliminated, these nutrients must be obtained from other sources to ensure good health.

Overly restricted or inappropriately selected vegetarian diets can result in significant malnutrition. In infants and children, malnutrition from insufficient intake of protein and energy (calories), failure to thrive, growth deficits, rickets, iron-deficiency anemia,

TABLE 1. VEGETARIAN DIETS^a

Lacto-ovovegetarian	Includes grains, fruits, vegetables, legumes, nuts, seeds, milk, and eggs; excludes meat, poultry, and fish and other seafood.
Lactovegetarian	Includes grains, fruits, vegetables, legumes, nuts, seeds, and milk; excludes eggs, meat, poultry, and fish and other seafood.
Strict, total, or pure vegetarian	Includes grains, fruits, vegetables, legumes, nuts, and seeds; excludes all foods of animal origin.
Vegan	The term vegan is also used to describe total vegetarians. Originally this term was used to describe persons who refrained from not only eating foods of animal origin, but also using animal products such as leather. The term is often used today to denote someone who excludes all animal products from his or her diet without implication regarding their use of other types of animal products.
Semivegetarian	Includes grains, fruits, vegetables, nuts, seeds, milk, and eggs; usually excludes red meat, but may include small amounts of fish or fowl on limited occasions.
Macrobiotic	Emphasizes whole grains and vegetables, including beans and sea vegetables (seaweeds). Uses only locally grown fruits. Foods of animal origin are limited to small amounts of white meat or fish once or twice a week. This diet may be similar to a vegan diet in its nutritional profile.

^aReprinted, with permission, from: Table 4.1, Johnson and Haddad.¹

and vitamin B₁₂ deficiency have been reported. Infants consuming a macrobiotic diet who are fed inappropriate infant formula are particularly at risk for severe nutrition problems. In adolescents, a delayed growth spurt, iron-deficiency anemia, and vitamin B₁₂ deficiency have been observed.²

NUTRITIONAL ADEQUACY

Vegetarian diets are consistent with the *Dietary Guidelines for Americans*³ and can meet the Dietary Reference Intakes (DRIs) for nutrients. With careful planning, vegetarian diets can provide a variety of nutrient-dense foods that promote healthy growth and development. Servings of legumes should be included first as part of the protein food group and then if additional servings are eaten, as part of the vegetable group.⁴ *MyPyramid* meal patterns are appropriate for lacto-ovovegetarians. In addition, other meal patterns for children and adolescents who are vegetarians or vegans have been suggested.^{5,6} Although slower growth rates have been reported in infants and children who followed vegan and macrobiotic diets during the first 5 years of life, “catch-up” growth usually occurred in these children by age.¹⁰ In adolescents who are vegetarians, menarche has been observed at a slightly later

age, which may be related to a lower percentage of body fat.²

ENERGY

Adequate food intake, which supplies energy from sources of carbohydrates, protein, and fats, is essential for growth, development, and activity. Decreased energy (caloric) intake may occur if food choices are excessively low in dietary fat and excessively high in fiber (eg, bran, raw fruits and vegetables). For those children and adolescents whose fiber intake is high, peeling fruits; sieving vegetables, cereals, or legumes; and replacing some whole grains with refined grains may be beneficial.

FAT

Vegetarian diets have the potential to be very low in fat. Fat should not be restricted in infants and children younger than 2 years and should not be overly restricted in older children and adolescents. Efforts should be made to ensure that children and adolescents consume enough fats by incorporating oils, avocado, seeds, nuts, or nut butters into their diets.

For optimal health, it is also important to have a balanced intake of omega-6 and omega-3 fatty acids. Vegetarian diets tend to be rich in omega-6 linoleic acid (LA), but reduced in the omega-3 fatty acids: alpha-linolenic acid (ALA), eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA).⁷ Cardiovascular disease risk, neurologic function, and inflammatory and immune disorders may be negatively impacted by low omega-3 fatty acid intake.⁸ The only naturally occurring sources of DHA in vegetarian diets are eggs and seaweeds. Because the amount of DHA is limited, vegetarians must rely on conversion from ALA. The efficiency of this conversion is poor and is further reduced by excessive intake of LA. The Institute of Medicine's Food and Nutrition Board has established adequate intakes for the essential fatty acids LA and ALA; however, it assumes EPA and DHA will also be consumed.⁹ For vegetarians, additional intake of ALA may be beneficial as well as limiting the amount of LA.⁷ Researchers have suggested a ratio of LA to ALA of 2:1 to 4:1 for vegetarians.⁸ To achieve this, high LA oils, such as corn, safflower, sunflower, soybean, and cottonseed, should be limited. These should be replaced with oils that are high in monounsaturated fats and limited amounts of high ALA oils. Ground flax, flax oil, canola oil, walnuts, and walnut oil are good sources of ALA. DHA-fortified foods and vegan nutritional supplements are also available. Infant formula fortified with DHA must be fortified with equivalent amounts of arachidonic acid to ensure optimal growth.⁸

PROTEIN

Breast milk is an ideal source of protein throughout the first 1 to 2 years of life. For infants who are not breastfed or who are partially breastfed, either commercially prepared fortified soy or modified cow's milk infant formula promotes growth and is recommended during the first year of life. At 6 to 8 months of age, foods containing higher amounts of protein should be introduced into the infant's diet. Appropriate foods are mashed legumes, lentils, and tofu as well as egg yolks, yogurt, and pureed cottage cheese for the lacto-ovo vegetarian.¹⁰

When energy needs are adequately met through the consumption of a variety of plant foods, protein needs are also likely to be met. When energy

supply is inadequate, protein will be used to meet energy needs rather than for tissue synthesis. Because infants and children have small stomach capacities, small amounts of nutrient-dense foods are recommended 5 or 6 times a day. Milk, milk products, and eggs provide high-quality protein. Soy, amaranth (grain), and quinoa (grain) have amino acid patterns similar to those of cow's milk and therefore are important protein sources.

Mixtures of plant proteins also provide balanced, complete sources of amino acids to adequately meet protein requirements. Due to differences in amino acid composition and digestibility of plant proteins, it has been suggested that protein needs of vegan children are above the DRI, ranging from an additional 30% to 35% for children ages 1 to 2 years, 20% to 30% for children ages 2 to 6 years, and 15% to 20% for those older than 6 years.¹⁰

Metabolic needs can be met by drawing on the body's amino acid pools if a variety of protein-containing foods are eaten throughout the day. Consuming precise combinations of plant proteins at the same meal to achieve complete proteins is not necessary.¹¹ However, foods containing protein in sufficient quality and quantity, or complementary proteins consumed within a few hours of one another, are recommended for infants and children younger than 2 years who are not fed breast milk or infant formula.

CALCIUM

Calcium absorption and retention may be 30% to 50% higher among vegetarians who consume moderate amounts of protein. Lacto-ovo vegetarians tend to have adequate calcium intake; however, vegan diets, if not well planned, may contain insufficient calcium.

Many vegetarian foods contain moderate amounts of calcium. Nonmilk sources of calcium in vegetarian diets include calcium-fortified soy milk, calcium-fortified juice and breads, tofu processed with calcium, blackstrap molasses, sesame seeds, tahini (sesame butter), almonds and almond butter, and certain vegetables (eg, broccoli, okra, collard and mustard greens, kale, rutabaga). Calcium in plant foods that contain high amounts of oxalates (eg, spinach, Swiss chard, beet greens, rhubarb) is not well absorbed since insoluble calcium oxalate

is formed. Fermentation, roasting, and yeasting increase calcium absorption from products (eg, miso, nuts, leavened bread).¹² Calcium supplements may be necessary if dietary intake is inadequate.

VITAMIN D

In addition to calcium, adequate intake of vitamin D is essential for bone health. Although vitamin D can be produced through exposure of the skin to sunlight (20–30 minutes 2 or 3 times per week), this source of vitamin D cannot be relied on in northern climates during the winter. Dark-skinned persons require longer exposure to sunlight (30 minutes to 3 hours per day) to produce adequate amounts of vitamin D.¹² Sunscreens, smog, and sunlight exposure through glass inhibit vitamin D synthesis.

Breastfed infants and those who consume less than 1 L of fortified infant formula per day should receive 400 IU of vitamin D supplementation beginning within the first few days of life.¹³ Children and adolescents can obtain vitamin D from a variety of fortified products, including soy milk, orange juice, breakfast cereals, and margarines.

VITAMIN B₁₂

An adequate intake of vitamin B₁₂ is essential for growth, red blood cell maturation, and central nervous system functioning. Because of rapid growth and limited nutrient stores in infancy, infants on a vegan diet are at high risk for vitamin B₁₂ deficiency, which may manifest as irritability, apathy, failure to thrive, or developmental regression. Vitamin B₁₂ deficiency has been reported in breastfed infants of women on vegan diets who do not supplement their diet with vitamin B₁₂. If untreated in early stages, vitamin B₁₂ deficiency can lead to serious and permanent neurologic damage.² High folate intake, which may occur in children and adolescents who follow a vegan diet, can mask hematologic changes associated with vitamin B₁₂ deficiency, while neurologic damage progresses.

Vitamin B₁₂ occurs naturally in animal products, including milk, milk products, and eggs. Although unfortified, fermented plant foods and sea vegetables may contain some vitamin B₁₂,

it seems to be present in inactive forms, some of which function as antivitamin. Thus these sources of vitamin B₁₂ are considered unreliable.¹⁰

To ensure adequate vitamin B₁₂ status, breastfed infants of women who consume a vegan diet should receive a vitamin B₁₂ supplement (0.4 µg/d birth–6 months and 0.5 µg from 6–12 months); if these infants are not breastfed, they should be given fortified soy infant formula. Children and adolescents who consume a vegan diet should receive a vitamin B₁₂ supplement or regularly consume 1 to 2 servings of the following: breakfast cereals, textured soy protein, soy milk fortified with vitamin B₁₂, or Red Star T-6635+ nutritional yeast flakes.¹⁰

IRON

Iron needs increase during periods of rapid growth. Although non-heme iron in plant products, milk, milk products, and eggs has a lower absorption rate (2%–20%) than that of heme iron in meat, fish, and poultry (15%–35%), vegetarians do not have a higher incidence of iron-deficiency anemia than persons consuming a mixed diet. Iron deficiency has been reported in children fed a macrobiotic diet. To account for the decreased bioavailability of iron in a vegetarian diet, the Food and Nutrition Board increased the DRI for children 1 year and older who are vegetarians by a factor of 1.8.¹⁴

Ascorbic and other organic acids found in fruits and vegetables enhance iron absorption. Inhibitors of iron absorption are phytates, tannins, and calcium in milk and milk products. Processes involved in leavening and baking whole-grain bread, fermenting soy products (eg, miso, tempeh), roasting nuts, sprouting seeds, and coagulation with gluconic acid (eg, tofu) decrease phytates and enhance iron absorption.¹²

Foods high in iron (eg, fortified breakfast cereals, instant oatmeal, blackstrap molasses, legumes, tofu, dried fruits, enriched pasta, bread) should be consumed daily. Increased intakes of foods rich in iron inhibitors should be avoided.

To ensure adequate iron status, breastfed infants should receive a low-dose iron supplement at 4 months of age and continued until adequate intake is achieved through supplemental foods.¹⁵ Infants on a vegan diet who are not breastfed should receive iron-fortified soy formula.

Children and adolescents should consume juices, fruits, and vegetables high in ascorbic acid daily with meals.

ZINC

Zinc is essential for growth and development. Infants fed breast milk or soy infant formula should receive adequate amounts of zinc. Zinc intake should be assessed and if determined to be inadequate, a supplement or zinc-fortified foods used when complementary foods are introduced.¹⁴ Milk and eggs are good sources of zinc in lactovegetarian and lacto-ovovegetarian diets. Plant sources of zinc include legumes, tofu, miso, tempeh, nuts, seeds, wheat germ, and whole grains.¹²

To increase the bioavailability of zinc and ensure adequate zinc intake, raw wheat bran should be avoided and the consumption of unleavened bread limited. Legumes should be soaked 1 to 2 hours before cooking, and the water discarded before cooking. Yeast-leavened bread and whole grains, roasted nuts, and sprouted seeds can be used. Although the Food and Nutrition Board does not set a separate recommended daily allowance for zinc for vegetarians, it suggests that zinc intake may need to be 50% higher in those vegetarians who consume large amounts of phytate-containing grains and legumes.¹⁵

SCREENING AND ASSESSMENT

The nutritional adequacy of vegetarian and vegan diets can be assessed by asking a few targeted questions. Vegetarian diets vary widely, so it is important to assess precisely what foods are eaten and eliminated from the diet and what supplements are used. Infants, children, and adolescents should be plotted on the standard growth charts as part of nutrition screening and assessment.

ANTICIPATORY GUIDANCE

Vegetarian eating practices need to be carefully planned to provide enough energy, protein, calcium, iron, zinc, and vitamins B₁₂ and D. The bioavailability of calcium, iron, and zinc should also be ensured. Careful planning of vegan diets is especially important because it is more difficult

to meet nutrient needs from plant foods alone. Parents of infants, children, and adolescents who are vegetarians should be given information on how to plan and provide a nutritionally adequate diet.

When adolescents become vegetarians, parents are often concerned about the diet's nutritional adequacy, especially about meeting protein requirements. Parents need reassurance that a vegetarian diet can meet their adolescent's nutrition needs, and they should receive information on the principles of healthy vegetarian eating for adolescents.

The following sections contain guidelines for vegetarian eating practices for infants, children, and adolescents.

INFANCY

- Breastfeeding an infant exclusively for the first 4 to 6 months of life provides ideal nutrition and supports the best possible growth and physical development.
- If breastfeeding is discontinued before 12 months, or breastfeeding occurs fewer than 3 times a day, feed an iron-fortified infant formula.
- Avoid inappropriate substitutes for breast milk or infant formula (eg, unfortified soy milk, rice milk, almond milk, formula prepared from grains).
- Avoid cow's milk during the first year of life and reduced-fat (2%), low-fat (1%), and fat-free (skim) milk during the first 2 years.
- Avoid corn syrup or honey.
- Provide a vitamin D supplement to breastfed infants and those consuming less than 1 L of fortified infant formula beginning within the first few days of life.¹³
- Provide an iron supplement for the breastfed infant starting at 4 months of age and continuing until adequate iron intake is achieved through supplemental food sources.¹⁶
- Provide a vitamin B₁₂ supplement to breastfed infants of mothers who consume a vegan diet.¹⁰
- Follow established guidelines for introduction of solid foods. Feed higher protein solid foods (eg, mashed legumes, tofu, cottage cheese, yogurt, or egg yolks) at 6 to 8 months of age.

EARLY CHILDHOOD AND MIDDLE CHILDHOOD

- Provide 3 meals and 2 to 3 snacks per day.
- Avoid bran and excessive intake of bulky foods (eg, raw fruits and vegetables).
- Encourage eating nutrient-dense foods (eg, avocado, cheese, soy cheese, hummus, nut butters, tahini, tofu).
- Provide an omega-3 fatty acid source (eg, canola oil, soy oil, tofu, soybeans, walnuts, wheat germ).
- Avoid excessive restriction of dietary fat.
- Ensure an adequate intake of calcium, zinc, iron, and vitamins B₁₂ and D.

ADOLESCENCE

- Avoid skipping meals.
- Avoid excessive restriction of dietary fat.
- Limit low-nutrient snacks high in fat and sugar.
- Encourage eating healthy, nutrient-dense snacks (eg, bagels, bean burritos, hummus and pita, nachos, nuts, nut butters [almond, cashew, peanut, soy], sunflower and pumpkin seeds, tofu dogs, tofu spreads, trail mix, veggie burgers, veggie pizzas, yogurt shakes).
- Provide an omega-3 fatty acid source (eg, canola oil, soy oil, tofu, soybeans, walnuts, wheat germ).
- Ensure an adequate intake of calcium, zinc, iron, and vitamins B₁₂ and D.
- Avoid inappropriate weight-loss practices.

REFERRAL

Referral to a registered dietitian is helpful in assessing dietary intake and planning healthy vegetarian diets. For infants, children, and adolescents consuming vegetarian diets, referral to a dietitian is essential if the health professional does not have training in or adequate knowledge of nutrition. (See Tool J: Nutrition Resources.)

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