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Addressing Childhood Obesity: Opportunities for Prevention

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INTRODUCTION

The prevalence of obesity in the United States remains dangerously high, at nearly 10% among infants and toddlers, 17% of children and teens, and more than 30% of adults[1,2]. While the prevalence has stabilized somewhat over the past few years[1], rates of severe obesity have continued to climb, particularly in high-risk populations[3]. Intervening during childhood is important due to the persistence of obesity into adulthood with associated increased morbidity and mortality[4–7]. Comorbidities often affect children before they reach adulthood, requiring increased diligence in evaluating and treating these conditions[8–10] and leading to increased healthcare expenditures[11,12]. The personal and emotional face of childhood obesity is also serious: daily quality of life can be significantly worsened by

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obesity[13]. The psychosocial complications of obesity include depression, body dissatisfaction, unhealthy weight control behaviors, stigmatization, and poor self-esteem[13].

Groups have advocated for the prevention of obesity for some time, yet efforts to advance preventative interventions may have been limited by the difficulties and expense of long-term studies of a complex problem and increasing focus on treatments. Despite the progress over the past 20 years, there is not a clear solution or “one-size-fits-all” approach. The body of literature on proven prevention interventions is not robust, though cross-sectional and associational studies have identified risk factors to address, and practical experience has provided a foundation upon which to work with children and families. Childhood obesity is incredibly complex and reflects numerous systems that impact a child's health. Repetition of concepts can aid in approaching an issue as complex as childhood obesity; the Ecological Model of Childhood Obesity (Figure 1) provides a broad framework for understanding the mediators and moderators of childhood obesity. This overview highlights evidence-based factors on which clinicians can focus efforts to effectively prevent the development of childhood obesity. In this chapter, we will review both general and age-specific risk factors for pediatric obesity and discuss specific strategies for intervention at the level of the pediatrician, school, government, and family.

RISK FACTORS

Genetic Risk Factors

Obesity is commonly known to “run in families.” The genetic contribution to this observation is difficult to discern, however, as families usually share not only genetic material but environments and habits as well. Obesity in children correlates with obesity in their parents, and the level of obesity in children increases when both parents are obese, as well as with increasing levels of obesity in the parents[15]. Indeed, it has been shown that parental overweight is the most significant risk factor for childhood overweight [16]. Children's food choices and eating behaviors are learned from parents at very young ages and influence eating behaviors as children get older [17,18].

Although the vast majority of cases of childhood obesity are exogenous, a small proportion may have endogenous causes. The following genetic disorders, both syndromic as well as monogenic in origin, predispose children to obesity:

- Syndromes: trisomy 21, Prader-Willi syndrome, Albright's hereditary osteodystrophy, Cohen syndrome, Bardet-Biedl syndromes, Alstrom syndrome, and WAGR (Wilms' tumor, aniridia, genitourinary anomalies, and retardation) [19,20].
- Monogenic disorders: leptin deficiency, leptin receptor mutations, proopiomelanocortin deficiency, preproconvertase deficiency, and melanocortin 4 receptor mutations[19].
- Hormonal disorders: hypothyroidism, growth hormone deficiency, Cushing's syndrome, hypothalamic obesity, polycystic ovary syndrome, and hyperprolactinemia[19].

Environmental/Societal Risk Factors: The child's living environment, both in the home as well as in the community, can contribute to a higher risk of development of obesity:

- Living in lower-income, predominantly white, or non-mixed-race neighborhoods[21].
- Parents' perceptions of the food and physical activity environments in their neighborhoods
- Difficulty getting to a main food store or difficulty purchasing fruits and vegetables there (food desert)
- Increased distance from parks
- Perceived danger of their neighborhood[21]
- Food insecurity, although the evidence is mixed[21,22]

Behavioral Risk Factors

Nutrition and Diet—Although it might seem logical that increased total energy intake should be associated with a higher risk of childhood obesity, the evidence does not support this relationship [16,23]. Similarly, the relationship between dietary fat intake and childhood obesity is not clearly established[23]. A lower intake of dairy products or calcium is associated with childhood obesity, but the data regarding intake of fruits and vegetables is mixed and does not indicate a strong association with childhood weight status [23,24]. Beverage choice may increase risk for childhood obesity: fruit juice, especially in large quantities [23]; sugar-sweetened beverages [23,25]; and sodas [23,26,27] are all positively associated with childhood obesity.

Some specific eating behaviors have been associated with childhood obesity. Skipping breakfast [23,28,29]; eating meals away from home, especially fast food [23]; quicker eating pace[30]; larger portion sizes [23]; and eating in the absence of hunger [30] are all positively associated with childhood obesity. No consistent association has been identified with frequent snacking[23,31], while eating meals as a family is inversely associated with childhood obesity[22,23].

While there can be conflicting evidence, or less-than-clear associations, clinicians can be confident in addressing intake of unhealthy foods, such as fast food, sugar-sweetened beverages, high-fat proteins and processed snacks, and encourage intake of healthy items, particularly fruits, vegetables, lean meats, and sugar-free beverages. Underneath the intake of these foods are the habits behind them, which the clinician should be cognizant of during an interaction: foods eaten away from home, eating in the absence of hunger, snacking and family meals. Awareness of these issues can assist clinicians in working with families to prevent the development of unhealthy habits and build healthy ones to prevent excessive weight gain.

Physical Activity—Overall, decreased physical activity among children is associated with obesity [16,23,32,33]. Prospective studies objectively measuring physical activity have yielded inconsistent results; however, studies of either self-reported or parent-reported physical activity have demonstrated an inverse relationship between physical activity and both

childhood and future adult obesity [32]. An inverse relationship exists between some specific activity-related behaviors and childhood obesity, including sports team participation and active commuting to school [34].

Physical inactivity and sedentary behaviors are likely associated with childhood obesity [23,27,32], although the effect size may be small [16]. Some prospective studies have found that more hours engaged in sedentary behavior, specifically watching TV or playing video games, was associated with an increased risk of becoming obese in the future [23,32]; however, other studies found no association between sedentary behavior and childhood obesity[35]. Increased screen time, including television[35] and electronic devices [36], is also associated with childhood obesity. While increased sedentary time and decreased physical activity are both associated with childhood obesity, they may not be inversely proportional. Regardless, efforts to lower the former and increase the latter will be key to preventing obesity development.

Sleep—While there is less evidence regarding sleep, it does appear that shorter sleep duration is associated with childhood obesity [22,37]. Some prospective studies have borne out this association, both in the short term in young children [38] and in the long term, persisting into adulthood [39]. In combination with other positive household routines (eating as a family and limiting screen time), obtaining adequate sleep has a strong inverse relationship with obesity among preschool-aged children [40].

Stress—The short- and long-term effects of stress on the development of obesity are an emerging area for research. There are several types of stress that can affect a child: personal, parental, and family. Each of these can increase the child's risk for obesity independently or in concert. Although the data is somewhat mixed, it is likely that there is a positive association between chronic stress and the risk of childhood obesity [41]. This can manifest during childhood[42] and may persist into adulthood[43]. In many studies, parental stress is associated with obesity in children; this relationship is strengthened when a parent experiences stress from more than one source[41]. Similarly, stress within the family is also associated with childhood obesity[41] (Box 1).

DEVELOPMENTAL APPROACH TO OBESITY PREVENTION

Many of the risk factors outlined above, related to diet, physical and sedentary activity, and sleep, apply to children of many different ages. Other risk factors for pediatric obesity may apply at distinct development stages, offering specific opportunities for intervention by a primary care provider. These stage-specific risk factors have been identified as early as the prenatal period. While obesity in either parent may increase the child's risk, as discussed above, the mother's pre-pregnancy BMI and gestational weight gain have been directly associated with obesity in infancy and early childhood[44–47]. Maintaining gestational weight gain within the Institute of Medicine guidelines[48] (see Table 1) is especially important for women who are overweight or obese at the time of conception and should be an important component of prenatal counseling. Both over- and under-nutrition at this stage are thought to affect fetal programming and predispose to future obesity and metabolic disorders[19,49]. One recent meta-analysis identified a moderate association between delivery via cesarean section

and offspring obesity, with persistence of the association into adulthood[50]. In addition, maternal exposure to tobacco[45,51,52] and caffeine[53] have both been associated with obesity at various points during gestation and throughout a child's life.

Additional risk factors become evident in infancy. High birth weight and rapid infant weight gain correlate with future childhood obesity[45], although they may be difficult to address specifically as modifiable risk factors. Many studies have attempted to determine optimal dietary intake during infancy, but the results are conflicting. While many studies suggest that breastfeeding is protective against the development of obesity[45,54,55], others show no relationship[56,57]. These differing results may be due to confounders present in the study; for example, it has been shown that lower protein content in infant formula is protective against obesity at 6 years, so studies on breastfeeding may differ based on the types of formula used by control infants. Results have also been mixed when assessing the effects of duration of breastfeeding[45]. It has been suggested that it is the infant's degree of self-regulation while breastfeeding rather than the composition of breastmilk which may be protective, so that bottle-feeding either formula or pumped breastmilk may be associated with increased risk[58].

Complementary foods represent another important dietary change during infancy, and both the timing of introduction and food selection may impact future risk of obesity. Early introduction of solids (defined as ages <3 to 5 months depending on the study) may be associated with increased childhood overweight[59]. Similarly, one systematic review concludes that higher intake of protein and energy during infancy can be associated with increased BMI[60], although other studies conclude that no specific complementary foods are associated with increased risk[61]. Overall, the available evidence makes it difficult to establish firm guidelines for infants' dietary intake.

Other exposures in infancy have also been investigated. Use of broad-spectrum antibiotics, especially with repeated exposures prior to 23 months of age, has a small but significant association with obesity in early childhood[62]. Studies have yielded mixed results for family socioeconomic status, maternal parity, and maternal marital status[45]. Finally, temperament traits identified as early as infancy, especially early negativity and lack of self-regulation, may predispose to later obesity[63,64].

Child temperament and parental feeding practices remain important predictors of obesity for toddlers and preschool-aged children. The concerning character traits are thought to be similar to those seen in infancy, particularly poor self-regulation and distress to limitations[64]. Part of the mechanism of this association may reflect parental response to the child's temperament, especially if parents initiate restrictive feeding practices given concerns over self-regulation or use emotional feeding habits, such as providing obesogenic foods to soothe a negative child[61,64]. Children are typically weaned from the bottle as toddlers; the timing of this transition may affect obesity risk. At earlier ages (between 12–36 months), there is an association between current bottle use and obesity, but this was not seen at later ages (37–60 months)[65]. Furthermore, an intervention centered on bottle-weaning effectively reduced total caloric intake in children but did not change overweight status[66], so the degree to which prolonged bottle use contributes to obesity risk is unclear.

Although sedentary behavior and screen time are concerns for children of all ages, one systematic review suggests that preschool children are most amenable to interventions addressing this risk factor[67]. Weight gain in this age group is known to be highly predictive of later obesity, with an earlier adiposity rebound (at less than 5 years old) associated with both BMI and adiposity at age 15 years[68]. Therefore, this is an important age group to target as effective interventions are identified.

Most studies of obesity in school-aged children focus on interventions delivered within the school system, which will be discussed later under Policy and Environmental Interventions. However, some research has shown that children with overweight and obesity actually gain more weight during the summer months than during the school year[69,70], suggesting that interventions outside of school should also be investigated. The primary difference noted between the school year and summertime is in the level of physical activity[70]. One intervention that has shown success in increasing physical activity in this age group, as well as adolescents, is exergaming, or use of electronic games designed to promote physical exercise[71]. While the video game experience makes activity more entertaining for children, use of exergames in several studies was found to increase energy expenditure and time spent on physical activity and to reduce waist circumference[71]. These findings suggest that targeting known risk factors during the summer months may be especially important for obesity prevention at this age.

Use of technology for obesity prevention continues to be important in the adolescent age group. Technology-based interventions targeting both diet and exercise have been shown to be effective in this population, although there is wide variation among studies[72]. Peer groups also take on increased importance during adolescence, and research has attempted to determine how this influences the risk of obesity. Peers are able to influence diet and activity levels in both positive and negative ways[73,74], so the inclusion of the peer group in interventions targeting adolescents is important[74].

Adolescence is a time of significant biological changes, most notably puberty. While there is a clear association between early puberty and obesity, it is difficult to determine cause and effect since pre-pubertal BMI influences the timing of puberty[49]. Some studies have demonstrated an effect of early puberty on subsequent adiposity and fat distribution, but results have been mixed[49]. Severe obesity in adolescence has been directly associated with poor health outcomes in adulthood[75], which makes prevention in this age group especially important. In addition, as they represent the next generation of parents, establishment of healthy lifestyle habits in the adolescent population has the potential to decrease the obesity risk of subsequent generations (Box 2).

ROLE OF THE PRIMARY CARE PROVIDER

Primary care providers play a unique role in the prevention of obesity as they see the same patients and families, often from birth, on a regular basis (Box 3). This gives them the opportunity to provide anticipatory guidance and counseling that can influence families' nutrition and physical activity habits. As discussed above, it is well established that there are strong familial links to obesity, both genetic[15,16] and environmental[18]. These influences do

not dictate fate, however. By recognizing risk factors early in a child's life, primary care providers can help families make positive changes that will improve a child's weight trajectory[76].

Pediatricians should screen for obesity by measuring height and weight and calculating BMI at least annually[77–79]. By following children closely over time, physicians are in the position to detect weight problems by observing trends, such as a rapidly increasing BMI, even before a child becomes overweight. When a child is discovered to be overweight or at risk for becoming overweight, physicians should provide brief counseling and suggest weight control interventions[77,79]. We recommend that clinicians use motivational interviewing techniques (see Figure 2)[77,80–83] when counseling patients and their families about making life changes.

Primary care providers offer anticipatory guidance about nutrition and physical activity at each well child check. This anticipatory guidance should be age appropriate and can significantly shape how and what parents feed their children. All children, even those of a healthy weight, benefit from counseling about general health and wellness, and this does not need to be framed around weight. Recommended anticipatory guidance for each age range is outlined in table 1 [23,32,77,84–95].

Primary care providers should advocate for their patients and families; to build community-wide efforts to prevent obesity, clinicians can look to successful models in other areas to support their efforts. The chronic care model[96] provides a useful framework for pediatricians to provide care to children who are overweight or obese. The chronic care model recognizes that families' self-management is dependent on support both from the medical system and their surrounding environment, such as school, work, and the community. Ideally, primary care physicians should be connected with numerous community resources, such as nutrition and exercise programs[77,96]. The chronic care model has been successfully implemented by health-related organizations such as Kaiser Permanente, that provided education for providers in motivational interviewing, and Wellpoint, that distributed parental toolkits to families in clinic[77].

Advocating for children's health and healthcare is an important role for pediatricians to embrace on both a local and national level, examples of areas for advocacy include:

- Third-party reimbursement to ensure that children continue to have access to services necessary for obesity prevention and treatment, such as yearly BMI screening and well-visits with their primary care provider
- Funding for research to prevent childhood obesity
- Promotion of healthy foods and beverages and physical activities in schools and daycares
- Maintenance of safe neighborhoods that encourage physical activity
- Availability of healthy food[26]

POLICY AND ENVIRONMENTAL INTERVENTIONS

Using the Socio-ecologic Model as a guide[14] on a societal level, policy and environmental interventions have the potential to exert the farthest-reaching influence in thwarting obesity[97]. Policy changes can address physical, economic, social or communication factors and may range in scope of efforts that target:

- A whole population: national or state legislation; industry-wide improvements; social marketing), or
- Population subsets or large groups: state or regional ordinances, or
- Local or smaller groups: single organization or community[98].

Policies can be formal documented standards or laws, or informal practices (e.g. a medical office giving patients stickers vs. candy). The over-arching goals are for policies to prevent obesity by: 1) increasing awareness of and actions to change attitudes and norms to support healthy energy balance; 2) making healthy options for physical activity and nutrition readily available and, where possible, the default choices; and 3) reducing barriers to making healthy choices.

For maximal impact, policy changes should be informed by the existing science of obesity prevention and established theories of behavior change, such as Social Cognitive Theory[99], Self-Determination Theory[100], and/or the Trans Theoretical Model of Behavior Change[101], and subsequently evaluated by rigorous studies demonstrating both feasibility and effectiveness. Optimally, studies of policy are thoroughly evaluated with application of appropriate methods such as the RE-AIM (Reach, Effectiveness, Adoption, Implementation and Maintenance) framework[102]. Where large studies have not been completed, efforts should be evidence-informed and practice-tested[103]. Once enacted, there should be ongoing monitoring of fidelity and accountability of policies for effectiveness and use of resources, with attention to social factors that contribute to inequality in access to healthy choices. Although the body of literature assessing polices for obesity prevention is growing, there are still many areas actively under study or for which evidence is inadequate for a definitive recommendation for wide scale adoption[98,104].

Select examples illustrative of policies with growing support and/or evidence and ranging in scope are shown in Table 2, and for specific settings in which children spend substantial time are shown in Table 3

Notable recent progress in the policy arena has occurred in standards for food programs affecting children including application of the 2010 United States Department of Agriculture (USDA) Dietary Guidelines for Americans to schools[109] and science–based nutrition standards for meals offered in daycare and after-school programs through the pending Child and Adult Care Food Program (CACFP). These changes are largely a result of passage of the Healthy and Hunger-free Child Act of 2010 that was motivated in large-part to curb the obesity epidemic[110]. The Act included several components to ensure meals served to children include more fruits and vegetables, whole grains, and less sugar and fat, while also promoting breastfeeding and increasing access to healthy beverages (water, low-fat or fat

free milk). Related changes are evident in the revised food package offered to participant in the Women, Infants and Children (WIC) program since 2007 and broadening of educational messages and materials supported by the Supplemental Nutrition Assistance Education Program (SNAP-Ed) Programs to include emphasis on energy balance and obesity prevention.

Despite progress in recent decades, there remain many areas for which evidence is insufficient or policies are lacking, emerging or facing challenges[97]. Although there are signs of growing partnership, remaining barriers include involvement of the food industry, marketing, and entertainment venues along with pervasive social and cultural attitudes and influences. Resistance may exist due to factors such as economic pressures or underlying fundamental political or philosophical tension between government vs. individual/parent rights and freedom of choice. Some barriers may be reduced as more evidence demonstrates links between academic performance and health/obesity status or health behaviors (to support policy changes in the school setting) or the economic benefits of a healthier population/workforce to factors such as defense preparedness and economic measures (to support changes in business and industry).

Pediatricians, primary care providers and any professional or individual with an interest in obesity prevention for children can actively support efforts in policy or environmental changes through lending expertise, providing advocacy or local support, or by leading and role modeling in one's own work setting and community (Box 4).

THE FAMILY

While environmental pressures at the national and community level contribute greatly to a child's risk of obesity, “families are the most central and enduring influence in children's lives… The health and well-being of children are inextricably linked to their parents' physical, emotional and social health, social circumstances, and child-rearing practices” (Schor 2003, page 1542)[111]. Inclusion of the family is established as the gold standard of treatment[77]. The same can and should be said for the prevention of obesity. As mentioned previously, a child's risk of obesity is greatly influenced by parental weight status. While the genetic contribution to the child's weight is great, the environmental influence is likely greater: parental obesity can predict genetic susceptibility, but a child's environment can determine the expression and severity of that risk[112]. Despite any genetic predisposition to obesity, the environment is likely the greatest potentially modifiable determinant of obesity, with the family being the most proximate of that environment. Determining exact familial components contributing to a child's weight is difficult, however, given the changing nature of families over the past few decades, and the complexity of studying and conceptualizing families[113]. As presently understood, family-related risk-factors for childhood obesity include[114]:

- Minority ethnic and cultural background
- Single parent household
- Lower maternal education

- Parent obesity status and family history of obesity
- Poverty: receipt of supplemental food assistance
- Higher levels of television viewing of family, particularly during meals, amounts and locations (bedrooms)
- Restrictive parental feeding practices

Of the risk factors above (out of a total of 22 studied), parental feeding practices and parent BMI were most associated with child weight status (child sleep duration was also determined to be significantly associated)[114]. These findings are preliminary, as the extensive, long-term studies necessary to link risk with later obesity development have not yet been performed. Clinicians should customize risk assessments to each family, knowing that sound anticipatory guidance can be safely provided to all families regardless of weight status and risk for later obesity.

Parenting styles and the risk of childhood obesity have been investigated extensively, though there are many areas still in need of study. As with many aspects of complex problems, such as childhood obesity, long-term definitive studies are lacking. However, research over the past decade has provided useful information about this interaction.[115,116,117,118,119]. Parenting styles are based on two dimensions of parenting: (1) demandingness, or demand for child self-control and (2) responsiveness, or sensitivity and emotional involvement. With a 2×2 table, this gives four distinct parenting styles: authoritative, authoritarian, permissive, and neglectful (Table 4). Authoritative parents had children with the lowest prevalence of obesity in Rhee's study of 1st graders, while authoritarian, or strict disciplinarian, parents had children with the highest prevalence of obesity, more than even permissive or neglectful parents. These findings are important, as parents of children with obesity could be more likely to institute dieting or restrictive behaviors to help their children lose weight. While this has not been proven or extensively studied, it provides guidance to clinicians and parents encouraging an authoritative approach to parenting, and specifically feeding, their children. A non-restrictive approach to early childhood feeding, while providing structure and healthy meals, is important for parents of young children to ensure healthy eating habits.

The bulk of parenting research and prevention of childhood obesity relates to early childhood feeding, though many principles can likely be extended to older age groups. Analysis of an older study identified the importance of healthy parenting skills, even if the focus is not obesity or weight-related behaviors[120]. Brotman et al reviewed outcomes of children at high risk for behavioral problems and high risk for obesity[120]. These children and their parents were part of an intervention aimed to improve parenting skills at age 4, then followed for 3–5 years. The intervention group had significantly lower prevalence of obesity as well as healthier nutrition and activity habits than control groups, despite the intervention not having a focus on nutrition, activity, or weight. Another representation of the importance of family is the influence of regular family meals, which appear to improve the nutritional status and weight of children[121], and “bleeds over” to improve family relationships and decrease risky behaviors[122]. Positive interaction between members during family meals may contribute just as much to these positive outcomes as changes in nutritional intake[121].

Despite this promising research, there are no clear answers on how to become an "obesity-resistant family." Future research must account for the complexity of families and may utilize established approaches, such as family systems theory, which views the family as more than the sum of its parts and respects its complex dynamics and function[113]. Increasing focus on family dynamics and communication will be key to successfully preventing childhood obesity within the context of the family (Box 5).

SUMMARY

Childhood obesity is a complex medical issue, representing the interplay of physical and environmental factors. The neuroendocrine control of weight includes multiple situations where genetic variation can influence a person's weight status. Unfortunately, the unhealthy evolution of food and activity environments has placed children at a higher risk for obesity and associated weight problems than they ever have been before. Although significantly more research is needed to optimize these strategies, interventions at the level of the pediatrician, school, government, and family have shown success in the prevention of childhood obesity.

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SYNOPSIS

The overweight and obesity epidemic among children and adolescents in the United States continues to worsen, with notable racial, ethnic, and socioeconomic disparities. Risk factors for pediatric obesity include genetics; environmental and neighborhood factors; increased intake of sugar-sweetened beverages, fast-food, and processed snacks; decreased physical activity; shorter sleep duration; and increased personal, prenatal, or family stress. Pediatricians can help prevent obesity by measuring body mass index at least yearly and providing age and development-appropriate anticipatory guidance to families. Public policies and environmental interventions aim to make it easier for children to make healthy nutrition and physical activity choices. Interventions focused on family habits and parenting strategies have also been successful at preventing or treating childhood obesity.

KEY POINTS

- Childhood obesity is a complex medical issue, representing the interplay of physical and environmental factors.
- The neuroendocrine control of weight includes multiple situations where genetic variation can influence a person's weight status.
- The unhealthy evolution of food and activity environments has placed children at a higher risk for obesity and associated weight problems than they ever have been before.

Box 1. Review of Risk Factors for Pediatric Obesity

- Genetic Syndromes, monogenic disorders, or hormonal disorders
- Living in neighborhoods that are lower-income, predominantly non-mixed-race, perceived as dangerous, or are an increased distance from parks and foods stores
- Increased intake of sugar-sweetened beverages, fast food, and processed snacks
- Decreased physical activity
- Shorter sleep duration
- Increased personal, prenatal, or family stress

Box 2. Review of Developmental Approach to Obesity Prevention

- Prenatal – appropriate gestational weight gain, no tobacco exposure
- Infancy – minimize rapid weight gain, later introduction of solid foods, avoid broad-spectrum antibiotics as possible
- Toddlers – encourage self-regulation of feeding and lots of physical activity
- School-aged children – exergaming, use of technology-based interventions to improve nutrition and physical activity
- Adolescents – include peer groups in interventions

Box 3. Review of the Primary Care Provider's Role in Preventing Obesity

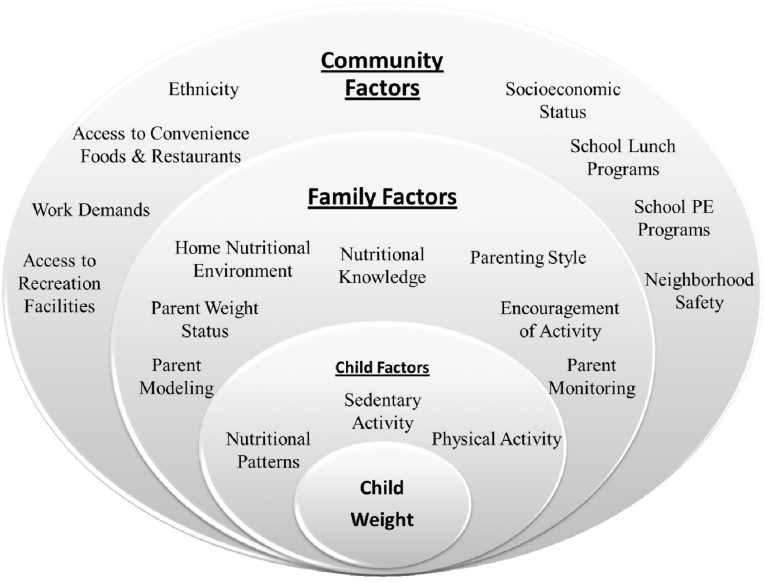
- Measure height and weight and calculate BMI at least annually, observing for trends such as a rapid increase in BMI
- Offer anticipatory guidance about nutrition and physical activity at every well child check
- Use motivational interviewing to help families to make healthier choices
- Advocate for children on a local and national level

Box 4. Review of Policy and Environmental Interventions to Prevent Obesity

- Improve attitudes and norms to support healthy energy balance
- Make healthy options for physical activity and nutrition easy and the default choices
- Reduce barriers to making healthy nutrition and physical activity choices
- Substantial progress has been made- policy changes are underway and are being evaluated

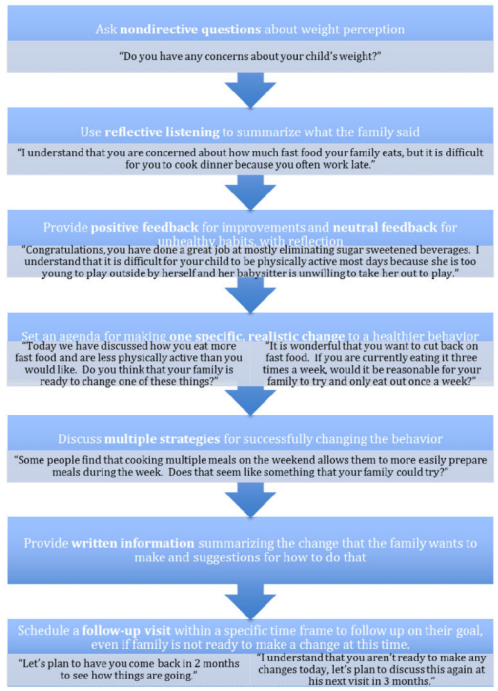
Box 5. Review of the Family's Role in Preventing Pediatric Obesity

- Include the entire family in obesity prevention and treatment
- Act as positive role models to children regarding healthy nutrition, physical activity, and emotional and social health
- Practice authoritative, not authoritarian, parenting styles
- Have a non-restrictive approach to early childhood feeding
- Provide structure
- Have regular family meals



(Adapted from Davison KK, Birch LL. Childhood overweight: a contextual model and recommendations for future research. *Obesity reviews.* 2001; 2(3):159-171; with permission.

Figure 1.
Ecological Model of Childhood Obesity



Data from Barlow SE, Expert C. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics*. 2007;120 Suppl 4:S164-192

Figure 2.
Motivational Interviewing to Help Families Make Positive Changes to Prevent Obesity

Table 1

Anticipatory guidance and specific interventions by age and developmental stage

	Nutrition	Physical Activity/Other	Specific Interventions
Prenatal Period	- Avoid over- and under-nutrition during pregnancy - Avoid caffeine	- Avoid tobacco	- Weight gain per IOM guidelines: Underweight: 28-40lbs Normal-weight: 25-35lbs Overweight: 15-25lbs Obese: 11-20lbs
Newborn-6 months	- Exclusive breastfeeding until 6 months - Only breastmilk or formula, no sugar sweetened beverages (SSB) - Be mindful of child's feeding cues - Allow child to feed at their own pace - Stop feeding when child is done - Don't put to sleep while feeding - No television, especially while feeding	- Tummy time - No screen time or television	- Avoid broad-spectrum antibiotics if possible
6–12 months	- Continued breastfeeding until 12 months and beyond - Introduce solids when developmentally ready (sit, open mouth on cue, close mouth around spoon) - Encourage fruits and vegetables - Finger foods with soft table foods - Wide variety of textures and flavors - Continue to offer foods that a child has previously not liked - Structured meal and snack times	- No screen time or television	- Avoid broad-spectrum antibiotics if possible
12–24 months	- Limited sugar-sweetened beverages - Eat together as a family at structured meal and snack times - Sit at table for all snacks, drinks, and meals - Prepare foods in a variety of ways - Limit eating at restaurants, especially fast food - Let child choose how much of offered food to eat	- <1 hour of screen time per day	- Consider early bottle weaning - Avoid broad-spectrum antibiotics if possible - Avoid restrictive or emotional feeding

	Nutrition	Physical Activity/Other	Specific Interventions
	- Encourage positive parent modeling - Provide perspective on portion size		habits
24–48 months	- Realistic expectations for table manners - 3 meals a day at set times - No grazing between meals except for scheduled snacks	- <2 hours of screen time per day	- Avoid restrictive or emotional feeding habits
4–12 years	- Set some basic rules, then allow child to choose after-school snack	- At least 60 min of moderate to vigorous physical activity daily	- Consider technological interventions
13–18 years	- Allow child to take responsibility for choosing and eating meals away from home - Expect child to be hungry at dinner - Teach how to plan and prepare meals and snacks	- 60 min physical activity daily	- Consider technological interventions - Involve peer groups in interventions

Table 2

Policy examples: Ranging in Scope

Scope	Examples of policies or environmental strategies
Site-specific	• Banks, stores, professionals give incentives for children that do not contribute to unhealthful habits or energy imbalance (example: stickers instead of candy; balloons instead of cookies)[c] • Corner stores and quick marts offer low fat/sugar snacks, fruits and vegetables[b] • Entertainment venues offer healthful options, water; allow outside (home-packed) foods[c] • Point of decision prompts- (elevator vs. stairs initiatives; menu, cafeteria or buffet signage and prompts[a]
Local	• Establish shared use agreements for physical activity space and equipment[b] • Promote ways to allow active transport to and from school (bike lanes and racks, crossing guards, group walks to school)[b] • Emphasize maintaining or re-establishing time for recess, physical activity, physical education[b] • Support school and community gardens, partnerships with local farmers[c] • Access to safe, free drinking water in recreation environments[b]
State	• Subsidies for schools/childcare sites for provision of healthy foods[a] • Incentives for grocers in rural or urban areas[c] • Mechanism for small vendors (farmers markets) to take SNAP (“food stamps”) cards[c] • Medicaid coverage for dietician services and preventive counseling[c] • Support for increasing sites and access for recreation[a]
National	• Healthy and Hunger Free Kids Act (HHFKA), including standards for meals in school (e.g the National School Lunch Program)[a] • Changes to Women, Infant and Children (WIC) food package and Supplemental Nutrition Assistance Program (SNAP) policies[a] • Changes to SNAP-Ed guidance for educational programs[a] • Menu labeling for restaurants[b] • Laws addressing advertising to children[c] • Food and beverage industry incentives[c]
International	• Published guidelines for member states for population level strategies for obesity prevention across settings[105]

[a] Evidence or existing systematic review to support[98].

[b] Emerging strategy but more data needed[98].

[c] Sample policy change needing pilot data and further study

Table 3

Examples of Policies and Programs in Settings where Children Spend Substantial Time

Setting	Example program	Description
General efforts may target	• Education about energy balance and negative health effects of obesity • Promotion of more opportunities for and enjoyment of physical activity • Offering age-appropriate portion sizes following USDA guidelines • Assuring program staff are knowledgeable and appropriately trained • Establishing and implementing local wellness polices • Improving quality and time in Physical Education (PE); working to designate PE as a core subject	
Childcare	• Nutrition And Physical Activity Self-Assessment for Child Care (NAP SACC; www.goNAPSACC.org)[a]	• Self-assessment, action planning, and educational tools to help early care and education programs set goals and make improvements to their nutrition and physical activity practices.
Elementary school	• Coordinated Approach To Child Health (CATCH, www.CATCHinfo.orR)), based on evidence from the Child and Adolescent Trial for Cardiovascular Health[a]	• Multifaceted intervention in elementary schools grades K-5: implemented in the classroom, cafeteria, PE and families to foster healthy behaviors in diet and PA[106]
	• SPARK program to improve physical education (www.SPARKPE.org)[a]	• Toolkit and training for schools to improve and increase PA time in PE
Middle School	• Motivating Adolescents with Technology to CHOOSE Health™ (MATCH; www.MATCHwellness.org)[b]	• Combined multidisciplinary educational-behavioral wellness intervention embedded in curriculum in 7th graders taught by classroom teachers over 4–5 months to build skills in healthy choices[107]
After school	• SPARK afterschool[b] (www.SPARKPE.org)	• As above for SPARK, targeting afterschool settings
	• Move More NC: Recommended Standards for Afterschool Physical Activity[b]	• Recommended standards for afterschool programs to increase and enhance quality of PA time[108]

[a] Evidence or existing systematic review to support the strategies included in this program.

[b] Addresses components with supporting evidence but further studies needed.

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Table 4

Parenting Styles

		High expectations for self-control	Low expectations for self-control
High Sensitivity	Authoritative: respects child's opinions but with clear boundaries	Permissive: minimal discipline, indulgent of child	
Low Sensitivity	Authoritarian: strict, significant discipline	Neglectful: no boundaries or discipline, minimally involved with child	

Data from refs[117,123,124]