

# Management approaches for pediatric obesity

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## SUMMARY

Childhood obesity is a worldwide problem that has reached epidemic proportions, resulting in an increased prevalence of premature obesity-related morbidities, and, thus, probable increased health-care costs to treat children. The development of viable approaches to manage this epidemic is crucial. Most experts in the field of childhood obesity agree that the prevention of obesity in children should be the first line of management. Pediatricians must be adept at recognizing children at risk of obesity, calculating and plotting the BMI at all visits, using a change in the BMI to identify excessive weight gain, and monitoring for comorbidities associated with obesity. If obesity is present, the cornerstone of treatment is modification of dietary and exercise habits. Practice-based counseling and community-based programs that support and encourage lifestyle modifications have yielded promising short-term results. Children with severe comorbidities who are unable to achieve lifestyle modifications can be considered for either pharmacologic therapy or surgery, but these options should be considered as a last resort. Early intervention and prevention strategies are the most cost-effective methods of dealing with this issue.

**KEYWORDS** office-based interventions, pediatric obesity, therapeutic options

## REVIEW CRITERIA

We searched for original articles focused on childhood obesity in MEDLINE and PubMed and published between 1990 and 2007. All papers identified were English-language, full-text papers. We also searched the reference lists of identified articles for further papers.

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### Learning objectives

Upon completion of this activity, participants should be able to:

- 1 Describe the prevalence of overweight and obesity among children.
- 2 Identify contributing factors to the recent rise in pediatric obesity.
- 3 Describe the change in prevalence of insulin resistance and type 2 diabetes among US adolescents.
- 4 Identify ethnic groups in the United States at increased risk for type 2 diabetes and obesity.
- 5 List the most common complications of gastric banding.

## INTRODUCTION

More than one billion people worldwide are affected by obesity.<sup>1</sup> Between 1963 and 2004, obesity rates more than tripled among adolescents (from 5% to 17%), more than quadrupled among children aged 6–11 years (from 4% to 19%), and more than doubled among children aged 2–5 years (from 5% to 14%).<sup>2</sup> Currently, greater than 30% of children in the US<sup>3</sup> and over 22 million children under 5 years of age worldwide<sup>4</sup> are overweight or obese. Obesity has, furthermore, replaced malnutrition as the major nutritional problem in several parts of Africa, with overweight or obesity being up to four times more common than malnutrition.<sup>5</sup> The most devastating statistic, however, is that even the very young are affected by this epidemic—almost 12% of infants aged 6–23 months in the US are currently classified as overweight.<sup>6</sup>

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Here, we discuss factors that have contributed to this epidemic and the effects of childhood obesity on the overall health of these children. We then discuss lifestyle modifications and approaches that physicians, schools, and parents can use to prevent childhood obesity or ameliorate this condition once it has occurred.

### **ENVIRONMENTAL CONTRIBUTIONS TO CHILDHOOD OBESITY**

There has been much debate about the cause of the current epidemic of obesity. Most experts agree that the increased prevalence of childhood obesity cannot be blamed on changes in either the environment or genetics alone. Environmental changes (i.e. nutrition and lifestyle) are, however, likely to be primarily responsible for the current epidemic, because it is not possible for the gene pool to change in less than one generation.

The past few decades have brought lifestyle changes throughout the world that have resulted in children having reduced physical activity and increased caloric intake. Children use cars and other automated means of transportation, including elevators and escalators rather than walking or climbing stairs, to get from place to place. The amount of time that children spend playing outside has diminished during the past few decades and physical education programs in schools have been reduced or eliminated.<sup>7</sup> The majority of families now have both parents or the single parent working, resulting in the need for nonparental supervision after school. Fear of children playing outside without adult supervision has led many parents to admonish their children to stay inside after school.

Children are thus spending more time watching television and playing on computers than exercising.<sup>8</sup> Watching television has been directly linked to obesity in childhood, with a rate of obesity that is 8.3-times greater in children who watch more than 5 h of television per day compared with those who watch up to 2 h of television per day.<sup>9</sup> Many parents rely on schools to provide their children with an appropriate amount of exercise, but only 25% of students participate in daily physical education classes.<sup>10</sup> Only 22% of American children meet the recommendations for a basic level of activity (see below) and 25% of American children are classified as completely sedentary.<sup>11</sup>

Changes in diet have also contributed to pediatric obesity. Portion sizes in food outlets

have more than doubled during the past 20 years.<sup>12</sup> In addition to a baseline increase in portion sizes, most fast food restaurants offer up to 20% larger portion sizes at a minimal additional cost, which contain hundreds of extra calories. Children nowadays tend to take larger bites from larger portions, consume more calories, and eat fewer vegetables.<sup>12</sup> Fast food is marketed to children using toys, music, and social icons. Studies have found that children's food preferences can be influenced by exposure to television commercials of just 30 s.<sup>13</sup> On one popular children's television station, 94% of food advertising was for foods of poor nutritional value.<sup>13</sup> One-third of American children aged 4–19 years eat fast food daily; it is estimated that this increases their weight by 6 lb per year.<sup>14</sup>

Additionally, many schools now offer fast food concessions as an alternative to the school lunch. Even children who receive free school lunches spend their money on buying preferred high-fat foods. Schools receive financial incentives to allow vending machines, thus providing an increased availability of soda, juice, snack cakes, and potato chips.

### **GENETIC CONTRIBUTIONS TO CHILDHOOD OBESITY**

The genetic component of obesity has been demonstrated by studies of twins and adopted children. Analysis of twins indicates a heritability of fat mass of 40–70%.<sup>15</sup> Adopted children have BMIs that correlate to those of their biological parents but not to the fat mass of their adoptive parents.<sup>16</sup> These findings indicate that, although the environment has a crucial role in the development of childhood obesity, genetic background is also important. Early-onset morbid obesity can result from defects in genes encoding adipose-tissue-derived hormones (e.g. leptin), neuropeptides (e.g. pro-opiomelanocortin, cocaine- and amphetamine-regulated transcript protein [CART], and melanocortin 4), or the receptors for these ligands.<sup>17</sup> Although most of these monogenetic causes of obesity are rare, one study showed that up to 4% of children who become obese before the age of 10 years have a defect in the melanocortin 4 receptor.<sup>18</sup> As evaluations of the genetic etiologies of obesity become clinically available, the screening for these known causes of obesity might become routine.

### CONSEQUENCES OF CHILDHOOD OBESITY

The expected medical consequences of obesity, previously only reported in adults, are now being found in children. Approximately 17 million people in the US have type 2 diabetes and an additional 16 million people in the US have insulin resistance, or prediabetes, associated with obesity.<sup>19</sup> A recent study found that approximately 52% of a sample of adolescents in the US had insulin resistance.<sup>20</sup> Although less common than insulin resistance, type 2 diabetes in youth is becoming more prevalent. Whereas in 1990 only 4% of newly diagnosed cases of childhood diabetes were type 2, by 2001 the proportion was 45% in adolescents from areas that have a large population of African American, Mexican American, or native American children.<sup>21</sup>

In North America, African American, Mexican American, and native American populations are disproportionately affected by type 2 diabetes.<sup>22</sup> African Americans are between 1.4 and 2.2 times more likely to have type 2 diabetes than white people, and the prevalence of type 2 diabetes in native Americans is 2.8-times the overall rate in North America.<sup>23</sup> Prevalence estimates from the SEARCH for Diabetes in Youth study indicate that 6% of non-Hispanic white youths aged 10–19 years had type 2 diabetes, whereas 76% of age-matched American Indian youths had the disease.<sup>24</sup> Several school-based studies have found that the prevalence of impaired fasting blood glucose levels in young children who are obese ranges from 2.5% to 40.5%, with the highest prevalence in schools that have a higher percentage of Hispanic and African American students.<sup>24–26</sup> Type 2 diabetes is more common in girls than boys, with one study showing that up to 80% of children who develop type 2 diabetes are female.<sup>20</sup> The prevalence of type 2 diabetes in children has largely paralleled the increased prevalence of obesity.

Additional medical complications owing to childhood obesity include an increased prevalence of the metabolic syndrome, which features obesity, carbohydrate intolerance or type 2 diabetes, hypertension, dyslipidemia, and/or a prothrombotic, inflammatory vascular environment and results in an increased cardiovascular risk.<sup>27</sup> Although the increased medical costs associated with obesity-related comorbidities have recently prompted increased recognition of the problem of childhood obesity, few solutions have been proposed to address the issues of intervention and prevention.

### LIFESTYLE MODIFICATIONS

Prevention of obesity in children should be the first line of treatment. In 2003, the American Academy of Pediatrics (AAP) issued a policy statement on the prevention of pediatric overweight and obesity. This statement recommended health supervision and advocacy to prevent obesity in children. The AAP states that pediatricians should become adept at recognizing children at risk of obesity, calculating and plotting the BMI at all visits, using a change in the BMI to identify excessive weight gain, and monitoring for comorbidities associated with obesity. Additionally, the policy statement recommends that pediatricians should encourage, support, and protect breastfeeding, promote healthy eating habits, promote physical activity, and recommend limitation of television viewing. The AAP statement also encourages pediatricians to become advocates for the prevention of obesity, by identifying and targeting influential people for education on obesity and directing funding towards the prevention of obesity in children.

Currently, there is a paucity of studies that identify effective programs for the prevention of obesity among young children. Children of preschool and elementary ages who are overweight (i.e. a BMI above the 85<sup>th</sup> percentile for sex and age) are greater than five times as likely to be overweight during adolescence.<sup>28</sup> Public health and health policy practitioners have, therefore, lobbied for the introduction of legislation that combats childhood obesity and development of effective prevention strategies for managing pediatric obesity early in life.<sup>29</sup> Pediatric office-based techniques, such as motivational interviewing, discussing weight trajectories, and targeting modifiable behaviors, such as television viewing and physical activity, show promising results,<sup>30</sup> but studies have shown relatively high drop-out rates for families approached with intensive prevention strategies.<sup>31</sup>

The most effective programs for the prevention of obesity have targeted children, rather than their parents, teaching them self-regulation of impulse control, decision-making skills, and social competence and encouraging the reduction of sedentary behaviors.<sup>32,33</sup> Children enrolled in these programs demonstrate positive changes in their food choices, patterns of television viewing, and activity levels. Internationally, programs for the prevention of childhood obesity have also focused on individual-level

behavior changes, but they require both parents and children to institute self-regulation and changes in physical activity levels.<sup>34</sup> If obesity is not prevented, however, the cornerstone of treatment for childhood obesity is lifestyle modification.

### Exercise

Encouraging increased levels of physical activity is vital in addressing the issue of pediatric obesity. Children and families must be counseled that dietary changes alone will not be successful in causing sustained weight loss. In adults, if caloric intake decreases, the metabolism slows, resulting in decreased calorie use and difficulty achieving weight loss.<sup>35</sup> Exercise is, therefore, vital for weight loss. The Centers for Disease Control and Prevention (Atlanta, GA, US) recommends 30 min of moderate-intensity exercise on 7 days per week for every person in the US.<sup>36</sup> For individuals attempting to achieve weight loss, the Institute of Medicine (Washington DC, US) recommends 60 min of moderate-intensity exercise on 7 days per week.<sup>37</sup> These recommendations are often difficult to achieve, because barriers to exercise, such as lack of motivation, time, and support, must be overcome to achieve them.<sup>38</sup>

The benefits of exercise include an improved metabolic state, with increased insulin sensitivity (irrespective of weight loss), cardiovascular fitness, and maintenance of weight loss.<sup>39</sup> Japanese researchers showed that cardiovascular risk in adults was halved as a result of just 1 h of exercise per week over an 8-week test period.<sup>40</sup>

### Diets

Many families request information on possible diets to achieve weight loss. These families should be counseled that lifestyle modifications, not short-term fad diets, are the key to successful weight loss in children. The long-term safety and efficacy of fad diets have not been evaluated in children. In adults, hypocaloric diets, either low fat or low carbohydrate, result in weight loss, decreased blood pressure, and reduced insulin resistance.<sup>41</sup> Adults who are obese and insulin-sensitive often lose more weight on low-fat diets, whereas those who are obese and insulin-resistant typically lose more weight on low-carbohydrate diets.<sup>42</sup> Studies have shown that low-carbohydrate diets might be more effective for short-term weight loss in adults, but in the longer term there are no

differences in weight loss between low-fat and low-carbohydrate diets.<sup>43</sup>

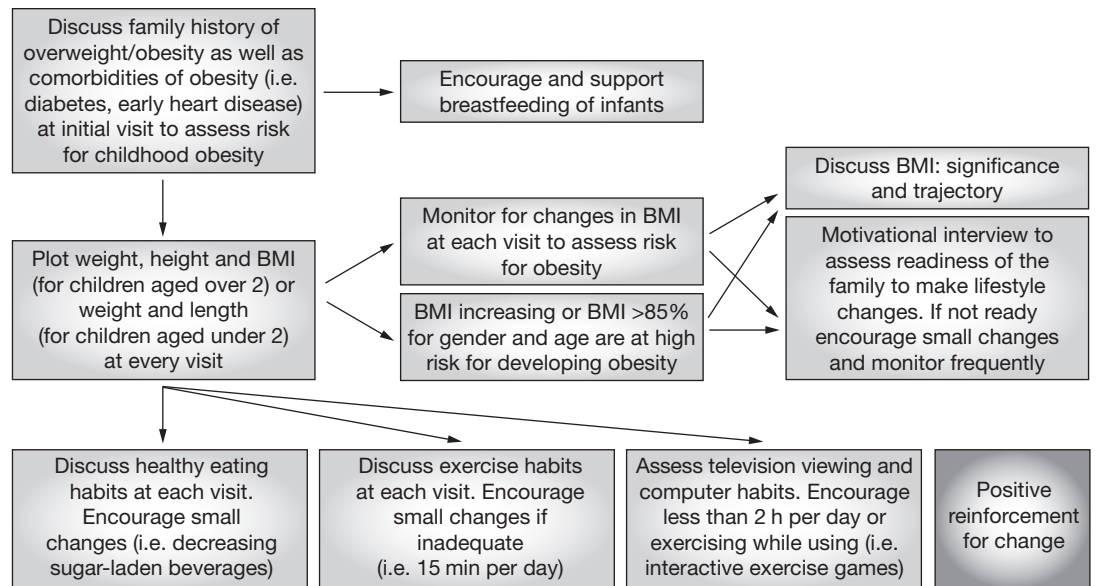
Lifestyle-modification diets usually are the most successful for long-term weight control. Two such diets are the Mediterranean diet and the Stoplight diet. The Mediterranean diet traditionally emphasizes fruits and vegetables, grains, nuts, and olive oil.<sup>43</sup> The Stoplight diet, developed by Leonard Epstein in the 1970s, teaches children proper nutrition by color-coding foods: high-calorie foods are coded red and should only be eaten rarely; moderate-calorie foods are coded yellow and can be eaten in moderation; and low-calorie foods, including vegetables and some fruits, are coded green and can be eaten freely.<sup>44</sup>

### Office-based interventions

Pediatricians and family practitioners are best placed to identify and prevent childhood obesity (Figure 1). They obtain a history to determine the risk factors for obesity (i.e. eating and exercise habits and a family history of obesity) and measure the weight and height of the child; therefore, they must make decisions on when to initiate counseling about lifestyle changes and screening for comorbidities. In 2000, the Centers for Disease Control produced BMI charts for children aged 2–20 years to assist physicians in identification of children who are overweight and obese. Despite the availability of this simple tool to assess obesity, studies have found that only 0.5–6.1% of pediatricians actually plot the BMI for children.<sup>45,46</sup> These same studies demonstrated that pediatricians accurately identify obesity in a large proportion of adolescents who have a BMI above the 95<sup>th</sup> percentile for sex and age, whereas they frequently miss obesity in toddlers and youths who are overweight but not yet obese (a BMI in the 85–95<sup>th</sup> percentile).

The inability to identify obesity in children who are younger and overweight results in missed opportunities for risk factor assessment and counseling about lifestyle changes and a decreased frequency of screening for comorbidities. Calculating and plotting the BMI of a child in the office setting at each visit is, therefore, the first, and most vital, step in determining when to intervene.

Once pediatric obesity, or overweight, is identified, the next step is assessing the readiness of the family to make lifestyle changes, including decreasing portion sizes, increasing the frequency of home cooking, decreasing the frequency of



**Figure 1** Strategies for pediatricians and family practitioners to use for the prevention of pediatric obesity.

eating out, and promoting physical activity. Motivational interviewing is one technique that has been successful in determining the readiness and perceived barriers to change, getting the child and family involved in goal-setting, and determining which changes to make between office visits.<sup>47</sup> Only two or three (achievable) goals should be set at a single visit.

Management of obesity involves the entire family. A child cannot be expected to successfully implement lifestyle changes if their environment does not change. Multiple studies have shown that individual counseling and web-based weight-loss programs are much less successful in promoting lifestyle changes for children than group-based or family-based treatments.<sup>48–50</sup> Recent studies have shown that many parents perceive that their overweight child is of normal weight.<sup>51,52</sup> If the family does not perceive that the child is obese or if they will not cooperate with lifestyle changes, then office-based interventions for pediatric obesity will not be successful.

#### Community-based interventions

Individualized programs have a dismal success rate at achieving and maintaining weight loss; therefore, community-based interventions have been implemented. These programs include parent focus groups, in addition to education of the family about exercise, diet, and behavior. Research on the effects of community-based

weight-loss programs shows that these multi-component, family-based programs are effective in the short term, especially for children aged 5–12 years.<sup>53–55</sup> This approach involves the parents in the decision-making process for planning and operating the program, so that they become invested in making the program successful.

Community-based intervention programs can also target specific risk factors for childhood obesity within communities, such as poor access to parks or playgrounds and zoning for fast-food restaurants, and ethnic populations who are at high risk of developing the comorbidities of childhood obesity. Community-based programs have been found, in the short term, to reduce the BMI and risk factors for cardiovascular disease and improve the physical performance of children. Longer-term studies are needed to see whether these benefits persist.

#### School-based interventions

Although office-based and community-based approaches are essential in addressing the issue of pediatric obesity, interventions in the school, at which children spend a majority of their day, are mandatory to combat the current epidemic of childhood obesity. Many states in the US are now making efforts to have soda removed from school campuses and mandating that school cafeterias offer healthy menus. In addition, mandatory physical education in schools is being legislated in many US states.

The Centers for Disease Control has developed a School Health Index, which targets, amongst other things, nutrition and physical activity in schools. This system is provided free of charge to schools to enable self-assessment of nutrition services, physical education and other programs of physical activity, family and community involvement, health education, and counseling, psychological, and social services. Studies of schools that have implemented this system have shown that changes in school lunch programs are acceptable to students and staff.<sup>56</sup> Additionally, other school-based studies have shown that if children are provided with basic information on diet and exercise during school, they are likely to make healthier choices and have reduced numbers of risk factors for obesity.<sup>57,58</sup> These studies indicate that relatively simple school-based interventions can lead to important changes in the risk of obesity-related diseases for children.

### PHARMACOLOGIC TREATMENTS

Lifestyle modification is the recommended modality for the achievement and maintenance of weight loss; however, dismal long-term compliance with lifestyle modification results in the families of many obese children and adolescents turning to fad diets, pharmacotherapy, or surgery to reduce the weight of their children. The long-term safety of these interventions has not been evaluated in children, but many parents, children, and practitioners are so desperate to achieve weight loss that they are willing to try anything.

Pharmacologic therapy for obesity is an option that is limited to those individuals with serious comorbidities owing to obesity who have failed to comply with a 6-month course of lifestyle modification, despite intensive efforts by the health-care team. The most popular available medications are orlistat (an intestinal lipase inhibitor), sibutramine (a central appetite regulator), and metformin (an oral hypoglycemic agent). Orlistat improves weight management in obese adolescents, but the side effects of bloating, flatulence, and stool leakage make it undesirable for many adolescents.<sup>59</sup> Studies have shown that one in three adolescents is generally not compliant with orlistat therapy because of the gastrointestinal side effects.<sup>60</sup> Orlistat is now sold over the counter for use at a relatively low dose, which has been associated with a weight loss of approximately 5% in adults.<sup>61</sup>

Sibutramine is approved for adolescents 16 years of age and older and is also effective in inducing weight loss in obese adolescents.<sup>62,63</sup> Sibutramine can cause vasoconstriction and increase heart rate and blood pressure.<sup>64–66</sup> The long-term safety of this medication is still being evaluated.

The use of metformin has been advocated for children who have obesity and prediabetes with insulin resistance, although it is not yet approved for use in this condition. The use of metformin in obese insulin-resistant adolescents results in some improvement in weight control, in addition to improved body composition.<sup>67,68</sup> These beneficial effects are likely to be due to a combination of improved insulin sensitivity and decreased food consumption in individuals treated with metformin.<sup>69–72</sup>

There are short-term studies of all these medications in obese adolescents but no longer-term data on side effects or maintenance of weight loss, and no studies have included younger children.<sup>73,74</sup> Studies indicate that adolescents who have the best weight-loss response to metformin are those who initially had the greatest level of insulin resistance (as evaluated by the area under the curve for the insulin-release response) in an oral glucose tolerance test.<sup>69,75</sup>

Other potential pharmacologic therapies for obesity include topiramate and peptide YY 3–36 (PYY). Topiramate is an anticonvulsant that induces weight loss. Although the effects of topiramate on weight loss are promising, the side effects, which include depression and difficulties with memory and concentration, make this medication unlikely to be acceptable for children.<sup>76,77</sup> PYY is a gut-derived peptide that modulates appetite circuits in the hypothalamus. PYY levels are low in obese individuals, and the administration of this hormone reduces food intake.<sup>78</sup> Pharmacologic manipulation of other gut-derived hormones and peptides related to hunger and satiety is being studied.

### SURGERY

Surgery is the last option for patients with severe obesity-related health problems who have failed to lose weight even after lifestyle modification and medication but who demonstrate a willingness and ability to change their behavior. Surgery should only be performed in a center that has an experienced surgeon and a team that includes a psychologist and a dietician. Surgical options

typically include either gastric bypass surgery or gastric banding. Gastric bypass surgery has become the most common surgical intervention for severe obesity in adults, and, because it is considered the most effective procedure for weight loss, it has now become a popular choice for weight loss in morbidly obese adolescents.<sup>79</sup> Data from several centers that perform this operation in adolescents show effectiveness, with excellent weight loss following surgery. There is, however, a paucity of long-term data and, therefore, there is uncertainty about the incidence of weight regain later in life.

Adolescents and their parents must assess the risk:benefit ratio of gastric bypass surgery and be fully aware of the possible complications of the surgery, including death and micronutrient deficiencies, in addition to a variety of other potential complications.<sup>79</sup> Gastric banding is considered a less-invasive operation because it is typically performed laparoscopically, has a much lower incidence of mortality than gastric bypass surgery, and is reversible, but it is not yet approved for use in adolescents.<sup>80</sup> Gastric banding also results in significant weight loss in obese adolescents but not to the same degree as gastric bypass surgery.<sup>81,82</sup> The most common complication of gastric banding is the need to have a repeat operation (~34%) because of gastric dilation or failure of weight loss after surgery.<sup>81</sup>

Adolescents must be carefully screened before being referred for these invasive interventions. Poor candidates, who are likely to be unsuccessful at weight loss or at high risk of postoperative complications, include those with poorly documented attempts at weight loss, inadequate family support, a lack of insight about their obesity, impaired decision-making capacity, and psychiatric problems.

### CONCLUSIONS

The prevalence of childhood obesity continues to increase throughout the world. Currently, obesity is the second-leading cause of preventable death, after cigarette smoking. If children continue to gain weight at the current rates, obesity will soon become the leading cause of death in the US. Children today are at risk of becoming the first generation that die at an earlier age than their parents. Although management strategies using pharmacologic agents and surgery are being investigated, earlier intervention and prevention strategies are more cost-effective.

### KEY POINTS

- Prevention should be the first management approach for childhood obesity
- Pediatricians must be able to recognize children at risk of obesity, calculate and plot the BMI at all visits, use changes in the BMI to identify excessive weight gain, and monitor for comorbidities associated with obesity
- If obesity is present, the cornerstone of management is modification of dietary and exercise habits

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