

## CLINICAL PRACTICE

# How can primary care providers manage pediatric obesity in the real world?

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### Abstract

**Purpose:** To provide information regarding evidence-based interventions and clinical practice guidelines as a basis for a clinical toolkit utilizing a step management approach for the primary care provider in managing childhood obesity.

**Data sources:** Evidence-based literature including original clinical trials, literature reviews, and clinical practice guidelines.

**Conclusions:** Interventions can be stratified based on initial screening of children and adolescents so that selection of treatment options is optimized. For all treatments, lifestyle modifications include attention to diet and activity level. Levels of initial success, as well as maintenance of target body mass index, may be related to the intensity and duration of interventions; involvement of family may increase success rates. For failed lifestyle interventions, or for patients with extreme obesity and/or certain comorbidities, pharmacologic or surgical options should be considered.

**Implications for practice:** Many intensive programs have shown success, but the resources required for these approaches may be unavailable to the typical community provider and family. However, using current guidelines, the primary care provider can initiate and manage ongoing interventions in pediatric obesity. A toolkit for primary care implementation and maintenance interventions is provided.

Childhood obesity has become a public health concern, both in the United States and worldwide. Because of an increasing population of obese children, the World Health Organization (WHO) has even labeled this global epidemic as “globesity” (WHO, 2006). Obese children are at risk for many comorbid conditions that can begin in childhood, continue into adulthood, and are associated with a decreased life expectancy (Williams & Strobino, 2008). Additionally, some conditions that previously were considered to be problems of adults are now evident in obese children. Experts in the field warn that children will “have a shorter lifespan than their parents” if our current practices do not address the prevention and treatment of childhood obesity (Davis et al., 2007, p. s230; see Figure 1: Haiku). Currently, 17%–19% of children in the United States aged 6–9 years old are classi-

fied as overweight or obese, based on the National Center for Health Statistics (NCHS) 2003–2004 survey (NCHS, 2006). One study including children ages 2–19 found that up to 20%–30% of the U.S. pediatric population are either obese or at risk for obesity (O’Brien, Holubkov, & Reis, 2004).

### Definitions and diagnosis

The current definitions in use in the United States of overweight and obesity have undergone revision over the years. Body mass index (BMI) measurement is now the most widely accepted method used for screening for overweight and obesity in children in the United States (Centers for Disease Control and Prevention [CDC], 2009a). Dietz and Bellizzi (1999) discussed the validity of BMI as

I am a fat kid  
 I have a fat mom and dad  
 But I will die first.

**Figure 1** Haiku for childhood obesity (author, K. F. Hopkins).

best practice for measurement of adiposity in the youth and found that “BMI offers a reasonable measure of fatness in children and adolescents” (p. 125s). In children, the BMI is plotted on a growth chart specific for age and gender revealing a percentile that relates the child’s BMI in relation to those of the same gender and age (Paxson et al., 2006). A BMI above the 85th percentile for age and gender is likely to correlate with the adult definition of overweight; a BMI above the 95th percentile correlates with the adult definition of obese (Anderson & Butcher, 2006).

### Barriers to diagnosis, prevention, and treatment

Studies have demonstrated that many providers do not regard childhood overweight and obesity as a priority diagnosis, or even a true disease. Some providers do not prioritize this diagnosis as compared to other health risks (Benson, Baer, & Kaelber, 2009). Although one of the most common chronic pediatric medical conditions, a 2002 study found that less than 20% of pediatricians were assessing the BMI of children (Caprio & Genel, 2005).

Another issue is the longstanding history of lack of reimbursement for obesity management. Medicare had a statement in their payment regulations until 2004 stating that obesity could not be considered an illness (Freedman & Stern, 2004). Time constraints and lack of provider resources such as adequate staff or access to nutritional specialists have also been cited as barriers to diagnosis and management (Peiris, 2006).

Furthermore, some providers do not feel competent in addressing obesity in children (Freedman & Stern, 2004). Personal characteristics of practitioners such as their own weight, eating habits, and exercise may influence their approach and management of obesity (Freedman & Stern, 2004). Even if screening and diagnosis take place, a “perceived futility of involvement” also exists in the minds of many providers (Benson et al. 2009, p. e157). This may be related to providers’ repeated failed attempts in managing obesity (Freedman & Stern, 2004).

### Risk factors for childhood obesity

The American Academy of Pediatrics (AAP) Policy Statement on Prevention of Pediatric Overweight and Obesity (2003) identifies genetic, biological, psychological, sociocultural, and environmental risk factors (Committee on Nutrition, 2003). These factors may be prenatal, genetic, social, endocrine, feeding behaviors, nutritional components, activity level, and types of activity. Some arise in infancy, such as whether the child was bottle-fed or breast-fed (self-regulation in breast-feeding behaviors as well as human milk components may be protective against later obesity; Lee, 2007; Salsberry & Reagan, 2005).

### Comorbidities associated with childhood obesity

Multiple comorbidities are associated with childhood obesity. These include clinical conditions that are orthopedic (musculoskeletal), gastrointestinal, respiratory, metabolic, cardiovascular, reproductive, renal, and psychological (Lee, 2007; US Preventive Services Taskforce [USPSTF], 2005). These may be limited to the childhood years, but many continue into adulthood and contribute to adult morbidity and mortality. “Overweight young children become overweight older children who then become overweight adults” (McCormick, Ramirez, Caldwell, Ripley, & Wilkey, 2008, p. 693). It has been found that an adolescent that is overweight has a 50%–70% chance of becoming an overweight or obese adult (Lee, 2007).

Orthopedic problems associated with childhood obesity include slipped capital femoral epiphysis, tibia vara, and osteoarthritis (Berkel, Walker, Poston, Reeves, & Foreyt, 2005; Lee, 2007). The multiple gastrointestinal conditions include nonalcoholic fatty liver disease (NAFLD) gallbladder disease, gastroesophageal reflux disease, and possibly an altered response to medications (Daniels, 2006; Kaechele, Wabitsch, Thiery, Kessler, Haenle, Mayer, & Kratzer, 2006). Obesity places the child at risk for sleep apnea and asthma because of mechanical and inflammatory processes (Lee, 2007; USPSTF, 2005).

Concurrent metabolic and cardiac consequences of childhood obesity include insulin resistance and Type 2 diabetes mellitus (T2DM), abnormal blood lipids (also called dyslipidemia or hyperlipoproteinemia), impaired glucose tolerance (prediabetes), metabolic syndrome, hypertension, and left ventricular hypertrophy (LVH; USPSTF, 2005; Scottish Intercollegiate Guidelines Network [SIGN], 2003). The Bogalusa Heart Study demonstrated that abnormal blood lipids, hypertension, and hyperinsulinemia were 2.4 times more likely to occur in children at risk of overweight (AROW) or who were diagnosed

overweight (Freedman, Srinivasan, Marsha, Webber, & Berenson, 1989). The diagnosis of T2DM alone increases the risk of acute myocardial infarction, cerebrovascular accident, or heart failure at an early age (such as in the third or fourth decade of life; Daniels, 2006).

Psychological diagnoses and social problems also exist at higher rates in those with childhood obesity. An increased prevalence of depression is also found in those children who are obese (Lee, 2007). Severely obese children and adolescents have reported a low health related quality of life, one equal to that of children with cancer (Lee, 2007).

### Literature-based interventions and clinical practice guidelines

A literature review was conducted to assist in the goal of developing a step-wise tool kit that the primary care provider can use to manage treatment of the obese child. The literature reviewed included current guidelines as well as original research studies utilizing various methodologies (nonpharmacological, pharmacological, and surgical). While the design of these clinical trials varied widely, a compilation of the results yielded valuable information regarding treatment options and outcomes in the treatment of childhood obesity. This information, together with evidence-based current clinical practice guidelines from governmental agencies and professional societies, was used to create the toolkit provided in the Discussion section below (see Figure 2).

A national "Expert Committee" guideline, endorsed by 15 professional organizations was published in 2007. This clinical practice guideline provides an overview of the subject, recommendations regarding screening and clinical evaluation, and evidence-based intervention and management (Barlow & the Expert Committee, 2007). Discussing the management of children with diagnosed medical conditions (comorbidities) is beyond the scope of this article; the remainder of this article focuses on the efficacy of various interventional and management approaches in the healthy overweight and otherwise healthy obese child. These interventions are divided into three groups: nonpharmacological, pharmacological, and surgical approaches.

### Nonpharmacological interventions

Current guidelines rely primarily on nonpharmacological methods as the basis for treatment of childhood obesity, in part because of past success rates with such modalities. The focus is on lifestyle modifications including diet and physical activity. The Expert Committee recommends using a staged treatment plan integrating evidence-based

effective treatment options. Brief, office-based interventions for the greatest number of children who are overweight or obese are encouraged. Increased intensification of efforts can be tailored to the clinical setting, including factors such as the capabilities of the office (providers and staff), motivation of the family, and degree of obesity and response to prior intervention. The most aggressive treatments are reserved for those who do not respond to previous interventions (Barlow & the Expert Committee, 2007). Interventions are categorized by "stage" of treatment.

**Stage 1.** Stage 1 is the "prevention-plus" tier. At this stage, overweight and obese children and families focus on healthy lifestyle (eating and activity) that lead to prevention of obesity in an effort to normalize BMI. Increased monitoring and focused patient education regarding diet and activity are initiated. The entire family is encouraged to partake in lifestyle changes. Motivational interviewing is used, which incorporates family, patient, and provider involvement in goal setting. The target behaviors can also be achieved along a stepped continuum. Follow-up visits are to occur frequently and involve family (no specific recommendation for periodicity of office visits; Barlow & the Expert Committee, 2007). Stage 1 dietary and activity level recommendations are as follows:

- Stage 1 dietary recommendations: This includes consumption of five or more servings of fruits and vegetables daily. The USDA website [www.mypyramid.gov](http://www.mypyramid.gov) is recommended for serving suggestions (Barlow & the Expert Committee, 2007). Other dietary recommendations are lifespan-tailored for children, such as the Traffic Light Diet. This diet breaks down foods based on the colors of the traffic light, green, yellow, and red in which green foods have no restrictions and consists of low-calorie, high-fiber foods. Yellow foods are to be eaten in moderation; these are foods that are higher in density and essential to diet. The red foods are those that are restricted to four or less servings per week and to only be eaten away from the home as these foods are high in fat or simple sugars (Singhal, Schwenk, & Kumar, 2007). Sugar-sweetened beverages are to be minimized. More meals should be prepared at home and meals are to be eaten at the table with family. Breakfast is to be eaten daily. The child is to have some choice in meals to avoid overly restrictive caregiver behaviors.
- Stage 1 activity level recommendations: Screen time is sedentary time spent watching television (e.g., viewing broadcasts, recorded media, or in

<p>1. Screen for Childhood Obesity</p>	<p>1. Calculate and plot BMI at every well child visit.                  2. <u>Identify risk factors for obesity:</u>                  a. <u>Diet:</u> Assess if breakfast is consumed daily, if meals are eaten primarily at home and with family, components of total dietary intake (snacks and meals). Use dietary recall or food diary.                  b. <u>Exercise:</u> Assess exercise routines including outside play, or ganized sports/organizations, family involvement in activities, amount of activity completed at school.                  c. <u>Sedentary Activity:</u> Assess hours of screen time per day, including TV, co mputer, and games.</p>
<p>2. Educate for Prevention</p>	<p>1. Educate regarding complications of childhood obesity: Include pathophysiological and psychosocial co-morbidities, adult sequelae, and mortality implications.                  2. <u>Give recommendations:</u>                  a. <u>Dietary:</u>  <ul style="list-style-type: none"> <li>• Eat breakfast daily.</li> <li>• Limit sugar sweetened beverages and fruit juices.</li> <li>• Drink water and fat free milk.</li> <li>• Eat a high fiber diet.</li> <li>• Encourage family togetherness at meals.</li> <li>• Involve child in preparation of meals.</li> <li>• Limit fast foods and junk foods.</li> <li>• Adhere to appropriate serving sizes.</li> <li>• Follow U.S. Dept. of Agriculture recommendations.</li> <li>• Encourage use of <a href="http://www.mypyramid.gov">www.mypyramid.gov</a></li> </ul>                 b. <u>Exercise:</u>  <ul style="list-style-type: none"> <li>• Participate in 60 minutes of physical activity.</li> <li>• Activity may be divided up throughout the day.</li> <li>• Incorporate enjoyable activity for compliance.</li> <li>• Encourage family involvement in activities.</li> </ul>                 c. <u>Sedentary Behavior:</u> Limit screen time to 2 hours or less each day.</p>
<p>3. Goals</p>	<p>1. <u>For overweight children (BMI 85<sup>th</sup>-95<sup>th</sup> percentile) with no co-morbidity:</u> goal is to stabilize current weight (prevent BMI increase).                  2. <u>For overweight children with co-morbidities as well as obese children (BMI ≥ 95<sup>th</sup> percentile):</u> goal is to begin weight reduction of 0.45 kg per month (if serious complications are present more aggressive weight loss may be attempted).</p>
<p>4. Monitor and treat for co-morbidities.</p>	<p>1. <u>If overweight without co-morbidities:</u>                  Order fasting lipid levels.                  2. <u>If overweight with co-morbidities OR obese:</u>                  Order fasting lipid, glucose, AST, ALT levels.                  3. <u>Further investigation:</u>                  Based on risk factors and physical exam findings.</p>
<p>5. Initial Lifestyle Intervention</p>	<p>1. <u>Data acquisition (flow sheet):</u>  <ul style="list-style-type: none"> <li>• Diet/nutrition guidance/adherence</li> <li>• Activity/exercise guidance/adherence</li> <li>• Serial measurements of weight and BMI.</li> </ul>                 2. <u>Multidisciplinary support:</u>  <ul style="list-style-type: none"> <li>• Consult or refer to specialty clinics to provide the best treatment options for children with obesity.</li> <li>• Consult or refer to specialists for support managing syndromes (e.g., Prader-Willi, T2DM, dyslipidemia).</li> </ul> </p>

Figure 2 Toolkit for primary care providers.\*

video gaming) and using the computer for something other than school or work (e.g., playing computer games or Internet activities). It has been recommended that screen time should be limited to 2

or fewer hours per day. In order to meet this goal, one strategy is to keep the television out of children’s bedrooms (National Association of Pediatric Nurse Practitioners [NAPNAP], 2006). One hour of

	<p>3. <u>Behavior Modification:</u></p> <p>a. <u>Monitoring:</u></p> <ul style="list-style-type: none"> <li>• Monitor with periodic evaluation at least every 3 months.</li> <li>• If managed solely by primary care, consider increasing monitoring frequency to monthly.</li> <li>• If weight loss, maintenance of target BMI, and improvement in comorbidities is successful, continue with current management and continued monitoring every 3 to 6 months.</li> </ul> <p>b. <u>Nutrition/Diet:</u></p> <ul style="list-style-type: none"> <li>• Gradual decrease in caloric intake by decreasing saturated fats (30% of calories from fat; 50% from carbohydrates; 20% from protein).</li> <li>• Help identify triggers for overeating.</li> <li>• Use the Traffic-light Diet or My Pyramid.</li> <li>• Consult/refer with dietician/nutritionist if available</li> </ul> <p>c. <u>Activity/Exercise:</u></p> <ul style="list-style-type: none"> <li>• Implement a gradual increase in physical activity to create a negative energy balance.</li> <li>• Ensure 60 minutes of moderate to high intensity activity per day.</li> <li>• Restrict screen time to 2 hours or less per day.</li> <li>• Consult or refer with community exercise programs and resources (YMCA/YWCA, hospital, city/county recreation departments).</li> </ul> <p>d. <u>Psychosocial:</u></p> <ul style="list-style-type: none"> <li>• Encourage social activities to promote success.</li> <li>• Reinforce importance of family involvement.</li> <li>• Consult or refer to mental health specialists as indicated</li> <li>• Offer encouragement and support</li> <li>• Incorporate positive reinforcement strategies</li> <li>• Adapt lifestyle modifications based on patient and family preferences and ability.</li> </ul>
<p>6. Failed lifestyle intervention – pharmacologic therapy</p>	<p>Pharmacologic Treatment: Consider for obese children with comorbidities or those who have not responded to lifestyle modification after 6 months or more.</p> <ul style="list-style-type: none"> <li>• <u>Continue intense behavioral modifications</u> during pharmacologic treatment.</li> <li>• <u>Begin medication considering patient's age and co-morbidities.</u> <ul style="list-style-type: none"> <li>○ <u>For those 12 years of age and older:</u> <ul style="list-style-type: none"> <li>▪ Begin Orlistat 120 mg TID with intake of fat containing meals.</li> <li>▪ Instruct to take multivitamin with vitamins A, D, E, K, and beta carotene at least 2 hours before or after medication.</li> <li>▪ Warn regarding gastrointestinal symptoms.</li> <li>▪ Continue to monitor at periodic intervals of at least every 3 months.</li> <li>▪ Continue medication for up to 1 year if weight loss is occurring until adequate loss is achieved.</li> <li>▪ Watch for rebound effect when/if medication discontinued.</li> </ul> </li> </ul> </li> </ul>

Figure 2 Continued.

physical activity is to be obtained daily (Barlow & the Expert Committee, 2007).

**Stage 2.** If, after 3–6 months, the child has not achieved appropriate weight loss goals, the provider is to then advance the obesity treatment to the next stage (structured weight management). During this stage, the aim is to advance support and increase specific goals using behavior monitoring (diet and activity logs) and positive reinforce-

ment methods. Some families may require a counselor to assist with parenting skills. Office visits need to take place monthly. Group sessions may also be beneficial at this stage, requiring additional involvement of office staff (Barlow & the Expert Committee, 2007). Stage 2 dietary and activity level recommendations are as follows:

- Stage 2 dietary recommendations: In this stage, a planned diet or daily eating plan can be initiated.

	<ul style="list-style-type: none"> <li>○ For those with evidence of pre-diabetes or hyperinsulinemia:             <ul style="list-style-type: none"> <li>▪ May consider trial of (off-label) metformin 500 mg BID.</li> </ul> </li> </ul>
7. Failed lifestyle intervention – surgical options	<p><b>Surgical Treatment:</b> Consider for those adolescents that are obese with comorbid conditions that have not responded to behavioral or pharmacologic treatment after at least 6 months.</p> <ul style="list-style-type: none"> <li>● <u>Refer to bariatric surgeon for evaluation those with criteria below:</u> <ul style="list-style-type: none"> <li>○ BMI &gt; 35 kg/m<sup>2</sup> with severe co-morbidities of T2DM, OSA, pseudotumor cerebri.</li> <li>○ BMI &gt; 40 kg/m<sup>2</sup> with any co-morbidity.</li> <li>○ Patient and family willing to commit to a lifetime of monitoring and strict nutritional changes.</li> </ul> </li> <li>● <u>Do not refer those with Prader-Willi syndrome.</u></li> <li>● <u>Educate regarding potential risks and benefits.</u></li> </ul>
8. Professional Responsibilities	<p><b>Awareness:</b> Be aware of most current efficacious treatments in childhood obesity.</p> <p><b>Advocacy:</b> Advocate for prevention and treatment of childhood obesity through involvement in the community, school systems, media, and policy.</p>

\*Derived from literature review results and Barlow and the Expert Committee, 2007; NAPNAP, 2006; Caprio, 2006; Young, 2005; Singhal et. al, 2007.

Figure 2 Continued.

For initiation of the structured plan for individuals several requirements are needed. The eating plan should be developed by a dietician or clinician with additional training in implementing specific eating plans for children.

- Stage 2 activity level recommendations: Another hour reduction of screen time can be implemented (reduction to 1 h total per day). An exercise therapist may need to be involved to promote an exercise regimen (Barlow & the Expert Committee, 2007).

**Stage 3.** Once again, if goals are not met, recommendations are to advance to the next stage, incorporating comprehensive multidisciplinary interventions which also increase the intensity of behavioral changes. This supersedes the typical office abilities, but used in collaboration with other facilities and specialists this is still possible in the primary care setting. At a minimum, food monitoring, short-term diet, and activity goal setting should occur. Parental participation in behavioral modification techniques is needed for children less than 12 years of age. Parents should also be trained on how to improve the home environment. A systematic evaluation of measurements, diet, and activity should be performed at baseline and at regular intervals throughout the program. A multidisciplinary team with experience in childhood obesity should be in place or available, including a behavioral counselor, registered dietician, exercise specialist, as well as the coordinating primary care provider who continues to monitor medical issues and promote support

with the family. Office visits would need to occur weekly for the first 2–3 months, and then taper to monthly visits. Group visits are also promoted (Barlow & the Expert Committee, 2007). Stage 3 dietary and activity level recommendations are as follows:

- Stage 3 dietary recommendations: A negative energy balance between diet and activity should be planned. Food monitoring is implemented and short-term goals are established. If the patient or family wishes to use a commercial weight loss management plan, it must be screened first and approved by the primary care provider’s office. The input of a registered dietician will be of value.
- Stage 3 exercise recommendations: Continued attention to regular exercise, in consultation with an exercise specialist as needed. This may be a physical therapist, or a provider with specialized training in this area (Barlow & the Expert Committee, 2007).

**Stage 4.** If goals for weight reduction for the severely obese child are not met with Stage 3 interventions, then a referral to a tertiary center for specialized interventions is indicated. These interventions encompass pharmacologic treatment, a very low calorie diet, and bariatric surgery. Use of expert multidisciplinary teams is needed, with the expectation that management of comorbidities is included. Patient selection for this stage includes evaluation of patient age, maturation, degree of obesity, motivation and emotional readiness, previous efforts to

control weight, and familial support. The Expert Committee notes that some patients that are appropriate candidates for tertiary treatment may not have it readily available to them based on geographical area or insurance coverage (Barlow & the Expert Committee, 2007).

### Pharmacological interventions

There is currently one medication approved by the Food and Drug Administration (FDA) for the treatment of adolescent obesity. This is prescription orlistat (Xenical™) for ages 12 years old and older. Orlistat is also available in a lower dose over the counter as Alli™. Metformin (Glucophage™, others) has also been trialed (off-label) in obese adolescents.

**Orlistat.** Orlistat is approved for adolescents ages 12 years old and older. It is a reversible inhibitor of lipases, and therefore reduces the absorption of dietary fats. At daily prescription-strength dosing of 120 mg three times daily, orlistat inhibits the absorption of dietary fat by 30%. Orlistat is indicated for obesity management, including weight loss and maintenance, for those with BMI of 30+ or 27+ with other risk factors. The medication should be used along with a reduced-calorie balanced diet containing 30% of calories from fat. A multivitamin including fat-soluble vitamins should be taken daily at least 2 h before or after administration as this drug will also reduce the absorption of some dietary fat-soluble vitamins and beta carotene. The most frequent adverse effects are gastrointestinal, as expected from the drug's mechanism of action, including anal soilage (oily spotting), flatulence with leaking of stool, increased stooling, fecal urgency, oily stool, and abdominal pain (Hennessey & Perry, 2006; Roche Laboratories, 2009).

**Metformin.** Metformin is an antihyperglycemic agent indicated in the treatment of T2DM. Its mechanism of action is reduction in hepatic glucose production, decreased intestinal absorption of glucose, and improved insulin sensitivity by increasing peripheral glucose uptake and utilization. In pediatric trials a mean net reduction of 64.3 mg/dL in blood glucose was shown as well as a decrease in body weight (Bristol-Myers Squibb Company, 2008). This drug has been studied for weight loss in children ages 10–16 years old as an off-label drug and these studies have demonstrated reduction in BMI even without additional lifestyle interventions (Freemark, 2007; Freemark & Bursey, 2001). The most commonly experienced adverse effects are diarrhea, nausea, vomiting, flatulence, asthenia, indigestion, abdominal discomfort, and headache. The usual starting dose is 500 mg twice daily with meals, not to exceed 2000 mg/day in pediatric patients (Bristol-Myers Squibb Company, 2008).

### Surgical interventions (bariatric surgery)

The International Pediatric Endosurgery Group (IPEG) recently released guidelines for surgical treatment in obese adolescents. The decision for treatment via bariatric surgery is to be judged on an individual basis according to associated comorbid conditions, physiologic and psychologic maturation, and family support structures. Indications for adolescent bariatric surgery are a BMI greater than 35 kg/m<sup>2</sup> with severe comorbidities of T2DM, moderate or severe obstructive sleep apnea, or pseudotumor cerebri. Those adolescents with a BMI 40+ kg/m<sup>2</sup> with any of the following less severe comorbidities may also be considered: hypertension, abnormal blood lipids, obstructive sleep apnea, venous stasis, panniculitis, urinary incontinence, significant impairment in activities of daily living, moderate-to-severe NAFLD, gastroesophageal reflux, severe psychosocial distress, significantly impaired quality of life, or weight-related arthropathies. These patients should also have attained or nearly attained adult stature, have failed to attain a healthy weight with prior conventional weight management programs, demonstrated commitment to psychological evaluation pre- and postsurgery as well as agree to avoid pregnancy within the first year following surgery. They must also be capable of and willing to adhere to nutritional guidelines following surgery and have decisional capacity in order to provide appropriate informed consent to the surgery. Different successful surgical options have been used in the obese adolescent population:

- Roux-en-Y (laparoscopic and open approach),
- laparoscopic adjustable banding (so far only approved by the FDA for adults),
- laparoscopic sleeve gastrectomy.

A multidisciplinary team is recommended for perioperative care, and lifelong supervision is needed to identify complications as well as reinforce compliance in the new lifestyle changes of eating behaviors, medications and supplements, and exercise routines. The guidelines recommend supplementation with multivitamins, calcium, vitamin B12, vitamin B1, and iron (in menstruating females) following surgery. The administration of ranitidine and ursodiol was recommended by some experts for the 6-month postoperative period (IPEG Standards and Safety Committee, 2009). The Longitudinal Assessment of Bariatric Surgery (LABS) is a federally funded multicenter research initiative and Teen-LABS will research adolescents undergoing bariatric surgery; hypothetical benefits to early bariatric surgical intervention will await these results for confirmation. Although evidence is lacking regarding the prevention of progression of NAFLD, it has been suggested that bariatric surgery

in adolescence is superior to waiting until adulthood because:

- Significant decreases in ventricular wall thickness and LVH are seen (versus only a small change after surgery in adulthood).
- The resolution in obstructive sleep apnea was found to be strongest when surgical treatment was initiated before increased severity of the disease.
- Surgically induced weight loss has also proved beneficial regarding endocrine function, improving both insulin resistance and beta cell function. Although adults usually fail to reach normal insulin levels, adolescents have shown complete resolution of hyperinsulinemia.
- Adolescents have improvements in psychosocial health that may lead to improved socioeconomic trajectory (Inge, Xanthakos, & Zeller, 2007).

### Results of the literature review

Findings from the aforementioned literature review are provided as supplemental supporting documentation of commonly utilized interventions and are summarized in tabular format. Table S1 lists results of nonpharmacological interventions, Table S2 of pharmacological interventions, and Table S3 of surgical interventions. Literature reviews (including meta-analyses) of multiple published trials utilizing similar interventions will be treated as individual studies. For all listed interventional studies, inclusion criteria were a minimum BMI of >95th percentile for age and gender.

#### Nonpharmacologic (psychologic, lifestyle, and patient education)

- Activity interventions (exercise duration and intensity): Most studies involved moderate-to-high intensity aerobic exercise of compared durations; exercise was found to have a dose-related effect, with the most improvement seen in those prescribed higher dosed exercise duration.
- Family interventions: These interventions were either narrow (goal of change in diet and activity without changes in general parenting) or broad (parenting skills, clarifying boundaries, strengthening hierarchies). There are increased benefits when parents act as change agents and participants were less likely to drop out.
- Diet, activity, and psychological interventions: Behavioral interventions (Traffic Light Diet, self-monitoring using diet and exercise journals, participation in meal preparation, praise and mod-

eling) produced greater results than those using cognitive approaches (monitoring of negative thoughts, restructuring negative thoughts, and self-reinforcement). Most took place in specialty settings; the more behaviorally intense interventions yielded the best outcomes.

- Diet, activity, psychological, and family interventions: Parents and children received family-based interventions as a positive reinforcement program (e.g., monetary reimbursement for families contingent on parent and child weight loss). Long-term (10 years) follow-up yielded sustained results.
- Maintenance therapy interventions: Modest (sustainable) lifestyle changes coupled with behavioral approaches yielded better long-term results. Either social facilitation or behavioral skills maintenance is shown to be effective.

#### Pharmacological

All pharmacological trials (except one metformin study) included attention to lifestyle changes (diet and activity).

- Orlistat (Xenical™, Alli™): Study results ranged from no significant benefit (short-term) to effectiveness (long-term).
- Metformin (Glucophage™): Use in adolescents was found to be effective in the short. Improvement in metabolic parameters was noted.

#### Bariatric surgery

This intervention is effective for weight loss and improved body image, both immediately and long term. However, the expected potential complications of this method were reported, with banding having fewer serious complications. Physical and sexual maturation was not impaired, but those with Prader–Willi syndrome did not demonstrate benefit.

#### Discussion/summary

Childhood obesity is prevalent throughout the United States, placing children and adolescents at risk for current or future comorbidities related to obesity. Behavior modification focusing on lifestyle changes in regard to diet, physical activity, and sedentary behavior is successful for both initial weight loss and maintenance, even in comparison to some medication trials. Maintenance of target weight requires continued adaptations in lifestyle; programs that strengthen awareness and self-monitoring provide resources for continued success. Those participating in the more intensive behavioral programs were more



1. The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity:  
<http://www.surgeongeneral.gov/topics/obesity>
2. The Weight Control Information Network: <http://www.win.niddk.nih.gov>
3. The Centers for Disease Control and Prevention-Overweight and Obesity:  
<http://www.cdc.gov/nccdphp/dnpa/obesity/childhood>
4. International Obesity Taskforce: <http://www.ietf.org>
5. The World Health Organization-Nutrition: <http://www.who.int/nut>
6. United States Department of Agriculture-My Pyramid Resources:  
<http://www.mypyramid.gov/professionals/>
7. National Institute for Health Care Management: <http://www.nihcm.org/publications/obesity>
8. Yale Bright Bodies Weight Management Program: [www.brightbodies.org](http://www.brightbodies.org)
9. American Society for Metabolic and Bariatric Surgery: [www.asbms.org](http://www.asbms.org)

**Figure 3** Internet resources

successful at losing and maintaining weight than those who were simply instructed to make simple lifestyle modifications. Similarly, a moderate-to-high intensity exercise routine completed over a longer period per week was more effective than a lower intensity, shorter period during the week. These results suggest a “dose dependent” paradigm in lifestyle interventions. Other important aspects of initial weight loss and successful maintenance include familial and social support. Children that began intervention at a younger age and during earlier stages of obesity were more apt to continue programs, therefore providing an increased opportunity for success.

Based on current guidelines, pharmacologic and/or surgical intervention is not considered until there is failure of less aggressive management strategies. Several medications have proved successful in obese children, with each medication having a known potential for complications and/or special nutritional or monitoring requirements. Bariatric surgery is used for those adolescents who are extremely obese (BMI 40 or greater), who also have comorbidities. There are potentially serious complications, including nutritional deficiencies, anemia, small bowel obstruction, pulmonary embolism, and need for repeat surgery. Gastric banding surgery had potentially fewer and less severe complications. Positive effects of surgery, beyond weight loss, include reversal or regression of comorbid conditions. However, lifelong monitoring and lifestyle changes must be embraced by the patient for continued maintenance success. In this regard, behavioral modification has shown efficacy following surgery. There are hypothetical advantages to early surgical intervention in adolescence. A toolkit is provided that sum-

marizes a stepped approach to the choice of interventions (see Figure 2) as well as selected Internet resources for the practitioner (see Figure 3).

Investigators in this field are unanimous in calling for increased research to strengthen the evidence base regarding patient selection for different interventions, efficacy of clinical setting (specialty or primary care), and guidelines for long-term follow-up. Many current recommendations for interventional programs supersede typical office abilities, but the primary care provider can still coordinate resources and support the child and family, even if aggressive interventions are employed.

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## Supporting Information

Additional supporting information may be found in the online version of this article:

**Table S1** Nonpharmacological interventions\*

**Table S2** Pharmacological interventions\*

**Table S3** Bariatric surgery—gastric bypass and gastric banding (gastroplasty)\*

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