Pediatric Obesity Epidemic: Treatment Options

SHELLEY KIRK, PhD, RD; BARBARA J. SCOTT, RD, MPH; STEPHEN R. DANIELS, MD, PhD

ABSTRACT
The increasing prevalence of overweight youth in the United States and the associated increase in medical comorbidities has created a growing need for effective weight-management interventions. The recommended treatment for an overweight child to achieve a more healthful weight uses four primary behavioral strategies: (a) reduce energy intake while maintaining optimal nutrient intake to protect growth and development, (b) increase energy expenditure by promoting more physical movement and less sedentary activity, (c) actively engage parents and primary caretakers as agents of change, and (d) facilitate a supportive family environment. Although this approach has the most empirical support, the impact on the pediatric obesity epidemic has been limited, particularly for adolescents with more severe obesity and for African-American, Native-American, and Hispanic children. This has prompted efforts to adapt strategies that have been effective in adult weight management for use in pediatric behavioral intervention programs. These include using motivational interviewing to increase readiness for health behavior changes, modifying the carbohydrate content of children’s diets, using culturally appropriate messages and materials, improving cultural competency of health care providers, and using computer-based strategies. Randomized, controlled clinical trials are needed to test the safety and efficacy of these approaches before they can be recommended for clinical practice. Pharmacotherapy and bariatric surgery are more aggressive and historically adult interventions with greater risk that are being considered for severely obese adolescents who have serious obesity-related medical complications and who have failed other more conventional methods.


Implementation of effective pediatric weight-management strategies in the United States warrants more resources given the increasing prevalence of overweight youth. The increase in obesity-related medical complications for this population with the associated health risks are also of increasing concern, given the rise in cardiovascular risk factors such as abnormal glucose tolerance, hyperlipidemia, and elevated blood pressure. Emphasis on early intervention is needed because overweight children are at greater risk of adult obesity and increased risk for heart disease, hypertension, diabetes, gallbladder disease, and some cancers (1). Recent recommendations by the Institute of Medicine for the prevention of childhood obesity also have implications for treatment. In particular, the report recommends routine monitoring of childhood obesity by health care professionals using the best available evidence-based approaches to address this important national health problem (2).

The objectives of this paper are to briefly define pediatric overweight and obesity, describe treatment goals, discuss treatment options that are currently advocated for overweight children and adolescents in a clinical setting, and review the evidence that supports their safety and efficacy.

PEDIATRIC OBESITY DEFINITIONS, TREATMENT GOALS, AND CRITICAL PERIODS FOR INTERVENTION

The determination of obesity for US children is typically made using the 2000 Centers for Disease Control and Prevention (CDC) body mass index (BMI; calculated as kg/m²) sex- and age-specific charts. The BMI charts consist of a series of percentile curves that illustrate the distribution of BMI in US children ages 2 to 20 years that can be used by health care providers to track changes in the relationship of weight for stature over time. (The BMI and other growth charts can be downloaded and printed from the CDC Web site: www.cdc.gov/growthcharts.)

As in adults, BMI is an imperfect indicator of adiposity in children. However, because BMI is nonlinear in children, BMI percentiles and not absolute BMI cutoffs must be used to evaluate weight. The weight classifications for youth using BMI percentile ranges are as follows: normal weight (≥5th and <85th), at risk for overweight (≥85th to <95th), and overweight (≥95th). The EpiInfo public domain software program (version 3.3.2, February 9, 2005) that can also be downloaded from the CDC Web site (www.cdc.gov/epiinfo/) can be used to calculate and plot BMI percentile and to calculate and track BMI scores for children whose BMI percentile exceeds the 97th percentile (the upper curve on the chart).

Children’s growth should be measured and plotted on the CDC charts at least annually, and pediatric practitioners should use these measurements to assess change
over time in the height, weight, and BMI percentiles. Upward shifts in BMI percentile, even for children with BMI less than the 85th percentile, should increase awareness and prompt more frequent monitoring. Parents can be educated about the interpretation of the growth charts and be given ideas for balancing their child’s diet and activity using principles of balance and moderation.

Many of the primary strategies for achieving a healthful weight in children, similar to those for adults, focus on achieving energy balance (energy intake = energy expenditure) for weight maintenance or energy deficit (energy intake < energy expenditure) for weight loss. However, because of the unique needs of children for growth and development, pediatric behavioral weight-management programs have specific characteristics that prioritize safety and consider the child’s growth rate and weight trajectory when identifying desired goals and outcomes of treatment. Thus, treatment goals for overweight children should be based on age, stage of growth and development, degree of overweight, and presence of associated comorbid conditions (3).

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Maintenance of height velocity is a critical indicator of the safety of any intervention. Weight goals for children who are at risk of overweight (BMI percentile ≥85th to <95th) or who are overweight (BMI ≥95th percentile) are based on age and health status and can be set along a continuum: slowing the rate of weight gain, stopping weight gain, or losing weight. As height continues to increase, all three of these outcomes will result in some decrease in BMI. Interventions for older, more overweight children with comorbid conditions require individualized approaches tailored to the severity of the comorbidities and degree of overweight. Because of the rapid growth and critical development that occurs early in life, treatment should rarely be instituted before 2 years of age.

There is still much to be learned about whether overweight that occurs at specific times or under specific circumstances is more likely to persist into adulthood and, if so, whether there are specific time intervals or critical periods in childhood that may be most important for prevention or treatment interventions. Studies examining associations between birth weight, infant feeding practices, and rate of weight gain in infancy with weight status later in life point to potentially important early influences that may or may not be appropriate targets for intervention. Perhaps of more relevance to pediatric treatment programs are the observations of an adiposity or BMI rebound that occurs between age 4 and 7 years. Similarly, the pre- and early pubertal periods, when dramatic changes in body composition occur and when parental control and influence over eating and activity habits tend to be tapering off, are also potentially important times for increasing nutrition surveillance and offering intervention when needed.

BEHAVIORAL INTERVENTION FOR PROMOTING A HEALTHFUL LIFESTYLE

The key components of a successful weight-management program for overweight youth will include strategies for adopting more healthful eating habits, becoming more physically active, and reducing time spent in sedentary activities. It has been shown that using a combination of behavioral approaches such as goal-setting, self-monitoring, stimulus control, and incentives within the context of a supportive family environment is the most effective approach to changing behaviors. These family-based behavioral interventions result in improved weight status and reductions in cardiovascular risk factors such as serum lipids and circulating insulin (4).

Little is known about the long-term outcomes of pediatric obesity treatment programs in an outpatient, clinical setting because many are still quite new. However, long-term results of seminal studies conducted by Epstein and colleagues provide compelling evidence for using comprehensive behavioral interventions for treating overweight children (5,6). The combined results of four randomized clinical trials involving 154 overweight children ages 6 to 12 years, who were in treatment for 6 months along with one obese parent, demonstrated that 34% of the children had maintained a reduction in percentage overweight by 20% or more, and 30% were no longer obese 10 years after the end of the intervention (5).

In a smaller sample from the same four clinical trials (n = 113), after 6 months of treatment, children’s percentage overweight decreased 20% on average, nearly twice the decrease in percentage overweight experienced by the parents. Ten-year outcomes for this same group of subjects found that the children had sustained their improvement in weight status, whereas the parents on average experienced a 7% increase in percentage overweight (6). These results have provided a more optimistic outlook for treating overweight children compared with adults and provide support for early intervention efforts.

The dietary component commonly used in these behavioral interventions with overweight children ages 6 to 12 years was the Stoplight Diet (7): (a) green-light foods were low-calorie, high-fiber foods, with no restrictions placed on intake; (b) yellow-light foods were viewed as essential to a healthful, well-balanced diet, but because of higher nutrient density, were to be eaten in moderation; and (c) red-light foods were high in fat or simple sugars and were limited to no more than four servings per week and had to be eaten away from the home. The energy goals for this diet ranged from 900 to 1,300 kcal/day, and daily recording of all food and drink consumed was an integral component of the intervention.

The dietary approach now recommended by most pediatricians and other health care providers for the management of childhood obesity is a moderate restriction in energy, using the US Department of Agriculture’s Food Guide Pyramid (8) and the dietary guidelines of the
American Heart Association (9) to develop a nutritionally balanced, portion-controlled eating plan that is age-appropriate. This is best accomplished by reducing the intake of foods high in fat and simple sugars and sweetened beverages, with an emphasis on eating more lower-calorie, high-fiber foods such as fruits, vegetables, and whole grains.

Some strategies to help overweight children and their families achieve these goals for consuming fewer, but more nutritious, calories may include targeting the following behaviors:

- establish a regular meal and snack pattern;
- eat smaller portions at meals and snacks;
- limit second helpings to fresh fruit or nonstarchy vegetables;
- drink more water and other sugar-free drinks to replace sweetened beverages;
- select lower-fat dairy products;
- eat more foods that are baked, broiled, grilled, or boiled, instead of fried;
- select healthful snacks that include a low-fat protein source along with fresh fruit, vegetables, or whole-grain bread or cereals; and
- when eating out, select more healthful options or split larger servings to share with other family members or peers.

Set limits on the availability, frequency, and amount of foods eaten that are high in fat and/or simple sugars. Conceptually these high-fat/high-sugar foods are referred to as “extras” and when eaten in moderation within the overall context of a healthful eating plan, do not interfere with progress toward a more healthful weight.

Another essential component of successful behavioral weight-management intervention is increasing the level of physical activity to increase energy expenditure. Studies have shown that calisthenics or programmed aerobic exercise are less effective than lifestyle exercise (4), which seeks to increase movement through daily routines and encourages regular time for active play or more interactive, fun, structured exercise such as community soccer, karate, or dance. The most recent guidelines for physical activity recommend that elementary-school-aged children and adolescents accumulate at least 30 to 60 minutes of age-appropriate activity on most days of the week (9). Appropriate movement for younger age groups occurs as intermittent bouts of physical activity lasting no longer than 10 to 15 minutes, alternating between moderate and vigorous activity and interspersed with periods of rest and recovery (10). This can best be accomplished when children have daily access to safe places for unstructured play. It is recommended that adolescents establish a physically active lifestyle by participating almost every day in activities at school, in the community, and with their family and accumulate 20 minutes or more of moderate to vigorous activity at least 3 days per week (11).

Overweight youth will be more inclined to achieve the recommended guidelines for physical activity if they experience movement as fun and noncompetitive, select activities they enjoy doing, go at their own pace to minimize any physical discomfort from exertion, share activity with peers or family members, and become more physically active as part of their daily routine such as walking or biking to and from school or doing household chores.

Reducing sedentary behaviors, such as watching TV, playing video games, or using a computer can contribute to increasing energy expenditure if these activities are replaced with behaviors that are more physically active. This change in behavior may also decrease energy intake because these sedentary activities often serve as prompts or triggers to consume more energy-dense drinks and snack foods. Several epidemiological studies show a positive correlation between time spent watching television and an increasing degree of obesity in youth (12). Furthermore, targeting either a decrease in sedentary behavior or an increase in physical activity resulted in a comparable decrease in percentage overweight when included as part of a comprehensive behavioral intervention for overweight children ages 8 to 12 years (13). These results support decreasing sedentary behaviors as an independent strategy for improving weight status of overweight children.

As a preventive measure for childhood obesity, the American Academy of Pediatrics now recommends limiting television and video time to a maximum of 2 hours per day. Families can more easily place limits on watching television and playing video games when engaging alternative activities are made available (14). Eating in the home should be limited to areas that are away from the television.

Evidence has shown that education alone is not enough to establish more healthful eating habits (4). Rather, diet and activity changes need to be presented within the framework of setting concrete and measurable goals that are reinforced with daily tracking of the desired behavior changes and use of incentives to help with sustaining motivation. To ensure that the changes advised are not overwhelming, start with a few goals that build over time as mastery is demonstrated. Written contracts can be used to specify the details (such as frequency and timelines) of meeting identified behavior goals in the areas of nutrition, physical activity, and family support. This approach will help to build self-efficacy and increase the likelihood that goals will be met.

Daily tracking of behavior changes is also essential for improving adherence. Methods that make record-keeping simple and require limited time to complete are more likely to be sustained by the child and the family (4). For example, using a calendar with selected symbols or stickers applied when behavioral goals are met each day is one simplified approach to self-monitoring. An important family support goal is for the parent or guardian to review the goals calendar with his or her child on a daily basis, providing an opportunity to give positive feedback about the child’s efforts to meet goals.

It is also important to tailor the intervention to each individual child and his or her family, to assess the family’s readiness to make lifestyle changes, and evaluate the child’s stage of cognitive and psychosocial development. Each intervention team should include a person with training in child and adolescent development who can determine how much of the responsibility for making behavioral changes that the child can reasonably be expected assume and how much of the responsibility lies with the parent(s).
Age-appropriate incentives are included as part of the contract and awarded when all goals are met for a specified time period. Behavior goals for subsequent contract periods are based on the extent to which previous goals were met and to which targeted behavior changes have become routine. This approach deemphasizes weight and focuses attention on targeted behavioral changes, with the family’s understanding that if behavior goals are consistently met, their child will achieve his or her weight-management goals over time.

**PROPOSED ENHANCEMENTS TO COMPREHENSIVE BEHAVIORAL INTERVENTIONS**

Even when this family-based behavioral approach is used to modify eating habits and increase the level of physical activity, achievement of weight-management goals is variable and improvement in weight status is modest. This has prompted many pediatric practitioners to consider alternative or additional approaches to enhance comprehensive pediatric behavioral weight-management programs.

**Motivational Interviewing**

Motivational interviewing is a patient-centered counseling approach that can potentially help children and their families involved in a behavioral weight-management program to more effectively address ambivalence or resistance to making needed behavioral changes to improve eating habits or increase level of physical activity. Most of the research supporting the efficacy of motivational interviewing has been done with the treatment of substance abuse and other problem behaviors. There is some evidence that motivational interviewing is effective short-term with promoting more healthful eating habits, increasing physical activity, and improving weight status, but the findings are not consistent (15, 16).

The goal of motivational interviewing is to have families consider and express their own reasons for and against advised behavior changes and then consider how these reasons either support or conflict with their overall goal for achieving a more healthful weight. This technique, when used on an individual basis in a nonjudgmental, empathetic, and positive manner, can provide families with the opportunity to customize and “buy into” a course of action for changing targeted health behaviors, thus increasing the likelihood that desired behavior changes will occur (17).

There is only one clinical trial that tested the effects of motivational interviewing as an adjunct to a 16-week behavioral weight-management program for older overweight women with type 2 diabetes (N = 22). Both groups experienced significant weight loss at the completion of the program, but there was no difference in weight change between the two groups (18). Motivational interviewing may possibly enhance the outcomes of behavioral weight-management programs, but considerably more research, particularly involving overweight youth and their families, is needed to provide evidence of its efficacy.

**Alternative Dietary Approaches**

The safety and efficacy of the low-carbohydrate, high-protein diets such as the Atkins diet have only recently been studied in controlled clinical trials in adults (19). This diet promotes the unrestricted intake of low-carbohydrate foods such as meat, fish, poultry, shellfish, eggs, cheese, vegetable oils, butter, and nonstarchy vegetables, while limiting the intake of most carbohydrates such as bread, fruit, vegetables, and milk. There is only one published controlled study with adolescents (ages 12 to 18 years) (20), which showed that the low-carbohydrate group (n = 16) lost significantly more weight than the control group (n = 14), who followed a portion-controlled, nutritionally balanced, low-fat diet (<30% of energy from fat) (9.9 ± 9.3 kg vs. 4.1 ± 4.9 kg). Neither group experienced any adverse effects on lipid values. However, because this was only a 12-week trial, conclusions about the long-term safety and efficacy of the diet cannot be generalized from this study. There are no data available about the effects of this diet on younger children. Until more clinical trials are done to assess the long-term safety and efficacy of a low-carbohydrate diet for overweight children and adolescents, this approach should not be recommended for general use in a pediatric population.

Recent research indicates that another popular diet approach, the reduced-glycemic load diet, may be a viable alternative to a conventional diet for the treatment of overweight youth. The concept of “glycemic load” takes into account the amount of carbohydrate consumed as well as the food’s ability to contribute glucose to the blood stream after ingestion, which is referred to as the glycemic index. The reduced-glycemic load diet ranks food as low, moderate, or high according to their glycemic index (ability to contribute glucose to the blood stream) and promotes consumption of low-glycemic-index foods. Results of one 6-month intervention study involving 16 overweight adolescents (ages 13 to 21 years) indicate that restricting the intake of high-glycemic-index foods such as refined grain products, white potatoes, and concentrated sugars promotes fat oxidation and increases postprandial satiety (21). The reduced-glycemic load diet imposed no specific calorie restriction, but was designed with the proportion of energy at 45% to 50% carbohydrate, 30% to 35% fat, and 15% to 25% protein, while promoting consumption of whole grains, nonstarchy vegetables, legumes, fruits, and low-fat dairy products and restricting the intake of refined grains and other high-sugar food and beverages. This diet was also found to reduce the postprandial increase in blood glucose in single-day studies with overweight children and adolescents and to decrease hunger and/or increase satiety as measured by decreased consumption of ad libitum food intake later in the day (22).

Other studies that involved overweight children and adolescents who followed a reduced-glycemic load diet in comparison to an energy-restricted, reduced-fat diet had a significantly greater decrease in BMI (21) and reduction in body fat mass (23), but the effect on other cardiovascular disease risk factors was not investigated. Larger, long-term studies need to be conducted before the reduced-glycemic load diet can be recommended for treating overweight youth.

**Cultural Competency**

The prevalence of overweight (BMI > 95th percentile) in the United States among non-Hispanic black (19.5%) and Mex-
American adolescent females (N=47; ages 11 to 15) and their families found only a modest mean change in weight status using behavioral strategies (BMI: 0.24) (28) when compared with another study with African-American females (N=47) that used a face-to-face behavioral intervention (BMI: 1.3) (27).

AGGRESSIVE THERAPIES TO CONSIDER FOR MORE SEVERE OBESITY

Pharmacotherapy

Currently in the United States there are two prescription drugs that are approved for long-term use by the Food and Drug Administration for the treatment of obesity: orlistat (Xenical, Hoffman-LaRoche Ltd, Basel, Switzerland) and sibutramine hydrochloride (Meridia, Abbott Laboratories, Abbott Park, IL). To optimize the effect of either of these drugs, it is recommended that they be used in conjunction with behavioral interventions that promote a healthful diet and a physically active lifestyle.

Orlistat blocks absorption of fat in the intestine by inhibiting lipase activity. This prevents approximately 30% of fat consumed in the diet from being digested, and thus potentially establishes a negative energy balance. Because orlistat may also interfere with the absorption of fat-soluble vitamins (A, D, E, and K), it is recommended that a daily multivitamin supplement be taken either 2 hours before or after orlistat is taken.

Orlistat was approved for use with obese adolescents by the Food and Drug Administration in 2003. This decision was based on the results from a 52-week randomized, double-blind, placebo-controlled trial in obese adolescents which showed that there was a modest, but significant (P=.005) improvement in weight status for the orlistat-treated group (BMI: 0.55) in comparison with the placebo group (BMI: +0.31). In addition, a greater proportion of subjects in the orlistat-treated group experienced a clinically significant improvement in weight status. It was noted that gastrointestinal side effects, such as fatty or oily stools, were more common in the orlistat-treated group, but it is not known to what extent this contributed to the 35% attrition rate (29).

One study found that mean vitamin D levels were significantly reduced when compared to baseline (P<.02) even when subjects were taking a daily multivitamin supplement as part of the study protocol (30). Monitoring vitamin D status while on orlistat may be warranted. Additionally, because the gastrointestinal side effects experienced may present a considerable deterrent for obese adolescents to follow this course of treatment, adherence may be limited. These side effects, when combined with the potential risk of developing a vitamin D deficiency with long-term use, are likely to limit the widespread use of orlistat for the treatment of pediatric obesity.

Sibutramine, currently only approved for adults, inhibits the reuptake of the neurotransmitters noradrenaline and serotonin, which helps promote satiety. In addition, enhancement of the sympathetic nervous system by sibutramine has been shown to stimulate thermogenesis and reduce the decrease in energy expenditure associated with weight reduction. In this way sibutramine helps to reduce food intake through enhanced satiety and stimulates energy expenditure, thus altering energy balance to favor weight loss. Results from adult studies on sibutra-
mine and one clinical trial with adolescents report a mod-
est but significant weight loss and some improvement in
vascular disease risk factors, such as serum lipids, 
glucose, insulin sensitivity, and uric acid (31,32).

Common adverse events reported with sibutramine in
adult studies include modest but significant increases in
blood pressure and heart rate (32). These adverse events
were also found in the clinical trial with adolescents (31).
It is recommended that blood pressure and heart rate be
closely monitored in patients taking sibutramine.

Surgical Intervention

Bariatric surgery for the management of severe obesity in
adults has been shown to be effective long term in main-
taining significant weight loss (mean of 61% loss of excess
body weight) and resolution or improvement in many of the
medical complications associated with being obese,
such as diabetes, sleep apnea, hypertension, and hyper-
lipidemia (33).

Adolescents who have had bariatric surgery for the
treatment of their obesity as offered through adult cen-
tered surgical programs have been shown to experience out-
comes comparable to adults (34,35). Based on long-
term follow-up (5 to 10 years) of 33 obese teenagers (ages
12.4 to 17.9 years) who underwent bariatric surgery (gas-
tric bypass: n=30; gastroplasty: n=3), it was con-
cluded that the procedure can be performed safely in
adolescents and results in significant weight loss (mean
of 63% loss of excess body weight), correction of obesity-
related comorbidity, and improvement in self-image and
socialization (34).

Comprehensive behavioral intervention programs for the treatment of childhood obesity have been shown to be effective long term, but reported outcomes are largely based on a selected population of younger children with minimal ethnic/racial diversity. Based on preliminary data, possible program modifications to consider for fu-
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cents, (b) using Internet capabilities can enhance behav-
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increase retention rates of minority youth, and (d) alter-
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Other alternative therapies and modifications to ex-
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of severely obese adolescents viable options to consider, particularly if they suffer from serious obesity-related medical comorbidities.

Other important future activities and initiatives in-
clude (a) developing and supporting systems that in-
crease access to intervention programs for children and
families from all socioeconomic and ethnic groups; (b)
learning more about the role of culture, ethnicity, and
income level in the determination of weight status and
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and employment opportunities in pediatric weight man-
agement for nutrition professionals; (d) designing and testing practical evaluation systems to measure and report both short- and long-term outcomes of intervention programs in a variety of arenas (weight, health, well-being, family systems); and (e) enhancing collaboration between entities working on prevention and treatment of pediatric obesity to identify and optimize important areas of shared attention.

References


