SUPPLEMENT ARTICLE

Recommendations for Treatment of Child and Adolescent Overweight and Obesity

Bonnie A. Spear, PhD, RD[a], Sarah E. Barlow, MD, MPH[b], Chris Ervin, MD, FACEP[c], David S. Ludwig, MD, PhD[d], Brian E. Saelens, PhD[e], Karen E. Schetzina, MD, MPH[f], Elsie M. Taveras, MD, MPH[g,h]

[a]Department of Pediatrics, School of Medicine, University of Alabama at Birmingham, Birmingham, Alabama; [b]Department of Pediatrics, Saint Louis University, St Louis, Missouri; [c]Georgia Diabetes Coalition, Atlanta, Georgia; [d]Obesity Program, Division of Endocrinology, Children's Hospital Boston, Harvard Medical School, Boston, Massachusetts; [e]Departments of Pediatrics and Psychiatry and Behavioral Sciences, University of Washington–Child Health Institute, Seattle, Washington; [f]Department of Pediatrics, James H. Quillen College of Medicine, East Tennessee State University, Johnson City, Tennessee; [g]Obesity Prevention Program, Department of Ambulatory Care and Prevention, Harvard Pilgrim Health Care and Harvard Medical School, Boston, Massachusetts; [h]Division of General Pediatrics, Children's Hospital Boston, Boston, Massachusetts

The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

In this article, we review evidence about the treatment of obesity that may have applications in primary care, community, and tertiary care settings. We examine current information about eating behaviors, physical activity behaviors, and sedentary behaviors that may affect weight in children and adolescents. We also review studies of multidisciplinary behavior-based obesity treatment programs and information about more aggressive forms of treatment. The writing group has drawn from the available evidence to propose a comprehensive 4-step or staged-care approach for weight management that includes the following stages: (1) Prevention Plus; (2) structured weight management; (3) comprehensive multidisciplinary intervention; and (4) tertiary care intervention. We suggest that providers encourage healthy behaviors while using techniques to motivate patients and families, and interventions should be tailored to the individual child and family. Although more intense treatment stages will generally occur outside the typical office setting, offices can implement less intense intervention strategies. We not ony address specific patient behavior goals but also encourage practices to modify office systems to streamline office-based care and to prepare to coordinate with professionals and programs outside the office for more intensive interventions.

www.pediatrics.org/cgi/doi/10.1542/peds.2007-2329F

doi:10.1542/peds.2007-2329F

Key Words
obesity, treatment

Abbreviations
GI—glycemic index
PSMF—protein-sparing modified fast
CDC—Centers for Disease Control and Prevention
FDA—Food and Drug Administration
CE—consistent evidence
ME—mixed evidence

Accepted for publication Aug 31, 2007

Dr Barlow's current affiliation is Department of Pediatrics, Baylor College of Medicine, Houston, TX.

Address correspondence to Bonnie A. Spear, PhD, RD, Department of Pediatrics, University of Alabama at Birmingham, 1600 7th Ave S, MTC 201, Birmingham, AL 35233. E-mail: bspear@peds.uab.edu

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

TREATMENT FOR CHILDREN who are overweight or obese seems easy, that is, just counsel children and their families to eat less and to exercise more. In practice, however, treatment of childhood obesity is time-consuming, frustrating, difficult, and expensive. In fact, choosing the most effective methods for treating overweight and obesity in children is complex at best. This is especially true for primary care providers, who have limited resources to offer interventions within their offices or programs and few providers to whom they can refer patients.

The need for evidence-based treatment recommendations is a critical health care issue, because obese children and adolescents are at risk for developing many of the comorbidities seen in obese adults. Studies demonstrated that fasting serum glucose, insulin, and triglyceride levels and the prevalence of impaired glucose tolerance and systolic hypertension increase significantly as children become obese (BMI of ≥95th percentile).[1] Even children and adolescents who are overweight (BMI of 85th to 94th percentile) are at risk for comorbidities. Therefore, interventions using dietary modifications, increased physical activity, and behavioral therapy may be beneficial for overweight children and adolescents, with more-aggressive intervention directed toward obese children and adolescents.[2]

Health care professionals, however, may find it difficult to determine which interventions will be most efficacious for their patients. To date, no clinical trials have determined whether specific dietary modifications alone (ie, without behavioral interventions and increased physical activity) are effective in reducing childhood overweight and obesity rates. Comprehensive interventions that include behavioral therapy along with changes in nutrition and physical activity are the most closely studied and seem to be the most successful approaches to improving long-term weight and health status.[3,4] However, the clinical trials testing these interventions often are limited in their ability to determine the relative efficacy of individual strategies. Ultimately, children and adolescents (and adults, for that matter) become overweight or obese because of an imbalance between energy intake and expenditure. Dietary patterns, television viewing and other sedentary activities, and an overall lack of physical activity play key roles in creating this imbalance and therefore represent opportunities for intervention.

This report reviews evidence about the treatment of obesity that may have application in the primary care setting. It examines current information about eating behaviors, physical activity behaviors, and sedentary behaviors that may affect weight gain. Many of the studies are correlational, rather than interventional. Also examined are studies of multidisciplinary, behavior-based, obesity treatment programs and information about more-aggressive forms of treatment, such as bariatric surgery. Reviews are followed by evidence-based treatment recommendations.

Studies of obesity treatment in the primary care setting have not been conducted. To provide guidance on obesity treatment to providers, the treatment writing group has drawn from the available evidence to propose a comprehensive approach (as yet untested) that is reasonable, feasible, and flexible. This report suggests that providers encourage healthy behaviors, use techniques to motivate patients and families, establish office systems that support monitoring and care of these children, and implement a staged approach to intervention that is tailored to the individual child and family.

NUTRITIONAL TREATMENT

Data Limitations

Virtually no clinical trials examining the effects of any specific dietary prescription on body weight or adiposity in children control for the effects of potentially confounding factors, such as treatment intensity, behavioral intervention strategies, and physical activity. Although comprehensive approaches aiming to modify diet, physical activity, family behavior, and the social and physical environment are undoubtedly needed, studies involving multiple modalities cannot assess the efficacy of any specific component (eg, diet). In the absence of data on the relative efficacy of various dietary prescriptions in the treatment of obesity in children, it is sometimes necessary to make inferences from the childhood obesity prevention and adult treatment literature.

Food Groups and Childhood Overweight

Fruits and Vegetables

Eight studies evaluating the relationship between fruit and/or vegetable intake and body weight were reviewed; none was longitudinal. A nationally representative study found an association between lower intake of fruits and overweight in both boys and girls and an association between lower intake of vegetables and overweight in boys only.[5]

Evidence from case-control studies that evaluated the intake of fruits and adiposity was mixed. Two studies found an inverse association with adiposity,[6,7] and 3 found no association.[8–10] All of the studies that evaluated the intake of vegetables found no relationship with adiposity.[5–12] The single study that evaluated the intake of fruits and vegetables combined found an inverse relationship with adiposity.[12] The studies that found a significant relationship with fruit or vegetable intake tended to have larger sample sizes than did those that found no relationship.[6,12]

School-based interventions have increased fruit and vegetable consumption, but the effect of these dietary changes on weight or weight loss has not been evaluated. School-based studies frequently combine increased fruit and vegetable intake with decreased fat intake, which makes it difficult to comment on the association between fruit and vegetable intake and weight. It should be noted, however, that in none of the studies reviewed was increased fruit and vegetable intake related to increased adiposity. The evidence was more compelling for fruits alone or for fruits and vegetables combined than for vegetables alone, possibly because different fruits and vegetables have differing effects on children's weight. Some of the most commonly consumed vegetables are relatively high in energy because of the way they are prepared. For example, more than one third of the total vegetable intake in the United States consists of iceberg lettuce, frozen potatoes (usually French fries), and potato chips. On balance, the evidence indicates that greater fruit and vegetable intake may provide modest protection against increased adiposity.[13] Research indicates that children are least likely to consume adequate amounts of foods from the fruit and vegetable groups, compared with other food groups.[14]

Fruit Juice

Intake of 100% fruit juice does not seem to be related to childhood obesity unless it is consumed in large quantities. Of the 10 articles reviewed, 3 found a positive association between consumption of large amounts of 100% juice (>12 fl oz/day) and increased incidence of overweight and 1 found a positive association with BMI of >95th percentile.[15] However, none of the longitudinal studies[16–18] or the nationally representative studies[19,20] reported any relationship between 100% fruit juice consumption and BMI.

In a small case-control study of 7- to 10-year-old children, obese children consumed greater amounts of 100% fruit juice than did nonobese control subjects.[10] One limitation of that study, however, beside small sample size, was the fact that the beverages reported as fruit juice on a food frequency questionnaire might have included artificially flavored drinks containing little or no fruit juice. This does not seem to have been a weakness of other studies.

In a cross-sectional study of 2- to 5-year-old children, those (n = 19) who consumed >12 oz of 100% fruit juice per day were at increased risk of short stature and overweight.[21] Additional analysis of the same study population found that only apple juice was significantly related to BMI. Welsh et al[15] found that fruit juice consumption among children 2 to 3 years of age with a BMI of ≥95th percentile was associated with continued obesity 1 year later. There was no significant difference in children with BMI of <95th percentile 1 year later. In that study, fruit juice was defined as vitamin C-containing juice (orange juice or juice with vitamin C added).

Skinner et al[18] monitored children longitudinally from 24 to 72 months of age and found no relationship between 100% juice intake and anthropometric measurements. However, one criticism of that study was that only 3 children consumed 12 oz of juice per day over time and only 1 of those reported 12 oz/day at all 7 dietary interviews. When fruit juice consumption was examined as a continuous variable, there still was no significant association between intake and BMI. In fact, children with a higher intake of fruit juice were more likely to have a lower Ponderal index (an indicator of weight status analogous to BMI but calculated as weight divided by height to the third power).

The 1994 Continuing Survey of Food Intakes by Individuals data on preschool-aged children who reported intake of >12 oz of 100% juice daily found no relationship between fruit juice consumption and BMI.[20] Similarly, a study of preschool-aged children enrolled in the Supplemental Nutrition Program for Women, Infants, and Children program, 79% of whom reportedly consumed >12 oz of fruit juice daily, found no relationship between 100% fruit juice consumption and BMI.[22] A study of preschool-aged children in Germany found no association between excessive consumption of fruit juice and BMI.[16] Similar data for adolescents are lacking, but data suggest that fruit juice consumption declines as children mature.

The American Academy of Pediatrics recently recommended that fruit juice consumption be limited to 4 to 5 oz/day for children 1 to 6 years of age and 8 to 12 oz/day for children 7 to 18 years of age.[23] Those recommendations, however, were based on considerations of nutrient and gastrointestinal problems. More research was deemed necessary before overweight could be considered a consequence of excess fruit juice consumption. The US Department of Agriculture has stressed the important contribution to nutrient intake of 100% fruit juices and advises that, when consumed in quantities consistent with the Dietary Guidelines for Americans, fruit juice is advantageous for healthy children.[13]

Sweetened Beverages

Intake of soft drinks and sweetened fruit drinks has increased dramatically among US children, particularly among adolescents, in recent decades. According to a national survey, soft drinks were the sixth leading food source of energy among children, constituting >50% of total beverage consumption and representing the primary source of energy intake for US adolescents.[24] Although there is no clear evidence that consumption of sugar per se affects food intake and weight gain, there is evidence to suggest that "liquid sweets," or energy consumed as a liquid, may be less well regulated by the body than energy consumed in a solid form. Furthermore, several studies suggest that consumption of soft drinks and other sweetened beverages is related to increased energy intake.

Of the 19 studies reviewed, 6 were longitudinal studies, 3 were nationally representative, cross-sectional studies, and 10 were case-control studies or other cross-sectional studies.[8,10,12,19,25–39] Although the evidence is mixed, the larger, more strongly designed, and higher-quality studies substantiated the idea that sweetened beverage intake is related to overweight among children. Of the 6 longitudinal studies, 3 found intake of soda or total sweetened beverages to be associated positively with at least 1 measure of adiposity, whereas 3 found no significant associations. A large, nationally representative study by Troiano et al[39] that measured height and weight directly found a positive association between energy from soda and overweight. Two smaller national studies by Forshee and Storey,[19] which found no such association, were based on reported heights and weights.

In a nationally representative sample of 2- to 19-year-old youths,[39] soft drink intake was greater among overweight youths than among nonoverweight youths in all age groups. Furthermore, the Growing Up Today Study,[26] a 1.5-year longitudinal study of children 9 to 14 years of age, found that high levels of consumption of sweetened beverages at baseline were associated with increased BMI.

In a recently published, randomized, controlled trial conducted among 103 high school students who regularly consumed sugar-sweetened beverages, students were assigned to either an experimental group that received home deliveries of noncaloric beverages or a control group that received no intervention. After 6 months, responses to the intervention were associated inversely with baseline BMI values. Among the heaviest one third of the cohort, BMI was significantly lower in the experimental group, compared with the control group (-0.75 ± 0.34 kg/m^2).[40]

Consuming excessive quantities of low-nutrient, energy-dense foods such as sugar-sweetened beverages is a risk factor for obesity. Reducing intake of sugared beverages may be one of the easiest and most-effective ways to reduce ingested energy levels.[41]

Dairy Foods and Calcium

As early as 1984, it was reported that dietary calcium intake was related inversely to BMI in adults. Only recently have additional research reports been published relating low dietary calcium intake to human adiposity.

Of the 7 studies reviewed that assessed dietary calcium intake, 4 found no associations[7,10,42,43] and 3 found inverse associations[12,44,45] between calcium intakes and various measures of adiposity. In a cross-sectional study of primarily white youths, intake of calcium, after controlling for dietary energy and intake of dairy foods, was lower among overweight than nonoverweight 9- to 14-year-old youths.[12] No studies found a positive association between calcium intake and adiposity.

Although energy intake was controlled for in most of those analyses, such epidemiologic findings may be misleading, because dairy products reportedly are avoided by individuals concerned about their weight. However, prospective studies of preschool-aged children confirmed that greater longitudinal intake of calcium was associated with lower body fat.[44,45]

The data suggest a potential role for calcium and dairy foods in the development of overweight and the potential for preventing weight gain by improving the dairy food intake of youths, indicating that a low intake of calcium may be associated with increased adiposity. However, the relative importance of calcium and dairy foods, in comparison with each other and in comparison with other factors involved in the development of overweight, remains to be established.

Dietary Fiber

Many governmental and scientific health agencies recommend that adults consume at least 20 to 25 g of fiber per day. Because children require less total energy, an "age + 5" rule for dietary fiber intake has been recommended.[46] This means, for example, that a 5-year-old child should consume at least 10 g of fiber per day and fiber intake should approach adult levels (20–25 g per day) by 15 years of age.

Unfortunately, persons of all ages in the United States eat far fewer than the recommended number of servings of whole-grain products, vegetables, and fruits.[47] In 1994 to 1996, only 3% of individuals $\geq$2 years of age consumed $\geq$3 daily servings of vegetables (with at least one third being dark green or orange vegetables), whereas only 7% consumed $\geq$6 daily servings of grains (with $\geq$3 being whole grains).[48] Currently, dietary fiber intake throughout childhood and adolescence averages ~12 g/day or 5 g/1000 kcal (4200 kJ), a level of intake that has not changed in the past 30 years.[46] Because total carbohydrate content has increased considerably during this period, most of this increase seems to be in the form of fiber-poor refined grains, starchy vegetables, and sugar-sweetened beverages. It is worth investigating whether this apparent increase in consumption of fiber-poor foods is causally related to the observed increase in childhood obesity prevalence.

Dietary fiber may be related to body weight regulation through plausible physiologic mechanisms that have considerable support in the scientific literature. A large number of short-term studies suggest that high-fiber foods induce greater satiety. Epidemiologic studies generally support a role for fiber in body weight regulation among free-living individuals consuming self-selected diets, although conclusive intervention studies that address this are lacking.[49] Therefore, there is considerable reason to conclude that fiber-rich diets containing nonstarchy vegetables, fruits, whole grains, legumes, and nuts may be effective in the prevention and treatment of obesity in children. Such diets may have additional benefits, independent of changes in adiposity, in the prevention of cardiovascular disease and type 2 diabetes mellitus.[50,51]

Macronutrient Alterations

Carbohydrates and Fat

Several adult studies have shown that significant weight loss can be achieved over 3 to 6 months with energy-restricted or ad libitum dietary prescriptions varying widely in macronutrient composition.[52–59] However, follow-up rates have been disappointing. Weight loss at follow-up times of 12 to 18 months rarely exceeds 5% of baseline weight.[52–54,60–67] Although ad libitum, very-low-carbohydrate diets seem to be more efficacious than energy-restricted, low-fat diets over the short term,[52,54,55,63] Foster et al[54] found no significant group difference in mean body weight at 12 months. A study by Stern et al,[63] which included patients with type 2 diabetes, had similar results. With regard to pediatric data from a short-term study, Sondike et al[68] reported greater weight loss (−9.9 kg, compared with −4.1 kg) for adolescents who were instructed to follow an ad libitum, very-low-carbohydrate diet, compared with an ad libitum, low-fat diet, for 12 weeks. Findings from that study must be interpreted cautiously, however, in light of data on adults indicating poor compliance and weight regain over the long term on an "Atkins-type" diet.[54,63] In addition, there is widespread concern about the safety of severe carbohydrate restriction, especially for children.[69,70] Although very-low-carbohydrate diets may have some beneficial effects on risk factors for cardiovascular disease and type 2 diabetes,[54,63] the overall effects of this approach on other disease processes and on growth and development are unknown.

Very-low-fat diets have been shown to promote weight loss in several studies with adults.[71–74] However, those studies were not included in our systematic review for ≥1 of the following reasons: the design was not a randomized control trial,[72,73] body weight was not a primary outcome,[74] the intensity of intervention varied (ie, very-low-fat diets combined with other intensive lifestyle changes were compared with usual care),[74] or long-term follow-up data were not included.[71]

Protein

Evidence of long-term effectiveness (>1 year after treatment) of a high-protein, low-carbohydrate diet (also known as a protein-sparing modified fast [PSMF]) is extremely limited. There are 2 obvious reasons for this lack of evidence. First, relatively few studies of programs that use this type of intervention have been conducted.[75–77] Second, the studies that do exist suffer from substantial methodologic limitations. For example, all studies were from the same treatment program and all analyzed only 1 component of a multicomponent intervention that included diet and physical activity. A major concern with the use of a PSMF diet to treat childhood overweight is that the very low energy intake may compromise children's growth.

The PSMF is not a diet to be used for long-term treatment of overweight. Rather, the purpose of using a PSMF diet is to bring about rapid weight loss during the initial phase of treatment while minimizing the negative effects of a very-low-energy diet. In studies using PSMF, patients were on the diet for a relatively short initial treatment period and then were placed on a reduced-energy, balanced-macronutrient, maintenance diet. The goal was for the children to maintain the significant weight loss achieved during the "acute" treatment phase. All studies reported a statistically significant decrease in measures of overweight at the end of the initial treatment period. However, only 1 study actually compared the outcomes with a PSMF diet versus a balanced-macronutrient diet.[75] That study found that subjects on the PSMF diet lost significantly ($P < .001$) more weight from baseline to after treatment (BMI decrease: 5.2 ± 1.3 kg/m^2) than did the children on the comparison, balanced-macronutrient diet (BMI decrease: 2.4 ± 1.4 kg/m^2). Although the investigators found significant weight loss after the initial treatment, the same degree of weight loss was not maintained at 1 year. In contrast, other researchers at the same facility[76,77] studying longer-term outcomes found that children were generally able to maintain the weight loss after the initial treatment. Average BMI values were significantly lower than baseline values ($P < .0001$) both immediately and 1 year after treatment. In summary, these studies demonstrated that children initially treated with a PSMF diet were able to maintain some weight loss at 1 year. However, the researchers did not provide a true diet comparison, because the PSMF diet contained ~200 kcal (840 kJ) less per day than did the balanced-macronutrient control diet and potential differences in other aspects of the multicomponent program were not accounted for.

Alternative Approaches

Dietary interventions based on energy density (ie, energy per mass of food) also have been considered as an approach to weight management. A series of short-term feeding studies, summarized by Rolls,[78] suggest that decreasing energy density decreases energy intake independent of macronutrient ratio, possibly because of effects on satiety. Diets of low energy density, which are typically rich in vegetables, fruits, legumes, and minimally processed grain products, allow individuals to consume satisfying portions of food while reducing their energy intake. Other studies included in the review indicate that the volume of food consumed exerts a stronger effect than energy content. Decreasing the energy density but maintaining or increasing the volume of core foods in a weight management program may help decrease energy intake. In a preliminary report of ad libitum diets in obese women, greater weight loss was achieved at 6 months by reducing energy density, with emphasis on increasing consumption of water-rich foods and decreasing consumption of high-fat foods, than by reducing fat intake alone[79]; however, weight loss did not differ between dietary intervention groups at 12 months.

The glycemic index (GI) has been proposed to affect body weight regulation and risk for obesity-associated complications.[80] The GI is defined as the area under the glucose dose-response curve after consumption of 50 g of available carbohydrate from a test food, divided by the area under the curve after consumption of 50 g of available carbohydrate from a control food (either white bread or glucose). Short-term feeding studies indicated that hunger and cumulative food intake were greater 3 to 5 hours after a high-GI versus low-GI meal, controlled for macronutrient and energy contents.[81] However, not all observational studies found a direct association between GI and weight gain. Translational studies found that pair-fed rodents consuming nutrient-controlled, high-GI diets had 70% to 90% greater adiposity than did those consuming low-GI diets.[82] Few long-term clinical trials evaluating low-GI diets in children have been conducted. After controlling for potentially confounding factors, 1 nonrandomized study found that children attending an obesity treatment clinic and assigned to a low-GI diet lost more weight than did those assigned to a low-fat diet.[83] A small-scale, randomized, controlled trial found that adolescents lost more weight on a diet with low glycemic load (mean GI × carbohydrate amount) than on a low-fat diet.[57] Studies comparing the effects of high-GI versus low-GI diets on body weight in adults have produced conflicting results; some showed that low-GI diets led to weight loss,[84] whereas others showed no difference in weight.[85]

Summary of Macronutrient Alterations

Data on optimal dietary approaches for weight management in children are lacking, and long-term studies of available interventions in adults have not demonstrated efficacy. Therefore, research into the development and testing of novel dietary approaches to obesity prevention and treatment is warranted. An emerging body of literature suggests that a focus on the macronutrient ratio is too simplistic and the quality of dietary carbohydrates and fats is an important consideration. The evidence for children and adolescents does not support any specific macronutrient or dietary strategy at this time.

FOOD BEHAVIORS

Breakfast Skipping

Evidence supports observations that obese children are more likely to skip breakfast or to eat smaller breakfasts than leaner children. The evidence seems to suggest that breakfast skipping may be a risk factor for increased adiposity, particularly among older children or adolescents. However, the strength of the evidence is limited because what constitutes a breakfast has not been defined consistently.[13]

Fifteen studies examining the link between breakfast skipping and adiposity were reviewed. Two studies were longitudinal studies,[38,86] 2 were nationally representative, cross-sectional studies,[31,87] and 11 were other types of cross-sectional investigations.[9,35,88–96] Both longitudinal studies[38,86] found that, for girls, breakfast skipping was related to weight gain among those who had normal weight at baseline but was related to weight loss among those who were overweight at baseline. For boys, no relationship was found with breakfast skipping except for weight loss among those who were overweight at baseline in 1 of the 2 studies. The 2 nationally representative studies[31,87] did not find an association between breakfast skipping and reported BMI in younger children, but Siega-Riz et al,[87] who studied food intake patterns for adolescents, did find a positive association.

Of the remaining 11 studies, 5 found a positive association between breakfast skipping and a measure of adiposity,[88,90–92,96] indicating that breakfast skippers were more likely to have a weight higher than normal. Four studies found no relationship between breakfast skipping and a measure of adiposity,[35,89,93,95] and 2 studies reported a negative relationship between breakfast skipping and a measure of adiposity, indicating that breakfast skipping was associated with lower measures of adiposity.[9,86]

Population-based surveys have revealed that many children, particularly adolescents, skip breakfast and other meals but consume more food later in the day, and this pattern has increased in recent years. Overweight children and adolescents have been shown to be more likely to skip breakfast and to consume a few large meals each day than their leaner counterparts, who are more likely to consume smaller, more-frequent meals. Overweight children have also been reported to eat smaller breakfasts and larger dinners, in comparison with nonoverweight children. It has been suggested that eating breakfast reduces fat intake and limits snacking over the remainder of the day.[88]

Snacking

In a review of the literature, the American Dietetic Association[13] found that snacking frequency or snack food intake might not be associated with adiposity in children. The majority of the studies reviewed found no association between snacking and adiposity.[35,36,88,96–99] Francis et al[100] found no relationship between snacking and changes in BMI among girls with nonoverweight parents. Among girls with overweight parents, only fat intake from energy-dense snacks was associated with increased BMI over the 4-year study. However, mixed results were reported among the 7 case-control and other cross-sectional studies that examined the amount of snack food consumed in relation to adiposity. Two found a positive relationship,[35,98] whereas 5 found no relationship.[8,10,88,97,98] Comparisons of the findings from those studies are limited because there was no clear definition of what constituted a snack or snack food. The best evidence suggests that snacking frequency is not associated with adiposity in children; however, studies that examined total snack food intake produced more-mixed results.

According to national surveys, although the average size of snacks and the energy per snack remained relatively constant, the frequency of self-defined snacking increased from 1977 to 1996 among children in all age groups between 2 and 18 years. Reportedly, between one fourth and one third of the energy intake of adolescents is derived from snacks.[39] Furthermore, snacks tend to have higher energy density and fat content than meals, and frequent snacking has been associated with high intakes of fat, sugar, and energy. The primary snacks selected by teens include potato chips, ice cream, candy, cookies, breakfast cereal, popcorn, crackers, soup, cake, and carbonated beverages.

Eating Out

Evidence shows that consuming food away from home, particularly at fast food establishments, may be associated with adiposity, especially among adolescents. A total of 12 observational studies were reviewed, including 2 longitudinal studies with children and 1 longitudinal study with adults,[38,101,102] 2 nationally representative, cross-sectional studies,[31,103] and 7 other cross-sectional studies.[89,92,104–107] Study sample sizes ranged from just over 50[104] to >60 000.[101] The majority of studies focused on older children and adolescents. In a longitudinal study of girls, Thompson et al[101] reported a positive association between eating at fast food establishments and BMI *z* scores for elementary school-aged girls but no association with eating at coffee shops or other types of restaurants. Taveras et al[103] found, in a study of >14 000 girls and boys, that greater consumption of fried foods eaten away from home was evident for heavier adolescents and that increasing consumption of fried foods eaten away from home over time led to an increase in BMI. In addition, the frequency of eating fried foods away from home was associated with greater intakes of total energy, sugar-sweetened beverages, and trans fats, as well as less consumption of low-fat dairy foods and fruits and vegetables. The other longitudinal study,[38] which was conducted in Japan, found no relationship between eating out in general and BMI among preschool-aged children. A nationally representative study by Lin et al[31] found no association between food eaten away from home and reported BMI. Pereira et al[102] found in the Coronary Artery Risk Development in Young Adults (CARDIA) study that consumption of fast foods was associated directly with body weight and insulin resistance over 15 years among young black and white adults. Findings from the other studies were mixed, ranging from positive associations to inverse relationships. Because both the largest longitudinal study and the largest cross-sectional study took place outside the United States (in Japan and Iran, respectively), their findings are not directly applicable to the US fast food environment. However, the limited evidence currently available suggests that frequent patronage of fast food restaurants may be a risk factor for overweight/obesity in children[13] and fast food ingestion year after year may accumulate into larger weight gains that can be clinically significant.[103]

DIETARY INTERVENTIONS

Use of Balanced-Macronutrient/Low-Energy Diets

As stated previously, limited research exists for evaluating dietary treatment programs in isolation. However, a few dietary components have been evaluated. Although the outcomes are mixed, evidence does suggest that, in both the short term and the long term, a reduced-energy diet (less energy than required to maintain weight but not less than 1200 kcal [5040 kJ]/day) may be an effective part of a multicomponent weight management program in children 6 to 12 years of age.[108–113] Use of a reduced-energy diet (not less than 1200 kcal [5040 kJ]/day) in the acute treatment phase for adolescent overweight is generally effective for short-term improvement in weight status; without continuing interventions, however, weight is regained.[13]

Six studies that used a reduced-energy diet (not less than 1200 kcal [5040 kJ]) for 6- to 12-year-old youths were reviewed. The studies indicated that the majority of treatment groups decreased in ≥1 measure of adiposity.[108–112] Only 2 studies reported an increase in weight at posttreatment or follow-up assessments.[112,113]

Six studies used an energy-deficit dietary treatment for adolescents. Five focused exclusively on adolescents,[62,68,114–116] whereas the sixth provided treatment for 11- to 16-year-old youths.[117] Five of the 6 studies reported a decrease in ≥1 measure of adiposity. Saelens et al[114] reported a statistical difference in posttreatment weight status among teens who received a behaviorally based treatment, compared with a single-session, energy-deficit and activity approach, but differences diminished at the 3-month follow-up assessment. Only 2 studies reported follow-up periods of ≥1 year.[62,117] In both of those studies, follow-up weight status was not higher than baseline. Generalizing the results of these studies is difficult because of differences in the treatment environment, duration, and intervention strategies. Treatment settings were outpatient clinics or boarding schools, whereas interventions ranged from computer-based programs with additional nutrition and activity counseling to health center-based, multicomponent programs.

In addition, the length of the programs ranged from 3 weeks to 9 months.[13]

Traffic Light Diet

Much of our current understanding of individual/family treatment of pediatric overweight comes from 4 long-term, family-based studies conducted by Epstein et al.[118–123] The studies by Epstein et al[118–123] targeted children 6 to 12 years of age. The traffic light diet (sometimes called the stoplight diet) was developed by Epstein et al[118–123] for use in research on overweight. Perhaps because of the groundbreaking nature of their research, the traffic light diet has become broadly recognized and in some cases copied. The traffic light diet is part of a larger core package of interventions that generally includes family components, physical activity, and interactions with a behavioral therapist. The core intervention program was used in all studies, whereas other variables were manipulated. This presents a problem in trying to isolate the independent effects of the specific dietary intervention on weight loss.

The goal of the traffic light diet was to provide the most nutrition with the lowest energy intake. Daily energy intakes ranged from 900 to 1200 kcal (3780–5040 kJ), with later studies increasing intake to 1500 kcal (6300 kJ)/day.[122] Food groups were divided into 3 categories, namely, green, yellow, and red. Low-energy, high-nutrient foods (eg, most fruits and vegetables) are considered "green" and may be eaten often. Moderate-energy foods (eg, most grains) are considered "yellow" and may be eaten in moderation, whereas high-energy, low-nutrient foods are considered "red" and should be eaten sparingly. Families were instructed to stay within a prescribed energy range and to reduce "red" food servings to less than a prescribed value for the week (eg, $<$4 times per week). In addition to the basic diet, and depending on the arm of the intervention study, participants might have been given self-monitoring training and support, praise and modeling, therapist contact, and/or behavioral contracting, in which children were given rewards for meeting dietary and activity goals. Once children/families met their weight goals, counseling was provided to ensure consumption of a balanced diet that would maintain a healthy weight.

The intervention and research program by Epstein et al[118–123] demonstrated modest sustained weight loss in children 5 years and even 10 years after the intervention.[123] However, not all of the behavioral interventions provided sustained weight loss.[123] It remains unclear what part the diet itself played in these overall results. Because the research by Epstein et al[118–123] focused primarily on white, middle-class, intact families with younger children (6–12 years of age), it is also unclear how well results may be generalized beyond this population.[13]

Food Guide Pyramid

The Food Guide Pyramid was designed as a general guide for diet and exercise and not as a weight loss tool. Although it may be used as a component of a comprehensive childhood weight management program, the evidence does not indicate that, by itself, the Food Guide Pyramid is an effective weight loss tool. Only 1 study was identified that used the pyramid as a weight loss tool. Saelens et al[114] found that adolescents who used the Food Guide Pyramid as part of their weight management program gained weight over the course of treatment and at follow-up evaluations. This was compared with adolescents in the control group who ate a balanced, lower-energy diet, whose weight either stabilized or decreased slightly.

PHYSICAL ACTIVITY

Importance of Physical Activity

Although obesity has a complex development, involving environmental, physiologic, and genetic factors, the basic cause of this condition is an imbalance between energy intake and energy expenditure. Physical activity is the only modifiable component of the energy expenditure portion of the energy balance equation. Consequently, increasing physical activity has the potential to improve weight loss and maintenance. Studies indicate that an increase in sedentary activities, particularly television viewing, and an overall decrease in physical activity are contributing to an increased incidence of overweight and obesity in children and adolescents.[124–127] Strategies to increase physical activity should include increases in structured and nonstructured physical activity and reductions in the amount of time spent in sedentary activities. Schools have a unique combination of factors, including facilities, fitness instructors, and contact with large numbers of young people for many hours each day during much of the year, that make them a good environment in which to study physical activity interventions for weight management and to implement proven approaches.[128]

Role of Physical Activity in Weight Management

Noting that accurate measurement of physical activity is complex and that comparisons between studies are difficult because of differences in designs and methods, some researchers have questioned whether it is possible to demonstrate an effect of physical activity in reducing obesity.[129] Because it is easier to reduce energy intake by 500 to 1000 kcal (2100–4200 kJ)/day than to increase energy expenditure by a similar amount, physical activity has less impact on weight loss than does dietary intervention.

In adults, increasing physical activity did not result in significant weight loss over a 6-month period. Most weight loss occurred as a result of decreased energy intake. Sustained physical activity did reduce the risk of weight regain and also decreased cardiovascular and diabetes risk factors, independent of the reductions in these risks that are associated with weight loss.[130]

Several but not all studies have demonstrated that increased physical activity is associated with decreased BMI in children and adolescents.[131–133] The largest of those studies[133] examined the association between changes in BMI over 1 year and same-year changes in self-reported recreational physical activity and in recreational inactivity (television, videotapes, and video games) among 11 887 boys and girls 10 to 15 years of age. After correction for growth- and development-related changes in BMI, an increase in physical activity was associated with decreasing relative BMI for girls (-0.06 kg/m^2 per 1-hour increase in daily activity; 95% confidence interval [CI]: -0.11 to -0.01 kg/m^2 per 1-hour increase) and for overweight boys (-0.22 kg/m^2 per 1-hour increase; CI: -0.33 to -0.10 kg/m^2 per 1-hour increase). Conversely, higher levels of inactivity were correlated with increased BMI in girls ($+0.05$ kg/m^2 per 1-hour increase in television, videotapes, and video games; CI: $+0.02$ to $+0.08$ kg/m^2 per 1-hour increase). One study found a relationship between inactivity in overweight preschool-aged boys but not girls.[132] The third study, involving 47 boys and girls 5 to 10.5 years of age, measured total energy expenditure directly by using the double-labeled water technique and calculated basal metabolic rate by using the Schonfield equation. It used these measurements to calculate physical activity levels, as follows: physical activity level = total energy expenditure/basal metabolic rate. Body fat and BMI were used to estimate body composition. Body fat and BMI were found to be significantly inversely correlated with physical activity levels.[131]

Studies that use weight loss as the only criterion with which to assess the value of increased physical activity may miss other important benefits this confers. In a meta-analysis, P. McGovern, PhD (unpublished data, 2006) found that physical activity decreased fat mass but not BMI. Other studies indicated that exercise also improved cardiovascular risk factors.[134,135]

Risks of Physical Inactivity

Physical activity may play a role in preventing weight gain and other health problems. Physical inactivity has been shown to be a risk factor for obesity and insulin resistance in school-aged children.[136] Inactive children may be at increased risk of developing health problems later in life. Several studies suggest that sedentary children are more likely than active children to become sedentary adults and to have increased risks of obesity, diabetes, hypertension, dyslipidemias, and cardiovascular diseases.[129,135,137,138] A sedentary lifestyle is also associated with increased risks of several cancers common in adults.[139]

Structured Versus Nonstructured Physical Activity

There is some debate in the literature regarding whether structured or unstructured activities should be promoted as a means to increase physical activity. The position of the American Academy of Pediatrics on physical fitness and activity in schools advocates increases in both forms of activity.[140] It states that the development of a physically active lifestyle should be a goal for all children. Opportunities to be physically active should include team, individual, noncompetitive, and lifetime sports, as well as recreational activities. The opportunity to be active on a regular basis, as well as the enjoyment and competence gained from activity, may increase the likelihood that a physically active lifestyle will be adopted.[140]

Beyond the school setting, increasing physical activity, even unstructured physical activity, seems to be beneficial.[133] It is thought that increasing the frequency or intensity of physical activity can reduce sedentary activities, particularly television viewing. This, in turn, can reduce excess energy balance effectively.[141] The goal is not to eliminate television watching; data suggest that children and adolescents can engage in both television viewing and physical activity as long as sedentary behavior is not at the expense of physical activity.[142–145]

Amount of Physical Activity

Since 2000, the US Department of Agriculture has recommended that children and adolescents participate in ≥60 minutes of moderate-intensity physical activity most days of the week, preferably daily.[146] This position was reaffirmed in the 2005 Dietary Guidelines for Americans[147] and is supported by the American Academy of Pediatrics[140] and the Centers for Disease Control and Prevention (CDC).[148] The American Academy of Pediatrics recommends that 30 minutes of this activity occur during the school day.[140] Very obese children may need to start with shorter periods of activity and gradually increase the time spent being active. The CDC suggests that parents can help children meet this activity goal by serving as role models, incorporating enjoyable physical activity into family life, monitoring the time their children spend watching television, playing video games, and using the computer, and intervening if too much time is spent in sedentary pursuits.[148]

Barriers to Physical Activity

Barriers to physical activity for the pediatric population include lack of opportunities for activity during the school day and environmental factors, such as lack of access to facilities in which to be active and urban environments designed for vehicular transportation that limit activity outside of school.[149–156] In the past decade, schools have been urged to spearhead improvements in childhood wellness through changes in the food and activity programs they offer. The amount of time spent on physical education, however, has decreased in the past 15 years. Between 1991 and 2003, the percentage of high school students enrolled in daily physical education classes decreased from 41.6% to 28.4%. Only 8% of elementary schools, 6.4% of middle/junior high schools, and 5.8% of senior high schools provided daily physical education or allocated the recommended amount of time per week (150 minutes for elementary and 225 minutes for junior and senior high schools), according to a 2000 study.[149]

More consideration needs to be given to the types of activities performed during physical education class, because time spent in class does not correlate with activity. Data for 37 000 students collected by the CDC as part of the annual Youth Risk Behavior Surveillance Survey found that high school students were active for only 16 of the 50 minutes in an average gym class. Spending more time in physical education classes did not help. When states required an extra year of physical education classes for high school students, which is ~200 more minutes of physical education per week, male students reported, on average, another 7.6 minutes per week spent exercising or playing sports in gym class. Female students reported, on average, an extra 8.1 minutes per week spent exercising in class.[150]

Increasing the intensity of activity during gym class can improve fitness and reduce body fat measurably. Fifty overweight (BMI of ≥95th percentile) children in middle school were assigned randomly to lifestyle-focused, fitness-oriented, gym classes or standard gym classes for 9 months. The children were evaluated for fasting insulin and glucose levels and body composition and assessed with maximal oxygen consumption treadmill testing at the beginning and at the end of the school year. Overweight children who participated in the fitness-oriented gym classes for 9 months showed significant improvements in body composition, fitness, and insulin levels.[151] These studies[149–151] indicate that public health policies should focus on revising school curricula to include adequate time for and intensity of physical activity.

Safety concerns, such as heavy traffic and high crime rate, lack of equipment, lack of space, and urban development that favors vehicular transportation are barriers to activity outside of school.[152–156] The World Health Organization has identified transport-related physical activity as an important intervention with which to address the global obesity epidemic, as well as environmental issues such as traffic congestion and its associated pollutants.[152] In the United States, a decrease in transport activity parallels the increase in pediatric obesity. Walking or biking to and from school can help students meet their physical activity needs. However, heavy traffic, lack of bicycle lanes, unmarked intersections, and other obstacles have reduced the number of children who transport themselves to school today, compared with previous generations.

Currently, only one third of students who live within 1 mile of school walk or bike there and <3% of students who live within 2 miles of school walk or bike there. Initiatives such as the government-sponsored, community-implemented, Safe Routes to School program may help reverse this trend. A pilot study conducted in Marin County, California, found that the number of children walking to school increased from 14% in 2000 to 23% in 2002 and the number riding bicycles more than doubled, from 7% to 15.5%, in the same period. Similar results have been observed in other communities around the country. These experiences highlight the need for parents and other interested community members to take an active role in reducing barriers to physical activity.[153]

Lack of access to safe exercise environments is of particular concern in low-socioeconomic status and minority communities, because this may account for racial and economic disparities in health, obesity, and physical activity rates. Burdette and Whitaker[154] found an inverse association between neighborhood safety and television viewing among preschool-aged children. Parents who rated their neighborhoods as unsafe were more likely to report that their preschool-aged children watched >2 hours of television daily. No association was found between television viewing and obesity in these young children; however, early television viewing may establish a pattern of sedentary activity that leads to obesity in later childhood. An observational study examined the associations between community physical activity-related settings (eg, sports areas, public pools and beaches, parks and green spaces, and bicycle paths) and race, ethnicity, and socioeconomic status in 409 communities throughout the United States.[155] The researchers reported that higher median household incomes and lower poverty rates were associated with increasing levels of available physical activity-related facilities and settings. Communities with greater proportions of ethnic minorities had fewer physical activity-related settings. Using data from the first wave of the National Longitudinal Study of Adolescent Health ($N = 20\ 745$), Gordon-Larsen et al[156] demonstrated a direct relationship between decreased access to physical activity facilities and overweight. They found that communities with low socioeconomic status and large minority populations had reduced access to recreational facilities. These factors were associated with decreased physical activity levels and increased incidence of overweight. These associations suggest that lack of opportunities for physical activity may contribute to the disproportionately greater incidence of obesity in ethnic minority groups and groups with low socioeconomic status.[156]

Other researchers have found that schools with large minority populations are less likely to have programs that support healthy eating and physical activity.[157–159] A survey of 3600 households with children 9 to 13 years of age that was conducted by the CDC in 2002 found that non-Hispanic black parents and Hispanic parents cited concerns about transportation, lack of local facilities, and expense as barriers to their children participating in physical activity and organized sports outside of school more often than did non-Hispanic white parents.[160] There are many communities and neighborhoods in which inadequate school wellness programs, lack of access to facilities for physical activity outside of the classroom, and lack of discretionary income may contribute to the high obesity rates seen among economically disadvantaged individuals.

Higher economic status does not guarantee that people will live in neighborhoods that encourage more activity. Built environments in suburban communities often are not conducive to walking, biking, and other physical activities. Neighborhood comparison and correlational studies with physical activity transport outcomes suggest that residents from communities with higher density, greater connectivity, and more land use mixture have higher rates of walking/cycling for utilitarian purposes than do low-density, poorly connected, and single-land use neighborhoods. Environmental variables seem to add to the variance accounted for beyond sociodemographic predictors of walking/cycling for transport.[161]

In what is thought to be the first study to examine the link between obesity in rural communities and environmental factors, Boehmer et al,[162] from the St Louis University School of Public Health, found that residents of rural communities who felt isolated from recreational facilities, stores, churches, and schools were more likely to be obese than were those who thought they were closer to such facilities. Closeness counted; people who thought that safe walking and/or biking routes were within 10-minute walking distance of their homes were more likely to be active. Approximately 25% of the population in states in the South and Midwest live in rural environments.[162] To ensure that people of all income levels have opportunities to be physically active as part of their daily routines, community leaders and environmental planners need to address safety and access issues.

Psychosocial barriers such as perceptions of class rank and self-esteem, and their impact on physical activity, have been studied but are not well understood. Physical activity self-efficacy (confidence in one's ability to participate in exercise) has been widely studied as a potential psychosocial correlate of increased levels of physical activity. However, this association is not clear for children and adolescents.[163]

Reducing Sedentary Activities

As a first step toward addressing neighborhood safety barriers to activity, the American Academy of Pediatrics recommends that activities that can be performed indoors, such as exercising to videotapes, using hula hoops, and dancing to popular music, should be encouraged.[164] A complementary strategy for promoting physical activity among children and adolescents is to decrease their inactivity by decreasing the time spent in sedentary activities such as television viewing, leisure time use of the computer, and video game playing. Staying active while watching television by stretching, performing calisthenics, or using exercise equipment can also reduce the time spent in sedentary pursuits. Television viewing may have a negative effect on both sides of the energy balance equation. It may displace active play and physical activity time and it is associated with increased food and energy intake, as an accompaniment to television viewing and as a result of food advertising.[165]

Summary

Addressing childhood obesity requires a comprehensive holistic approach. Although the evidence is limited, increased physical activity alone has not improved children's weight status substantially. Promotion of routine physical activity in children from preschool age on may help prevent the development of overweight and obesity and has other benefits, including reductions in cardiovascular disease risk factors. Particular consideration should be given to methods of increasing activity in adolescents. Studies suggested that time, cost, availability, and convenience were key factors that influenced what adolescents ate and whether they were physically active.[166,167] Students reported that social support from friends and family members, as well as teachers and adults who modeled healthy behaviors, enhanced their likelihood of eating healthy foods and being physically active.[168–170] Finally, the American Academy of Pediatrics[140] recommends that (1) all children meet the goal of 60 minutes of moderate activity per day; (2) schools be provided with the necessary resources to incorporate 30 minutes of moderate to intense activity into each student's daily schedule; (3) clinicians instruct parents on techniques for increasing activity in the home environment, including reducing time spent in sedentary activities; and (4) health care providers become involved in the community to address access and safety issues.

TELEVISION VIEWING AND MEDIA USAGE

Television Viewing and Obesity

Investigators have examined many aspects of diet and physical activity, but some of the strongest evidence of a behavioral risk for overweight in children points to the impact of television viewing. Epidemiologic and experimental evidence from the past decade supports decreased television viewing as a primary preventive intervention for the reduction of overweight and other chronic disease risks. Many cross-sectional[136,171–177] and longitudinal[133,173,178–180] observational studies in the United States document the effect of television viewing on overweight. These studies are reinforced by others in at least 12 other countries.[173,181–190] The observational studies have been corroborated by randomized, controlled trials designed to reduce levels of both television viewing and overweight. In a randomized, controlled trial, Gortmaker et al[191] showed that reductions in television viewing were associated with decreased obesity. Among girls, each 1-hour reduction in television viewing predicted reduced obesity prevalence. Guillaume et al[190] found a significant relationship with BMI and systolic blood pressure for television viewing in boys. In a randomized, controlled, school-based trial, Robinson[192] showed that intervention groups had statistically significant decreases in BMI with reductions in television viewing and eating meals in front of the television. That author also found reductions in waist circumference and waist/hip ratios. In a randomized trial, Epstein et al[193] found that, at 1-year follow-up assessments, children who were counseled regarding decreasing sedentary activities versus increasing physical activity or a combination of the 2 had a greater decrease in the percentage of overweight than did children from the other 2 groups. In fact, children in the sedentary activity-reduction group increased their liking for high-intensity activity and reported lower energy intake than did children in the exercise group.

Influences on Diet, Physical Activity, and Chronic Disease Risks

Television viewing is likely to influence overweight by replacing more vigorous activities, as well as affecting diet.[144,178,194] Foods are heavily advertised in children's television programming,[105] and television viewing is associated with children's between-meal snacking.[195] A randomized trial indicated that increased television viewing resulted in increased energy intake and decreased energy expenditure.[196]

Other studies documented similar effects of television viewing on overweight among preschool-aged children.[197] Reducing excess television viewing among youths is a national health objective for 2010.[198] Since 1986, the American Academy of Pediatrics has recommended limiting television viewing to no more than 2 hours/day for children $\geq$2 years of age.[199] The American Academy of Pediatrics has broadened this guideline by recommending no television viewing for children $<$2 years of age and suggesting that total entertainment media time be limited to no more than 1 to 2 hours/day for children $>$2 years of age.[200] Other studies demonstrated that having a television in the room where a child sleeps is a major predictor of television viewing[177,180,201,202] and that, once in the room, televisions often are not removed.[203] These data point to the utility of early intervention strategies to limit television viewing.

An important fact about television viewing is that it correlates only minimally with measures of moderate and vigorous physical activity[203] and therefore is an independent risk factor for overweight. Similar findings on the impact of television viewing on overweight, independent of the effects of moderate and vigorous physical activity, have been reported in prospective studies of adults[204,205] and in studies of television viewing, physical activity, and diabetes incidence among men and women.[206,207]

Several studies also indicated that television viewing has substantial effects on other risk factors for chronic disease, including smoking,[208] reduced fruit and vegetable consumption,[209] increased aggression,[200] and less time spent reading and doing school homework.[210] During the developmental period in which television viewing becomes an entrenched habit (ie, the preschool/early primary school years),[211] children also are developing physical activity skills and learning to read. Other potential benefits of reduced television viewing in this age group may be increased physical activity and reading.

Socioeconomic Status, Ethnicity/Race, Television Viewing, and Overweight

The prevalence of childhood and adolescent overweight in the United States has grown most rapidly among black and Hispanic youths, and health disparities have widened in the past decade.[212] The treatment writing group strongly supports the Healthy People 2010 goal of eliminating gender-, race/ethnicity-, and socioeconomic status-associated disparities in health status, risks, and use of preventive services. Groups with lower socioeconomic status and racial/ethnic minority groups generally are at greater risk of morbidity and death resulting from chronic diseases, including cardiovascular disease, stroke, and diabetes mellitus.[213–216] Therefore, reducing television viewing among young ethnic minority children in the United States has the potential to reduce excess chronic disease among youths, as well as to reduce adult rates of morbidity and death resulting from chronic illnesses.[136] Several studies have noted substantially higher levels of television viewing among ethnic minority children, particularly black children, and among boys, compared with girls.[175,177,217,218] A number of studies also reported stronger associations between television viewing and overweight among girls, compared with boys,[126,191,210,219,220] including a randomized trial that found that the strongest effects of reduced television viewing were in black girls.[219] These differences according to gender and ethnicity[221] indicate the need to focus on cultural diversity[222] in developing interventions, as well as increasing awareness that efforts to reduce television viewing have the potential to reduce ethnic and gender disparities in overweight.

Other Media Usage

In the past 5 years, media use by children has increased significantly. However, limited research is available on uses of "screen time" other than television, such as computers, video games, DVDs, and instant messaging. In a recent study of parents of children 0 to 6 years of age, Vandewater et al[223] found that, on a typical day, 75% of children watched television and 32% watched videotapes/DVDs, for ~1 hour and 20 minutes, respectively, on average. New media also are making inroads with young children; 27% of 5- to 6-year-old children used a computer (for 50 minutes, on average) on a typical day. Many young children (one fifth of 0- to 2-year-old children and more than one third of 3- to 6-year-old children) also have a television in their bedrooms. The most common reason given was that this frees up other televisions in the house so that other family members can watch their own shows (54%). The majority of children 3 to 6 years of age fell within the American Academy of Pediatrics guidelines, but 70% of 0- to 2-year-old children did not.

Another study of older children and adolescents[224] found that approximately one half (53%) of all 8- to 18-year-old youths said that their parents gave them no rules about television watching. Nearly one half (46%) said that they did have rules regarding screen time but only 20% said that the rules were enforced most of the time. Most importantly, youths with rules that were enforced reported 2 hours less of media exposure per day than did those in homes without this supervision. Despite the concerns parents express about the impact of media on their children, this study did not find much evidence of major parental efforts to curb or to monitor viewing habits.

Summary

Epidemiologic and experimental evidence from the past decade supports decreased television viewing as a primary preventive intervention for the reduction of overweight and other chronic disease risks. Screen time for children >2 years of age should be limited to no more than 1 to 2 hours/day. Television viewing is not recommended for children <2 years of age. Parents need to take an active role in setting total screen time limits and monitoring their children's viewing habits. Health care professionals should encourage parents not to put a television in the room where their child sleeps and to remove the television if it is already there.

BEHAVIORAL APPROACHES

Techniques

Behavioral therapy for pediatric obesity uses a number of techniques that modify and control children's food and activity environments in ways that bring about weight loss. These techniques include removing unhealthy foods from the home, monitoring behavior by asking children or parents to keep track of the foods consumed, setting goals for energy consumption and physical activity, and rewarding children's and sometimes parents' successful changes in diet and physical activity. Additional behavioral approaches include training in problem solving and other parenting skills. These techniques have been described in detail elsewhere.[225]

Subjects, Settings, and Delivery Formats

Most published trials of behavioral interventions have taken place in specialty treatment centers staffed by physicians, nutritionists, exercise therapists, and/or psychologists. The programs studied were conducted or designed by a multidisciplinary team of providers, including a psychologist, and included children and adolescents 5 to 17 years of age. These programs generally included behavioral interventions in conjunction with changes in diet and physical activity, delivered at least in part in a group setting. Comparative data that identify the optimal frequency of visits do not exist. However, most outpatient-based interventions included 8 to 16 initial weekly group sessions lasting 45 to 90 minutes, followed by visits of decreasing frequency for a total duration of 4 to 12 months.

In one trial, group-only treatment was as effective in producing weight loss and was more cost-effective than combined group and individual family sessions.[226] Two inpatient programs based in Belgium and an 8-week summer camp program in Massachusetts showed efficacy in producing weight loss and improved psychological well-being.[227–229] Another trial, conducted in Germany in an inpatient treatment program with 9- to 19-year-old obese adolescents, compared self-management of weight and muscle relaxation training as additions to a structured exercise and diet program and found no added benefit beyond inpatient effects.[230]

Few studies of pediatric obesity treatment have been conducted as part of primary care. One trial of overweight adolescents included a single session with a primary care provider, followed by either telephone- and mail-based behavioral intervention or no additional treatment. There was some evidence of better efficacy among the behaviorally treated adolescents, although absolute efficacy was less than with more-intensive clinic-based and inpatient interventions.[114] Approaches using Internet-based treatment offer some evidence that, even when delivered in this nontraditional format, behavioral treatment is more efficacious than dietary and physical activity education alone.[231]

Several researchers have addressed a key question, namely, who should be the target for change. Including parents as agents of change seems critical for children's success, particularly for younger children. Several studies by Epstein et al[118,123,232] of children 8 to 12 years of age demonstrated that targeting and reinforcing behavioral changes in parents as well as their children was more effective than targeting children alone. Another study of obese adolescents 12 to 16 years of age produced similar findings.[233] Studies conducted in Israel with children 6 to 11 years of age suggested that targeting exclusively parents for change was superior to targeting only children for change.[234,235] Israel et al[236] found that providing training in parenting skills sustained improved child weight status at 1-year follow-up assessments. Although parents need to be active in helping their children make healthy diet and physical activity choices,[237] the evidence suggests that targeting parents to lose weight improves their child's outcomes, particularly for children <12 years of age.[234] The evidence on the amount and type of parental involvement in adolescents' weight control is far more inconsistent.

Evidence for Efficacy of Behavioral Therapy Components

The most effective treatments for childhood obesity include both dietary and physical activity interventions; however, simply providing education about needed changes is inadequate.[238–241] A number of behavioral therapy techniques, including environmental control approaches (such as parental modeling of healthful eating and physical activity), as well as monitoring, goal-setting, and contingency management, can facilitate recommended changes in children's diet and physical activity.[225] A nonrandomized trial conducted in Israel by Eliakim et al[242] demonstrated that children and adolescents who completed a 12-week program that included behavioral therapy sessions with a psychologist reduced their BMI more than did untreated control subjects. An early study of children 5 to 8 years of age by Epstein et al[239] demonstrated that family-based behavioral therapy, including praise, modeling, and contracting, produced greater benefits than did diet and exercise education without behavioral therapy. Similarly, in their study of children 10 to 11 years of age, Flodmark et al[108] found that the addition of family therapy to dietary counseling and medical visits was effective.

Published descriptions of various weight management interventions and programs indicate that self-monitoring or parental monitoring is a nearly universal component, even in pharmacologic intervention trials. Monitoring usually consists of written documentation of foods eaten (or categories of foods, on the basis of the prescribed dietary plan) and/or physical activity performed. Goal-setting and contingency management are commonly reported behavioral tools, but interventions differ in their dietary and activity targets and in whether specific weight change is a rewarded goal. Environmental control is a less common behavioral strategy, but more than one half of the studies reviewed described specifically how caregivers were encouraged to make obesity-discouraging changes in the home and other environments.

Several factors complicate efforts to determine the relative efficacy of individual behavioral strategies. A major obstacle is that strategies included in interventions often are not described completely. Another obstacle, with only a few exceptions,[243] is the limited number of dismantling trials that test the efficacy of single strategies in isolation. Furthermore, most intervention programs teach and encourage the use of many behavioral strategies to help children change their diet and/or physical activity levels; however, few report on whether participants use these strategies and whether their level of use, individually or collectively, is associated with observed changes in weight. Some evidence supports their collective effectiveness and, to a lesser degree, their individual impact. In one study, Epstein et al[118] found that children's reports of seeking low-energy snacks, graphing their weight, and eating fewer items classified as "red foods" (on the traffic light diet) were related to weight outcomes and an association with weight loss did exist. Others have reported that more-frequent and more-accurate self-monitoring is related to better outcomes in children.[244–246] Still others have found that positive parental modeling of healthy choices and parental praise of such choices are related to better outcomes.[247] It is noteworthy that children whose parents mastered various behavioral strategies had better treatment outcomes than did children whose parents did not master the strategies.[248]

Many interventions encourage children and caregivers to use additional behavioral techniques that can be classified as problem-solving approaches, including strategies such as preplanning and relapse prevention. The addition of structured or formal problem-solving training to a family-based, behavioral, weight loss program was found to be more effective in one trial[249] but not in another.[248] Cognitive strategies, such as cognitive restructuring, have been used to augment behavioral strategies, but cognitive strategies alone seem less effective than behavioral strategies alone,[249] and addition of cognitive strategies fails to improve the efficacy of behavioral strategies alone.[250]

Behavioral strategies seem efficacious in changing both dietary and physical activity behaviors. Several trials by Epstein et al[144,243] have examined how behavioral approaches can be used to affect activity levels. Using environmental control and providing reinforcement to reduce sedentary behaviors were reported to be effective in improving weight status. A study by Faith et al[251] of obese children 8 to 12 years of age demonstrated that simply placing an exercise bike in front of the television was not effective but making viewing contingent on pedaling reduced viewing and increased physical activity.

Overall, systematic training and parental adoption of various behavioral skills for helping change children's dietary and physical activity behaviors are core and seemingly necessary components of pediatric obesity treatment. However, it is unclear whether all skills are necessary for all families or whether tailoring can be used to optimize outcomes while minimizing intervention resources.

Potential Psychological Complications of Behavior-Based Treatment

Only one study, a 10-year follow-up study of children who completed behavioral interventions for obesity, reported on potential complications of treatment. Epstein et al[123] found increased rates of psychiatric disorders such as depression, substance abuse, and eating disorders, but it was unclear whether these conditions were a result of treatment or simply comorbid conditions associated with obesity. Other trials showed improvements in children's psychological functioning and did not find higher rates of eating disorders among children treated with a family-based, behavioral, weight management intervention.[251]

OTHER INTERVENTIONS

Weight Loss Medications in the Treatment of Pediatric Obesity

The use of weight loss medications in obesity treatment has a complicated history. Many medications used to treat obesity were eventually withdrawn from the market or their use restricted after documentation of dangerous side effects.[252–255] The most-recent examples are the withdrawal of the prescription medication fenfluramine, which was banned in the United States in 1997, because of associated cardiac valve abnormalities[254–255] and the removal of ephedra from the herbal market[256] and phenylpropanolamine from the over-the-counter market because of cardiovascular concerns.[254–255] These experiences underscore the need to use weight loss medications conservatively for all obese patients. Particular care must be taken when the use of weight loss medications is considered for children, because the long-term effects of these substances on growth and development have not been studied.

Pharmacotherapy alone has not proved to be an effective obesity treatment.[252,254,255] Medication used as part of a structured lifestyle modification produces an average weight loss of 5% to 10%, which typically plateaus at 4 to 6 months of therapy, after which weight regain may occur. Weight regain is common if the drug is withdrawn.[252,254,255] Despite these limitations, pharmacologic agents may be helpful in the treatment of obesity for carefully selected patients, as part of a multimodal therapy[257] that includes diet, exercise, and behavior modification.

Few guidelines are available regarding the use of weight loss medications in the pediatric population. Weight loss through lifestyle changes is optimal. However, when clear health risks are present and lifestyle changes alone have not been effective, medications may be used as adjunctive therapy. Freedman et al[257] used cross-sectional (N = 10 099) and longitudinal (N = 2392) analyses to assess risk factors associated with excess adiposity in very overweight children and adolescents between 1973 and 1996. They concluded that the 99th percentile of BMI for age may be an appropriate threshold for identifying children and adolescents who are at very high risk for biochemical abnormalities and severe adult obesity and thus may be candidates for more-aggressive treatment such as pharmacotherapy.[257] Obese pediatric patients who seem to be candidates for drug therapy should be referred to a tertiary care center for evaluation and treatment. Presently, the Food and Drug Administration (FDA) approves 6 drugs specifically for obesity treatment,[254] only 2 of which, orlistat and sibutramine, have been approved for limited use among pediatric patients. Some research suggests that drugs developed and approved for the treatment of insulin resistance also may improve weight control. Preliminary research suggests that metformin may improve weight control, but this has not been tested in children and the drug is not approved for this indication.

Medications Approved by the FDA for Limited Use in the Treatment of Pediatric Obesity

Sibutramine, an appetite suppressant, is a nonselective reuptake inhibitor. It is most effective against serotonin and norepinephrine but also blocks dopamine reuptake.[258] Sibutramine is currently licensed in the United States for use for persons ≥16 years of age. The FDA has extended the period of treatment to 2 years.[259] Tolerability and side effects of sibutramine are similar for adults and adolescents.[259] The major undesirable side effect of sibutramine is vasoconstriction, leading to increased heart rate and blood pressure. This effect persists even after significant weight loss,[259] limiting the usefulness of this drug for obese individuals with concomitant hypertension.

A 1-year, multicenter study of 498 adolescents 12 to 16 years of age found that those who received sibutramine plus behavioral therapy lost significantly more weight than did those who received a placebo and behavioral therapy.[260] Patients in the sibutramine group lost an average of 6.35 kg during the study, whereas those in the placebo group gained 1.8 kg. The adolescents in the sibutramine group also exhibited significant decreases in insulin and triglyceride levels. The main adverse reaction was tachycardia, which was twice as common in the sibutramine group (12.5%) as in the placebo group (6.2%).[260] A previous but much smaller (N = 82) randomized, control study at the same medical center found that sibutramine used in combination with behavioral therapy increased weight loss by 4.6 kg, compared with placebo.[244] However, weight loss in the sibutramine group plateaued after 6 months of therapy, and serious side effects such as hypertension and tachycardia were observed for 19 of 44 patients. A second group of researchers who studied the safety and efficacy of sibutramine in a double-blind control study involving 60 obese adolescents reported an average weight loss of 8.1 kg at 6 months in the sibutramine group but did not observe any significant changes in blood pressure.[261] All investigators concluded that more research is required to determine the long-term safety and efficacy of sibutramine in adolescents.[244,260,261]

Orlistat is a reversible lipase inhibitor. It binds lipase in the lumen of the stomach and intestine, making it unavailable to hydrolyze dietary fat (triglycerides) and cholesterol to free fatty acids and glycerol. Intact triglycerides and cholesterol cannot be absorbed; they pass through the intestine and are excreted in the feces. Through this mechanism, orlistat reduces fatty acid absorption by ~30% (16 g/day) in persons consuming a 30% fat diet. The side effects of orlistat are consistent with its method of action on intestinal lipase.[253,262] The drug's most common side effects are abdominal cramping and flatus. The most troubling side effects are oily bowel movements, flatus with discharge, and oily spotting on underwear caused by unabsorbed fat in the feces.[262] In a tolerability study with 20 adolescent patients, 3 patients dropped out and those who completed the study reported taking 80% of their prescribed medication. Side effects were usually mild to moderate and generally decreased in frequency with continued treatment.[263,264] The observed decrease may be attributable to improved compliance with the recommended dietary changes (no more than 30% of energy from fat), reinforced by unpleasant side effects. Orlistat does not inhibit other intestinal enzymes. It is minimally absorbed and exerts no effect on systemic lipases.[262] Because it can interfere with the absorption of fat-soluble vitamins, patients taking the drug must also take a daily supplement.

In a 54-week, double-blind, randomized, control trial of 539 obese adolescents 12 to 16 years of age, those taking orlistat reduced their BMI (-0.55 kg/m^2), whereas those taking a placebo showed a slight increase in BMI ($+0.31$ kg/m^2). This difference was significant ($P < .001$). Changes in waist circumference followed a similar pattern. Waist circumference decreased in the orlistat group (-1.33 cm) but increased in the placebo group ($+0.12$ cm; $P < .05$). No significant between-group differences in blood glucose and lipid levels were observed, however, which suggests that the weight loss was too small to change metabolic risk factors. Up to 50% of participants reported moderate side effects.[263] The 17 adolescents who completed the tolerability study lost an average of 5.4 kg (BMI change: -2.0 kg/m^2) at 6 months.[262] In adult studies, the drug improved weight loss among people on a weight-reducing diet and helped them maintain weight loss for up to 2 years.[252] One disadvantage of using orlistat in the pediatric population is that it must be taken with each meal, which may reduce its usefulness for children who typically eat lunch at school. In 2006, the FDA recommended that orlistat be approved for over-the-counter use.[265]

Choosing the Right Medication

More than 120 potential drugs for treatment of obesity are currently in various stages of research, but presently no agent that treats obesity effectively as a single therapy is available. Weight management medications should be prescribed only for patients who have significant weight-related health risks, who have not reduced their weight successfully with a structured diet and lifestyle modifications, and who understand the limitations of available pharmacotherapy, including the need for concomitant lifestyle changes and the fact that the effectiveness of currently approved medications decreases after 6 months of treatment. Obese pediatric patients who may benefit from pharmacotherapy should be referred to a tertiary care center for evaluation and treatment. The choice of pharmacotherapy should be made on an individual basis, taking into account the patient's weight-related health risks, the mechanism of action and adverse effects associated with various medications, patient/family preferences, and, if known, the cause of obesity. Medication should be used only as part of a multimodal weight loss therapy that includes diet, physical activity, and behavior modification.

Discontinuing Medications

It is not possible to provide uniform guidelines regarding the duration of pharmacotherapy. Physicians must recognize that weight regain is common after drugs are withdrawn. Patients should participate in an intensive lifestyle-modification program while using medications, so that they will be better able to manage their weight on their own. Lifestyle-management techniques may need to be intensified when medication is discontinued.

Bariatric Surgery

Severe obesity has proved difficult to treat through diet and lifestyle changes, even with the addition of weight management medications. The increased use of bariatric surgery to treat morbid obesity and associated comorbidities in adults has generated interest in using this therapy for adolescents. There is limited research on the safety, efficacy, and long-term outcomes of bariatric surgery for adolescents; therefore, data from adult studies must be considered as surrogate evidence.

Bariatric Surgical Procedures

Bariatric weight loss procedures can be divided into 3 main categories, that is, malabsorptive, restrictive, and combination. Combination procedures, such as the

Roux-en-Y gastric bypass, restrict food intake and limit the amounts of energy and nutrients the body absorbs. Gastric bypass procedures are the only form of bariatric surgery currently approved by the FDA for use in adolescents, because they are the most extensively studied.[266] European and Australian researchers have reported success with a restrictive procedure known as a laparoscopic adjustable-gastric band procedure.[267] The least-invasive bariatric procedure, it has the added advantages of being totally reversible and having the least potential for adverse nutritional consequences. However, the laparoscopic adjustable gastric band has not been approved by the FDA for use in people <18 years of age, because of a lack of both short-term and long-term safety and efficacy data for adolescent patients. Currently, a multicenter clinical trial of the laparoscopic adjustable gastric band is being conducted with adolescents.

Case Series

Two retrospective case series on bariatric surgery in adolescents, totaling ~40 patients who underwent gastric bypass procedures, reported significant weight loss for most patients, with resolution of most comorbid conditions. Complications included nutritional deficiencies, including iron and folate deficiencies. Perioperative complications included pulmonary embolism, wound infection, and dehydration, with later complications such as small bowel obstruction, incisional hernias, and weight regain in up to 15% of cases.[268,269] Apovian et al[270] reviewed 8 retrospective case-series studies of weight loss surgery in children and adolescents between 1980 and 2004. They found that bariatric surgery in adolescents could promote durable weight loss for most patients; however, there seemed to be significant complication and mortality rates. Appropriately designed trials are needed to determine whether other bariatric surgical procedures are acceptable for use in adolescents.[266,271]

Recommendations and Controversies

An expert panel of pediatricians and pediatric surgeons made recommendations about selection criteria for bariatric surgery in minors.[266] The panel recommended that patients be physically mature, have a BMI of ≥50 kg/m^2 or ≥40 kg/m^2 with significant comorbidities, have experienced failure of a formal, 6-month, weight loss program, and be capable of adhering to the long-term lifestyle changes required after surgery. In addition, centers should offer this procedure only if surgeons are experienced in bariatric surgery and a team of specialists is capable of long-term follow-up care of the metabolic and psychosocial needs of the patient and family. In response to these recommendations, others have proposed a lower BMI cutoff point, similar to adult recommendations, citing greater success with earlier intervention and lower operative risks when patients are at lower weights.[272] Freedman et al,[257] using cross-sectional (N = 10 099) and longitudinal (N = 2392) analyses to assess risk factors associated with excess adiposity in very overweight children and adolescents, concluded that the 99th percentile of BMI for age may be an appropriate threshold for identifying candidates for more-aggressive treatment, including bariatric surgery. Attainment of physical maturity can be assessed through Tanner stage and bone age. Generally, girls should be ≥13 years of age and boys ≥15 years of age. Assessing the patient's psychological readiness for bariatric surgery is often more difficult than determining physical readiness.[266] Patients must be capable of and willing to adhere to nutritional guidelines postoperatively, must demonstrate decisional capacity, and must provide informed assent for surgical treatment.

After the procedure, meticulous, lifelong, medical supervision of patients who undergo bariatric procedures during adolescence is essential to ensure optimal postoperative weight loss, eventual weight maintenance, and overall health. This is particularly important for adolescents, because the long-term effects of bariatric surgery in younger, reproductively active populations have not been well characterized.[266,270,271] Given the limited quantity and scope of data on the risks and benefits of adolescent bariatric surgery, a conservative approach is needed.

RECOMMENDATIONS

Stages of Treatment

On the basis of the evidence in this report, a step or staged approach for weight management in the pediatric population is recommended. Evidence supports the components of these stages, but the staged approach itself has not been evaluated. We suggest this approach as a practical way to address childhood obesity. The staged care process is divided into 4 stages, that is, (1) Prevention Plus (healthy lifestyle changes), (2) structured weight management, (3) comprehensive multidisciplinary intervention, and (4) tertiary care intervention. Each stage and its appropriate application are described. Two primers have been developed to help primary care providers and other practitioners assess the ability of commercial weight loss programs and bariatric surgery centers to treat pediatric obesity patients.

The purpose of this article is to offer practical guidance to providers by providing recommendations, including those that lack the best possible evidence. When evidence of an effect of obesity treatment was not available, the writing group considered the literature, clinical experience, the likelihood of other health benefits, the possible harm, and the feasibility of implementing a particular strategy before including it. Although a thorough, evidence-based review was beyond the scope of this project, the writing group provided a broad rating of

TABLE 1 **Suggested Staged Approach to Weight Management for Children and Adolescents**

Stage	Components	Where Implemented	Implemented by Whom and Skills Needed	Frequency of Visits/Duration Before Moving to Next Stage
1. Prevention plus	Recommend ≥5 servings of fruits and vegetables per day, ≤2 h of screen time per day, no television in room where child sleeps, and no television if <2 y of age. Minimize or eliminate sugar-sweetened beverages. Address eating behaviors (eg, eating away from home, daily breakfast, family dinners, and skipping meals). Recommend ≥1 h of physical activity per day. Amount of physical activity may need to be graded for children who are sedentary; they may not achieve 1 h/d initially. Involve whole family in lifestyle changes. Acknowledge cultural differences.	Primary care office	Primary care provider or trained professional staff member (eg, registered nurse)	Visit frequency should be based on accepted readiness to change/behavioral counseling techniques and tailored to patient and family. Provider should encourage more-frequent visits when obesity is more severe. Advance to more-intensive level of intervention depending on responses to treatment, age, health risks, and motivation. A child in this stage whose BMI has tracked in same percentile over time with no medical risks may have low risk for excess body fat. Clinicians can continue obesity prevention strategies and not advance treatment stages.
2. Structured weight management	Develop plan with family for balanced-macronutrient diet emphasizing small amounts of energy-dense foods. Because diet provides less energy, ensure that protein is high quality and sufficient to prevent loss of muscle mass. Increase structure of daily meals and snacks. Reduce screen time to ≤1 h/d. Increase time spent in physical activity (≥60 min of supervised active play per day). Instruct patient and/or parent in monitoring (eg, screen time, physical activity, dietary intake, and restaurant logs) to improve adherence. Perform medical screening (eg, vital signs, assessment tools, and laboratory tests).	Referral to dietitian; primary care office	Registered dietitian or physician/nurse practitioner with additional training, including assessment techniques, motivational interviewing/behavioral counseling (may need to provide specific information with environmental change and reward examples), parenting skills and managing family conflict, food planning (including energy density and macronutrient knowledge), physical activity counseling, and resources/referrals.	Monthly visits should be tailored to patient and family, based on family's readiness to change. Advance to more-intensive level of intervention depending on responses to treatment, age, health risks, and motivation.
3. Comprehensive multidisciplinary intervention	Distinguished from stage 2 by more-frequent patient/provider contact, more-active use of behavioral strategies, more-formal monitoring, and feedback regarding progress to improve adherence. Multidisciplinary approach is essential. Components of multidisciplinary behavioral weight control programs include (1) moderate/strong parental involvement for children <12 y of age; parental involvement should decrease gradually as adolescents increase in age; (2) assessment of diet, physical activity, and weight (body fat) before treatment and at specified intervals thereafter to evaluate progress; (3) structured behavioral program that includes at least food monitoring, short-term diet and activity goal setting, and contingency management; (4) parent/caregiver training to improve home food and activity environments; and (5) structured dietary and physical activity interventions that improve dietary quality and result in negative energy balance.	Primary care office can coordinate multidisciplinary care; weight management program (community), pediatric weight management center, or commercial programs with the following components: age-appropriate and culturally appropriate treatments; nutrition, exercise, and behavioral counseling provided by trained professionals; and weight loss goals of ≤2 lb/wk. Use primer 1 to evaluate commercial programs.	Multidisciplinary team with expertise in childhood obesity, including behavioral counselor (eg, social worker, psychologist, trained nurse practitioner, or other mental health care provider), registered dietitian, and exercise specialist. Alternative could be dietitian and behavioral counselor based in primary care office, along with outside, structured, physical activity program (eg, team sports, YMCA, or Boys and Girls Club program). For areas without services, consider innovative programs (eg, telemedicine).	Frequent follow-up visits (weekly for a minimum of 8–12 wk is most efficacious) and then monthly follow-up visits. If not feasible, then telephone or other modalities could be used, with weight checks no less than once per month in local health care provider office (eg, primary care provider or health department). Advance to more-intensive level of intervention depending on responses to treatment, age, health risks, and motivation.
4. Tertiary care intervention	Continued diet and activity counseling plus consideration of meal replacement, very-low-energy diet, medication, and surgery.	Pediatric weight management center operating under established protocols (eg, clinical or research) to assess and to monitor risks and outcomes; residential settings (camps or boarding facilities with appropriate medical supervision). Use primer 2 to evaluate centers.	Multidisciplinary team with expertise in childhood obesity, including behavioral counselor (eg, social worker, psychologist, trained nurse practitioner, or other mental health care provider), registered dietitian, and exercise specialist. For areas without services, consider innovative programs (eg, telemedicine).	According to protocol

See text for evidence level of recommendation.

TABLE 2 **Staged Treatment of Pediatric Obesity According to Age and BMI Percentile**

BMI Percentile	Age of 2–5 y	Age of 6–11 y	Age of 12–18 y
5th–85th (normal)	Prevention stage	Prevention stage	Prevention Stage
85th–94th (overweight)[a]	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile and persistent medical condition or parental obesity. Weight goal is weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile or persistent medical condition Weight goal is weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if increasing BMI percentile or persistent medical condition. Weight goal is weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
95th–98th	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if not showing improvement. Weight goal is weight maintenance until BMI of <85th percentile; however, if weight loss occurs with healthy, adequate-energy diet, it should not exceed 1 lb/mo. If greater loss is noted, monitor patient for causes of excessive weight loss.[b]	Start at Prevention Plus stage. Advance to structured weight management stage depending on responses to treatment, age, degree of obesity, health risks, and motivation. Advance from structured weight management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement. Weight goal is weight maintenance until BMI of <85th percentile or gradual weight loss of ~1 lb/mo. If greater loss is noted, monitor patient for causes of excessive weight loss.[b]	Start at Prevention Plus or structured weight loss stage depending on age, degree of obesity, health risks, and motivation. Advance to more-intensive level of intervention depending on responses to treatment, age, health risks, and motivation. Weight goal is weight loss until BMI of <85th percentile, with no more than average of 2 lb/wk. If greater loss is noted, monitor patient for causes of excessive weight loss.[b]
≥99th	Start at Prevention Plus stage. Advance to structured weight management stage after 3–6 mo if not showing improvement. Advance from structured weight management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement and comorbidity or family history indicates. Weight goal is gradual weight loss, not to exceed 1 lb/mo. If greater loss occurs, monitor patient for causes of excessive weight loss.[b]	Start at Prevention Plus stage. Advance to structured weight management stage depending on responses to treatment, age, degree of obesity, health risks, and motivation. Advance from structured weight management stage to comprehensive multidisciplinary intervention stage after 3–6 mo if not showing improvement. After 3–6 mo with comorbidity present and patient not showing improvement, it may be appropriate for patient to receive evaluation in tertiary care center. Weight goal is weight loss not to exceed average of 2 lb/wk. If greater loss is noted, monitor patient for causes of excessive weight loss.[b]	Start at stage 1, 2, or 3 of treatment depending on age, degree of obesity, health risks, and motivation. Advance to more-intensive levels of intervention depending on responses to treatment, age, health risks, and motivation of patient and family. Advance from comprehensive multidisciplinary intervention stage to tertiary care stage after 3–6 mo with comorbidity present and patient not showing improvement. Patients may warrant tertiary care evaluation to determine next level of treatment. Weight goal is weight loss not to exceed average of 2 lb/wk. If greater loss is noted, monitor patient for causes of excessive weight loss.[b]

In most circumstances, the general goal for all ages is for BMI to deflect downward until it is <85th percentile. Although long-term BMI monitoring is ideal, short-term (<3-month) weight changes may be easier to measure. Resolution of comorbidities is also a goal.

[a] Children in this BMI category whose BMI has tracked in the same percentile over time and who have no medical risks may have a low risk for excess body fat. Clinicians can continue obesity prevention strategies and not advance treatment stages.

[b] Because Youth Risk Behavior Surveillance Survey responses indicated that 15% of teens practice some unhealthy eating behaviors, all teens should be evaluated for these symptoms. Providers should be especially concerned if weight loss is >2 lb/week in this age group and should evaluate patients for excessive energy restrictions by the parent or child/teen or unhealthy forms of weight loss (meal skipping, purging, fasting, excessive exercise, and/or use of laxatives, diet pills, or weight loss supplements).

the evidence, so that readers can appreciate the limitations of these recommendations and watch for new studies that will refine them. The rating categories were as follows: (1) recommends with consistent evidence (CE), that is, multiple studies generally show a consistent association between the recommended behavior and either obesity risk or energy balance; (2) recommends with mixed evidence (ME), that is, some studies demonstrated evidence for weight or energy balance benefit but others did not show significant associations, or studies were few in number or small in sample size; (3) suggests, that is, studies have not examined the association of the recommendation with weight or energy balance, or studies are few, small in number, and/or without clear findings; however, the expert committee thinks that these recommendations could support the achievement of healthy weight and, if future studies disprove such an effect, then these recommendations are likely to have other benefits and are unlikely to cause harm. The rating categories for the treatment recommendations may differ from those for the prevention recommendations because of limited research in certain areas of treatment of childhood obesity.

Table 1 is designed to acquaint providers with the dietary, physical activity, and behavioral interventions that correspond to each of the 4 stages of the staged weight management process. Table 1 also identifies the appropriate setting, caregivers, and frequency of follow-up evaluation corresponding to each stage of treatment. It should be noted that patients who require stages 3 and 4 may benefit from referral to a community-based program or a pediatric weight management center for additional evaluation and treatment, to access a multidisciplinary health care team.

Table 2 provides a treatment algorithm to help physicians determine the appropriate weight management stage for each patient, on the basis of his or her age, BMI percentile, and, if applicable, weight-related disease sta-

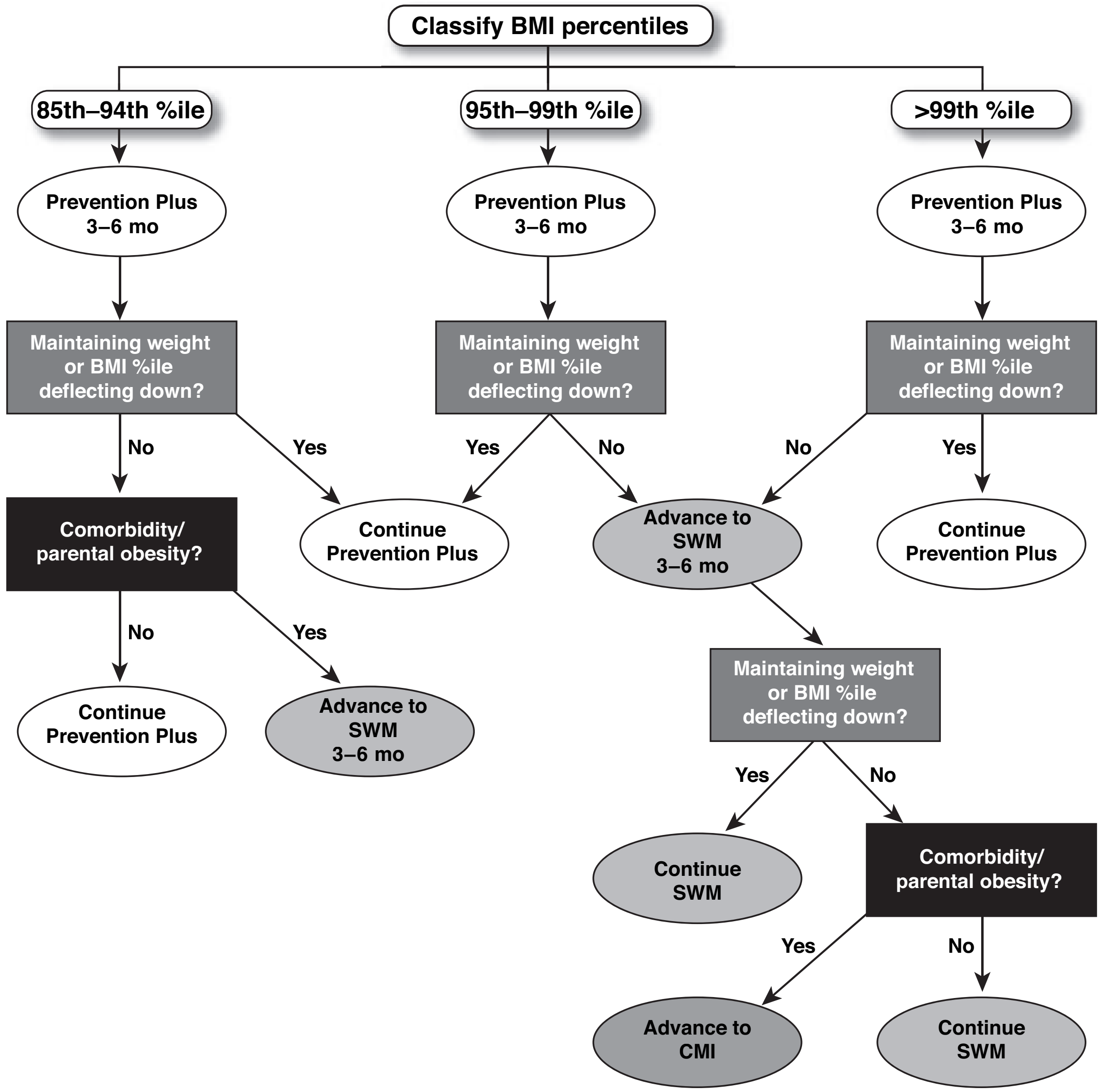

FIGURE 1
Suggested staged treatment for 2- to 5-year-old children. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; CMI, comprehensive multidisciplinary intervention.

tus and former obesity treatment history. Age-appropriate, BMI-dependent, weight goals are also provided for treatment stages 1 to 3. Figures 1, 2, and 3 present this information in a flow algorithm. New data indicate that extreme obesity in children is increasing in prevalence, and these children are at high risk for multiple cardiovascular disease risk factors.[257] Because of this, the expert committee proposes recognition of the 99th percentile BMI. The marked increase in risk factor prevalence at this percentile provides clinical justification for this additional cutoff point. Although more research is needed, the committee recommends that providers use this BMI cutoff point in providing treatment with the staged approach. Table 3 provides 99th percentile cutoff points according to age and gender.

Choosing and Advancing Treatment Intensity

The Prevention Plus stage may be an appropriate initial treatment intervention for all overweight and obese children 2 to 18 years of age. Obese children and adolescents with significant comorbidities and those with severe obesity may be immediately enrolled in a more-advanced stage of treatment if such services are readily available and if the child demonstrates appropriate motivation and readiness to change. It may take 3 to 6 months for the lifestyle changes to produce a notable decrease in BMI. In most circumstances, the general goal for all ages is for BMI to deflect downward until it is <85th percentile. Although long-term monitoring of BMI is ideal, short-term (<3-month) weight changes may be easier to measure. However,

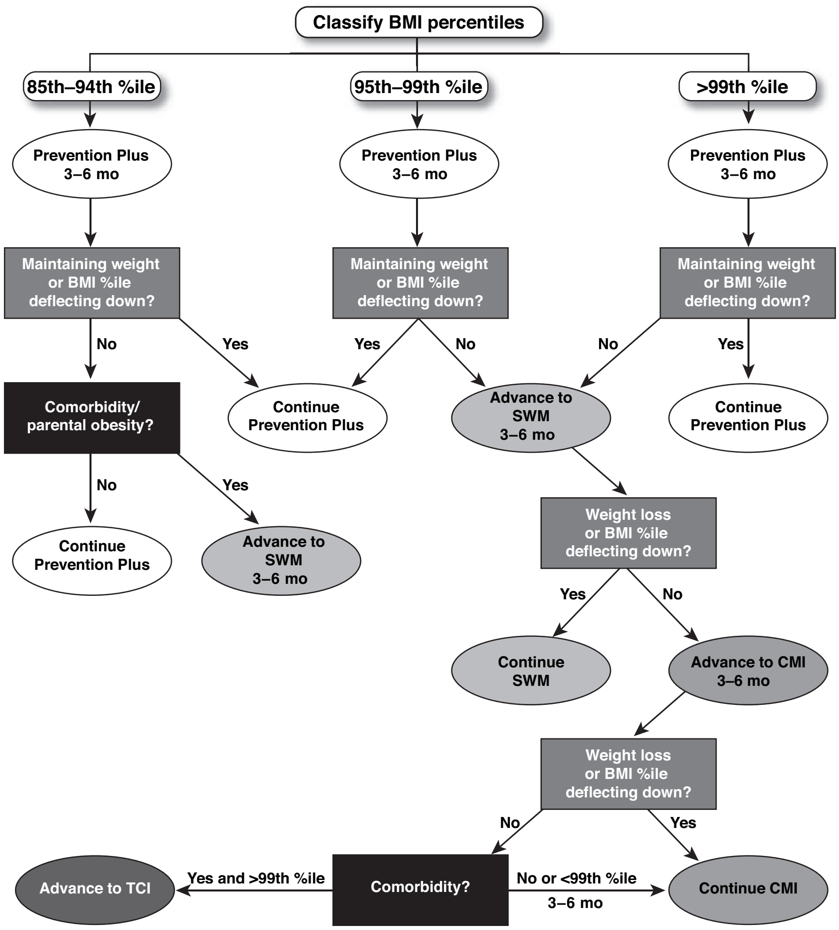

FIGURE 2
Staged treatment for 6- to 11-year-old youth. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; Cont, continue; CMI, comprehensive multidisciplinary intervention; TCI, tertiary care intervention.

children may be advanced to a more-intensive level of treatment at any time if, in the judgment of the health care provider, they are not making adequate progress, their BMI has increased, comorbidities have developed or worsened, or children who are candidates for more-aggressive treatment show appropriate readiness to change.

Stage 1: Prevention Plus

To foster development of a healthful lifestyle, all children 2 to 18 years of age with a BMI percentile in the normal range (5th to 84th percentile) should follow the recommendations for food consumption, activity, and screen time, as described in the accompanying prevention report. Children with BMIs in the 50th to 85th percentile may become overweight during adolescence, underscoring the need for providers to address weight management and lifestyle issues with all patients regardless of their presenting weight.

For children 2 to 18 years of age with BMI of >85th percentile, it is recommended that the Prevention Plus stage be introduced. This differs from the prevention stage in that providers need to spend more time and intensity on the recommendations and provide closer follow-up monitoring (3–6 months). However, children in this stage who have BMI values between the 85th and 95th percentiles, whose BMI values have tracked in the same percentile over time, and who have no medical risks may have a low risk for excess body fat. Clinicians may continue obesity prevention strategies and not advance the treatment stage. These recommendations can be implemented by primary care physicians or allied health care providers who have some training in pediatric weight management or behavioral counseling.

Stage 1 interventions should be based on the family's readiness to change and include the following (level of evidence is identified in parentheses): (1) consumption of ≥5 servings of fruits and vegetables per day (ME), (2) minimization or elimination of sugar-sweetened beverages (ME), (3) limits of ≤2 hours of screen time per day, no television in the room where the child sleeps, and no television viewing if the child is <2 years of age (CE), and (4) ≥1 hour of physical activity per day (ME). Physical activity can be increased gradually for sedentary children. Children may be unable to achieve 1 hour of activity per day initially but can gradually increase activity to reach ≥1 hour/day. If musculoskeletal pain prevents patients from engaging in activity, then referral to a physical therapist may be warranted.

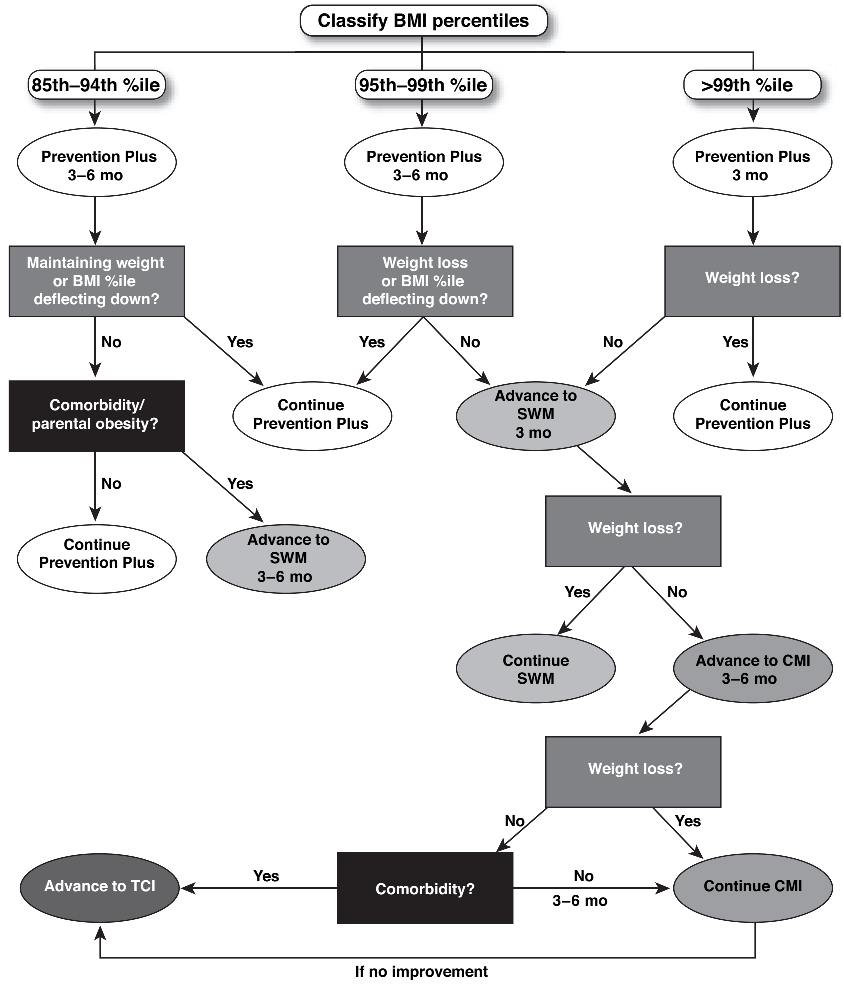

FIGURE 3
Staged treatment for 12- to 18-year-old youths. The order of the stages and the time in each stage should be tailored to the child's physical and emotional development and the readiness of the child and family to change. SWM indicates structured weight management; Cont, continue; CMI, comprehensive multidisciplinary intervention; TCI, tertiary care intervention.

Patients and family members should be counseled to facilitate the following eating behaviors: (1) eating breakfast daily (ME); (2) limiting meals outside the home, including at fast food venues and other restaurants (ME); (3) eating family meals at least 5 or 6 times per week (ME); and (4) allowing the child to self-regulate his or her meals and avoiding overly restrictive behaviors (CE for children <12 years of age and suggested for those >12 years of age). Providers should acknowledge cultural differences and help families adapt recommendations to address these differences (suggest).

Within this category, the goal should be weight maintenance with growth that results in decreasing BMI as age increases. Monthly follow-up assessments should be performed. If no improvement in BMI/weight status has been noted after 3 to 6 months, then advancement to stage 2 is indicated, on the basis of patient/family readiness to change. Prevention Plus can be implemented by primary care providers or allied health professionals (registered nurses or registered dietitians) with additional training in pediatric weight management.

Stage 2: Structured Weight Management

This stage targets the same behaviors as the Prevention Plus stage (food consumption, activity, and screen time) and offers additional support and structure to help the child achieve healthy behaviors. This stage requires additional training in behavioral counseling for primary care providers or other providers. It is characterized by closer follow-up monitoring, more structure, and inclusion of monitoring activities. Eating and activity goals specific to this stage of treatment are described below.

Stage 2 recommendations include the following (level of evidence is identified in parentheses): (1) development of a plan for use of a balanced-macronutrient diet, emphasizing small amounts of energy-dense foods (suggest); (2) provision of structured daily meals and snacks (breakfast, lunch, dinner, and 1 or 2 snacks per day) (suggest); (3) ≥60 minutes of supervised active play per day, to ensure activity (ME); (4) ≤1 hour of screen time per day (suggest; CE for ≤2 hours); (5) increased behavioral monitoring (eg, screen time, physical activity, dietary intake, and restaurant logs) by provider, patient,

TABLE 3 **Cutoff Points for 99th Percentile of BMI According to Age and Gender**

Age, y	99th Percentile BMI Cutoff Point, kg/m²	
	Boys	Girls
5	20.1	21.5
6	21.6	23.0
7	23.6	24.6
8	25.6	26.4
9	27.6	28.2
10	29.3	29.9
11	30.7	31.5
12	31.8	33.1
13	32.6	34.6
14	33.2	36.0
15	33.6	37.5
16	33.9	39.1
17	34.4	40.8

Results were adapted from the report by Freedman et al,[257] with permission. The data were for ~500 children in each year from 5 through 11 years of age and ~850 children in each year from 12 through 17 years of age. Cutoff points are at the midpoint of the child's year (eg, 5.5 y).

and/or family (CE); and (6) reinforcement for achieving targeted behavior goals (not weight goals) (suggest).

Within this category, the goal should be weight maintenance that results in decreasing BMI as age and height increase; however, weight loss should not exceed 1 lb/month for children 2 to 11 years of age or an average of 2 lb/week for older overweight/obese children and adolescents. If no improvement in BMI/weight status is observed after 3 to 6 months, then the patient should be advanced to stage 3.

Ideally, a dietitian with expertise in childhood obesity could provide the nutrition and physical activity counseling in conjunction with the primary care provider. Additional training in motivational interviewing/behavioral counseling, monitoring and reinforcement, family conflict resolution, meal planning, and physical activity counseling could help primary care providers implement treatment.

Parents should be involved in behavioral modification for children <12 years of age, with gradual decreases in parental involvement as the child ages. Referral to a physical activity program may be necessary to help some families develop an active lifestyle. Monthly follow-up assessment is recommended for most patients in this stage of treatment.

Stage 3: Comprehensive Multidisciplinary Intervention

The eating and activity goals associated with this stage of treatment are generally the same as those of the preceding treatment stage, that is, structured weight management. The distinguishing characteristics of comprehensive multidisciplinary intervention are increased intensity of behavioral change strategies, greater frequency of patient-provider contact, and the specialists involved in the treatment. At this level of intervention, ideally the patient should be referred to a multidisciplinary obesity care team. The need for formalized behavioral therapy and a multidisciplinary treatment team exceeds the capacity of the services most primary care providers can supply. An individual provider, or several providers, can coordinate and supervise a multidisciplinary care program.

For stage 3, the eating and activity goals are the same as in stage 2 (level of evidence is identified in parentheses). Activities within this category should also include the following: (1) planned negative energy balance achieved through structured diet and physical activity (ME); (2) structured behavioral modification program, including food and activity monitoring and development of short-term diet and physical activity goals (CE); (3) involvement of primary caregivers/families for behavioral modification for children <12 years of age (CE); (4) provision of training for all families to improve the home environment (suggest); and (5) frequent office visits. Weekly visits for a minimum of 8 to 12 weeks seem to be most efficacious (CE), and subsequent monthly visits help maintain new behaviors. Group visits may be more cost-effective and have therapeutic benefit (ME).

Systematic evaluation of body measurements, dietary intake, and physical activity should be conducted at baseline and at specific intervals throughout the program. Within this category, the goal should be weight maintenance or gradual weight loss until BMI is <85th percentile. Weight loss should not exceed 1 lb/month for children 2 to 5 years of age or 2 lb/week for older obese children and adolescents.

For implementation of the comprehensive multidisciplinary intervention, comprehensive treatment should be provided by a multidisciplinary obesity care team, including a behavioral counselor (for example, social worker, psychologist, other mental health care provider, or trained nurse practitioner), registered dietitian, and exercise specialist (physical activity specialist or other team member with training or a community program prepared to assist obese children). The primary care provider should continue to monitor medical issues and maintain a supportive alliance with the family. Referral to a commercial weight loss program that meets the criteria outlined in primer 1 should be considered.

Stage 4: Tertiary Care Intervention

The intensive interventions in this category have been used to only a limited extent in the pediatric population but may be appropriate for some severely obese youths who have been unable to improve their degree of adiposity and morbidity risks through lifestyle interventions. Candidates should have attempted weight loss at the level of stage 3 (comprehensive multidisciplinary intervention), should have the maturity to understand possible risks associated with stage 4 interventions, and should be willing to maintain physical activity, to follow a prescribed diet, and to participate in behavior monitoring. Lack of success with stage 3 treatment is not by itself a qualification for stage 4 treatment. It is recommended that programs that provide these intensive treatments operate under established protocols to evaluate patients, to implement the program, and to monitor patients.

The components of stage 4 include referral to a pediatric tertiary weight management center that has access to a multidisciplinary team with expertise in childhood obesity and that operates with a designed protocol. This protocol should include continued diet and activity counseling and consideration of additions such as meal replacement, a very-low-energy diet, medication, and surgery (suggest).

There are few reports on the use of highly restrictive diets for children or adolescents. A restrictive diet has been used as the first step in a childhood weight management program, followed by a mildly restrictive diet.

Two medications have been approved by the FDA for use in adolescents, that is, sibutramine, a serotonin reuptake inhibitor that increases weight loss by decreasing appetite, and orlistat, which causes fat malabsorption through inhibition of enteric lipase. To be effective, these medications must be used in conjunction with diet and exercise. The FDA has approved sibutramine for patients ≥16 years of age and orlistat for patients ≥12 years of age.

Generally, gastric bypass has been used to treat severely obese adolescents who have not improved their weight or health with behavioral interventions. Inge et al[266] proposed stringent patient selection and facility qualification criteria, that is, BMI of ≥40 kg/m^2 with a medical condition or ≥50 kg/m^2, physical maturity (generally 13 years of age for girls and ≥15 years for boys), emotional and cognitive maturity, and ≥6 months of participation in a behavior-based treatment program. Surgery should be performed only by experienced surgeons associated with a pediatric obesity center. Adolescents who undergo this procedure require careful medical, psychological, and emotional evaluation before surgery and prolonged nutritional and psychological support after surgery; many youths who might otherwise qualify live too far from an adolescent bariatric center.

For implementation of stage 4, the multidisciplinary team should have expertise in childhood obesity and its comorbidities, with patient care being provided by a physician, nurse practitioner, a registered dietitian, a behavioral counselor, and an exercise specialist. Standard clinical protocols for patient selection should evaluate patient age, degree of obesity, motivation and emotional readiness, previous efforts to control weight, and family support. Standardized clinical protocols for evaluation before, during, and after the intervention should be followed. These evaluations should focus on the physical and emotional effects of the treatment. These protocols should be established by physicians, dietitians, physical activity specialists, and behaviorists familiar with weight management and pediatric care.

Weight Loss Goals

In most circumstances, the general goal for all ages is for BMI to deflect downward until it is <85th percentile. With the realization that some children are healthy with BMI values between the 85th and 95th percentiles, however, clinical judgment plays a critical role in weight recommendations. Although long-term monitoring of BMI is ideal, short-term (<3-month) weight changes may be easier to measure. Resolution of comorbidities is also a goal.

The expert committee recommends that the weight loss recommendations indicated in Table 4 be considered when the staged treatment plan is implemented. The recommendations are based on clinical recommendations and judgment because of the limited amount of evidence. Children whose BMI is between the 85th and 94th percentiles, whose BMI has tracked in the same percentile over time, and who have no medical risks may have a low risk for excess body fat. Clinicians can continue obesity prevention strategies and not advance to the next treatment stage.

Because the Youth Risk Behavior Surveillance Survey indicates that 15% of teens practice some unhealthy eating behaviors, all teens should be evaluated for these symptoms. If the average weight loss is >2 lb/week in any age group, then it is important to evaluate for excessive energy restrictions by the parent or the child/teen or unhealthy forms of weight loss, such as meal skipping, purging, fasting, excessive exercise, and/or use of laxatives, diet pills, or weight loss supplements.

Primers

Use of Primers

Two primers, one for commercial weight loss programs and one for bariatric surgery centers, have been developed to help primary care physicians identify, by using a question-and-answer format, facilities capable of treating adolescent patients.

Primer 1: Primary Care Physicians' Primer for Assessing Commercial Weight Loss Programs

1. Do you have a program for adolescents? The program should have options specific for children and adolescents or should be targeted specifically for the child's age group.
2. What type of counseling/behavior modification models do you follow? The program should provide behavior modification that (a) emphasizes positive efforts and rewards success, (b) is sensitive to child/

TABLE 4 **Weight Recommendations According to Age and BMI Percentile**

Age	Target
2–5 y	
BMI of 85th to 94th percentile	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
BMI of ≥95th percentile	Weight maintenance until BMI of <85th percentile; however, if weight loss occurs with healthy, adequate-energy diet, then it should not exceed 1 lb/mo. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
BMI of >21 kg/m² (rare, very high)	Gradual weight loss, not to exceed 1 lb/mo. If greater loss occurs, then patient should be monitored for causes of excessive weight loss.
6–11 y	
BMI of 85th to 94th percentile	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
BMI of 95th to 98th percentile	Weight maintenance until BMI of <85th percentile or gradual weight loss of ~1 lb/mo. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
BMI of ≥99th percentile	Weight loss not to exceed average of 2 lb/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
12–18 y	
BMI of 85th to 94th percentile	Weight maintenance until BMI of <85th percentile or slowing of weight gain, as indicated by downward deflection in BMI curve.
BMI of 95th to 98th percentile	Weight loss until BMI of <85th percentile, no more than average of 2 lb/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.
BMI of ≥99th percentile	Weight loss not to exceed average of 2 lb/wk. If greater loss is noted, then patient should be monitored for causes of excessive weight loss.

adolescent body image issues, (c) is culturally appropriate, (d) incorporates family members both to change the environment and to reinforce progress, (e) incorporates all 3 elements of weight loss/management (behavior, eating, and activity), and (f) meets frequently enough to support the child's efforts and to monitor progress toward established goals.

3. Do you offer nutrition and exercise counseling/education? Programs should provide nutrition and exercise counseling/education tailored to the needs of the adolescent or child. Programs should have trained professionals conducting the sessions.
4. Must participants purchase proprietary meals? What are the initial and long-term costs? Initial fees, proprietary meals, and recurring costs, and how they will affect the patient's participation, should be factored into the costs of the program. Proprietary meals can be costly, and no studies have examined their effect for children or adolescents.
5. Do you offer culturally appropriate services? The program should offer culturally appropriate services.
6. What are your immediate and long-term weight loss results? Immediate weight loss should not be more than 2 lb/week. The percentage of clients who are able to maintain adequate weight loss should be determined.
7. What is your attrition rate? The likelihood of patient success in program can be gauged by inquiring about the program's attrition rate.
8. Do you advocate complementary/alternative weight loss methods? Programs that advocate complementary/alternative weight loss methods should use researched or reasonably approved methods, without the use of over-the-counter medications or products.

Primer 2: Primary Care Physicians' Primer for Assessing Bariatric Surgery Services

1. Are you affiliated with a tertiary care center or pediatric hospital? Bariatric centers should be affiliated with a pediatric tertiary hospital.
2. Do you have specific guidelines for adolescents? There should be specific guidelines for adolescents.
3. What are your enrollment criteria? The enrollment criteria should include the following: (a) patients who have been unable to achieve significant reduction in BMI (<99th percentile) through nonsurgical means, including the use of medications, over a period of ≥6 months; (b) patients with BMI of >99th percentile or BMI of ≥40 kg/m² who are demonstrating the complications of diabetes, cardiovascular disease, or other comorbidities of obesity or patients with BMI of ≥50 kg/m² without complications, and (c) patients and families that demonstrate the ability to follow the behavior modifications and adapt to the psychological burdens associated with the child's condition and expected outcomes.
4. Do you have a multidisciplinary team (with mental health care workers, dietitians, exercise specialists, and case managers)? The center should have a multidisciplinary team (with mental health care workers, nutritionists/dietitians, exercise specialists, and case managers) with specific training to address pediatric concerns.
5. Do you offer preoperative and postoperative weight loss/behavior modification, with diet/exercise and/

or medication? There should be both preoperative and postoperative weight loss/behavior modification, with diet/exercise and/or medication.

6. What surgical options do you provide? The surgical options should be approved for use in adolescents. Currently, Roux-en-Y gastric bypass is the only bariatric surgical procedure approved by the FDA for use in adolescents. However, other methods are currently in clinical trials.
7. What are the long-term potential complications? What are your long-term results? Long-term complications include delayed healing, multiple operations (including skin revision), and malnourishment. Immediate weight loss results should be within accepted guidelines, and long-term weight loss should be considered with respect to continued development.
8. What is the postoperative follow-up care, including duration? Postoperative follow-up care should include intensive nutritional guidance with attention to micronutrient balance and monitoring and psychological support for a minimum of 6 months to 1 year; this can be in an individual or group setting.
9. How are primary care/pediatric health concerns integrated? The primary care pediatrician should be integrated into the process so that ongoing pediatric health issues can be addressed and monitored after weight maintenance has been achieved.
10. What is the financial burden? The bariatric center should help in securing adequate financial support or facilitate minimization of the financial burden to the patient and family. It should be stated that the center will facilitate incorporation of the patient's lifestyle changes (diet and special health needs) at the child's school, to minimize the impact on the child's psychosocial and educational environment.

Future Directions

With the realization that conventional treatment programs are not available to a large number of children in the United States, an emerging area of intervention involves the use of outreach clinics, distance education/counseling, or telemedicine. The University of Iowa hospitals and clinics outreach program confirmed the success of this approach by expanding the availability of tertiary care. The university established a network of outreach clinics throughout the state, and >75% of its tertiary care patients receive treatment outside the city and county where the university's main hospital is located.[273] Use of telemedicine and other electronic communication techniques can extend the reach of specialty care experts associated with tertiary care centers and allow them to partner with primary care providers in the management of very obese patients. Two research studies, with a combined enrollment of 289 adult subjects, demonstrated that patients participating in weight management programs who received counseling via e-mail or telephone lost as much weight as those who attended in-person counseling sessions.[274,275] Little information is available on the use of remote weight loss counseling in the pediatric population. However, one small study by Saelens et al[114] developed a weight management intervention that provided computer-based diet and activity education along with physician visits and counseling via telephone and mail. Adolescents who used this program lost slightly more weight than did those who received typical care, and they reported a higher level of satisfaction with the intervention.

A hospital-based, regional obesity center in South Dakota currently is studying how it can help primary care providers and adult patients living in remote rural communities participate in a medically monitored, multidisciplinary, weight management program. Primary care physicians received 3 hours of computer-based training in obesity assessment techniques and the medical monitoring procedures required to ensure the safety and efficacy of patients following an ~1000 kcal (4032 kJ)/day, full meal replacement diet regimen. Patients participated in a weekly group behavioral modification program via telephone or video conference. A therapist associated with the tertiary care center facilitated all behavioral change sessions. Patient medical records were reviewed weekly by a nurse practitioner and the supervising physician associated with the tertiary care center. Preliminary results indicate that weight loss, improvement in comorbid conditions, and patient satisfaction are comparable to those of patients participating in the same treatment at the tertiary care center. In addition to promoting preventive strategies, the public health system can support national weight management goals by providing community-based programs that meet some of the multidisciplinary treatment needs of patients enrolled in structured weight management programs (V. Mermel, PhD, unpublished data, 2006).

Larger-scale research programs are needed to validate the use of electronic counseling as a behavior management training tool for pediatric patients. In addition, investments in information technology infrastructure are required to enhance delivery of health care services, including obesity treatment, to rural areas.

Improving the Availability of Obesity Treatment

In 2006, the Institute of Medicine released a progress report on nationwide efforts to prevent childhood obesity.[276] It concluded that obesity prevention requires the coordinated efforts of government agencies (federal, state, and local), industry representatives (involved in the manufacture and marketing of foods, beverages, leisure, and recreational products), communities, schools, and families. While acknowledging some progress, the

Institute of Medicine described current efforts to increase activity and to promote healthful eating as "generally fragmented."[276]

Special attention must be paid to ensuring that members of ethnic minorities and groups of low socioeconomic status have equal access to obesity prevention and treatment programs and to healthier foods and recreational opportunities within their communities. Black and Hispanic children and adolescents have higher rates of obesity, and such weight-driven diseases as type 2 diabetes and hypertension, than do their white peers, but they receive less care for these conditions.[277] Fewer recreational facilities,[155] fewer full-service grocery stores,[278] and the relatively high cost of foods low in energy density[279] have been identified as possible causes of the increased incidence of obesity in minority and low-socioeconomic status groups. A comprehensive policy is needed to address economic and cultural barriers to a more-healthful lifestyle.[279] Health care professionals of different ethnic backgrounds must be involved in the development and implementation of culturally appropriate, weight management programs for children and adolescents with diverse ethnic, racial, and cultural backgrounds.[280]

Developing a coordinated approach to the treatment of obesity is no less complex. Few primary care providers have the time[281] or training[280,282] needed to implement fully basic obesity treatment such as that described for the structured weight management stage. In addition, the number of tertiary care centers specializing in pediatric weight management is limited, and currently there is no registry of centers or programs. In fact, obesity treatment, even when available and medically necessary, is rarely reimbursed.[280,283] Given the large number of obese children and adolescents in need of intensive intervention and the limited availability of specialty care, some experts suggest that the role of primary care providers must change.[282] For pediatric providers to take on this role, pediatric primary care would need to be revised, because currently the system is geared toward treatment of acute conditions and not management of chronic diseases such as obesity.

Most primary care practitioners lack the training and time to assess, to modify, and to monitor obese patients' diet, physical activity, and behavioral habits properly. A survey of $>$900 health care professionals (physicians, dietitians, and nurse practitioners) involved in pediatric care identified behavioral modification strategies, guidance in parenting techniques, and addressing of family conflicts as the 3 treatment techniques in which they felt least competent. Dietitians alone reported feeling confident in their ability to assess and to modify diets and activity.[282] The American Medical Association is working with federal agencies, public health organizations, and medical societies to ensure that more physicians currently in practice, as well as those presently in medical school, are trained in the management of obesity in children and adults.[284] In addition, the American Medical Association is encouraging primary care providers to identify community resources and referral services that can help them care for obese patients. Similar training must be made available to nurse practitioners, dietitians, behaviorists, and exercise specialists, because it is these health care professionals, together with physicians, who form the multidisciplinary treatment team required for tertiary obesity care. The American Dietetic Association has provided postgraduate certification in adult and childhood obesity management for several years. More dietitians must be encouraged to pursue this training, because their expertise is required in the early stages of obesity management. Training in obesity treatment for health care professionals also is limited. Recently, the American Dietetic Association sponsored a continuing education program to teach its members how to use Internet-based tools in pediatric weight management counseling. No formal research is available to validate the utility of these Internet-based resources for pediatric patients. However, clinical experience with the use of these resources has been positive.

Coaching patients in the process of behavioral change lengthens patient/provider encounters. The time constraints of the current primary care system represent a barrier to providing this aspect of treatment.[282] Lack of reimbursement for weight management services is an additional obstacle. Generally, third-party payers do not reimburse physicians who provide such services themselves or who employ multidisciplinary teams within their practices to provide the services.[280,283] Some efforts are being made to increase the number of physicians qualified to treat obesity and to improve reimbursement for those services. Because the National Institutes of Health and other health organizations recognize obesity as a disease, pressure is growing for third-party payers to reimburse health care providers for preventive counseling and management. Many organizations are lobbying actively for insurance coverage of obesity treatment. State and federal policymakers are evaluating which obesity treatments are effective and thus may qualify for Medicaid and Medicare reimbursement.[281] More research is needed to identify successful weight management interventions and to secure reimbursement for obesity treatment from all third-party payers.

Increasing the number of health care practitioners with expertise in obesity treatment and securing reimbursement for a staged approach to obesity treatment services are necessary and eventually should foster development of additional tertiary care centers. Such centers cannot be developed soon enough to meet current and projected treatment needs, however, and, even when new tertiary care centers are created, people in rural areas are unlikely to have access to one. Some researchers have proposed that obesity treatment centers be regionalized in the way that pediatric cancer treatment centers are. Other approaches, such as development of satellite/outreach tertiary care clinics, use of telemedicine, and involvement of public health services, must also be explored. Obesity is a chronic condition. Therefore, individuals will need follow-up care after successful weight loss. Ultimately, a broad range of strategies must be developed to support maintenance of a healthy weight.

ACKNOWLEDGMENT

We acknowledge the assistance of Virginia Mermel, PhD, CNS, CLC, in the preparation of this manuscript.

REFERENCES

1. Weiss R, Dziura J, Burgert TS, et al. Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med.* 2004; 350:2362–2374
2. Speiser PW, Rudolf MC, Anhalt H, et al. Childhood obesity. *J Clin Endocrinol Metab.* 2005;90:1871–1887
3. Jelalian E, Saelens BE. Empirically supported treatments in pediatric psychology: pediatric obesity. *J Pediatr Psychol.* 1999; 24:223–248
4. American Dietetic Association. Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. *J Am Diet Assoc.* 2006;106: 925–945
5. Lin BH, Morrison RM. Higher fruit consumption linked with lower body mass index. *Food Rev.* 2002;25:28–32
6. Neumark-Sztainer D, Story M, Resnick MD, Blum RW. Correlates of inadequate fruit and vegetable consumption among adolescents. *Prev Med.* 1996;25:497–505
7. Ortega RM, Requejo AM, Andres P, Lopez-Sobaler AM, Redondo R, Gonzalez-Fernandez M. Relationship between diet composition and body mass index in a group of Spanish adolescents. *Br J Nutr.* 1995;74:765–773
8. Bandini LG, Vu D, Must A, Cyr H, Goldberg A, Dietz WH. Comparison of high-calorie, low-nutrient-dense food consumption among obese and non-obese adolescents. *Obes Res.* 1999;7:438–443
9. Boutelle K, Neumark-Sztainer D, Story M, Resnick M. Weight control behaviors among obese, overweight, and nonoverweight adolescents. *J Pediatr Psychol.* 2002;27:531–540
10. Tanasescu M, Ferris AM, Himmelgreen DA, Rodriguez N, Pérez-Escamilla R. Biobehavioral factors are associated with obesity in Puerto Rican children. *J Nutr.* 2000;130:1734–1742
11. Hanley AJ, Harris SB, Gittelsohn J, Wolever TM, Saksvig B, Zinman B. Overweight among children and adolescents in a Native Canadian community: prevalence and associated factors. *Am J Clin Nutr.* 2000;71:693–700
12. Rockett HR, Berkey CS, Field AE, Colditz GA. Cross-sectional measurement of nutrient intake among adolescents in 1996. *Prev Med.* 2001;33:27–37
13. American Dietetic Association. Evidence analysis library. Available at: www.adaevidencelibrary.com. Accessed July 12, 2007
14. Baranowski T, Smith M, Hearn MD, et al. Patterns in children's fruit and vegetable consumption by meal and day of the week. *J Am Coll Nutr.* 1997;16:216–223
15. Welsh JA, Cogswell ME, Rogers S, Rockett H, Mei Z, Grummer-Strawn LM. Overweight among low-income preschool children associated with the consumption of sweet drinks: Missouri, 1999–2002. *Pediatrics.* 2005;115(2). Available at: www.pediatrics.org/cgi/content/full/115/2/e223
16. Alexy U, Sichert-Hellert W, Kersting M, Manz F, Schoch G. Fruit juice consumption and the prevalence of obesity and short stature in German preschool children: results of the DONALD Study: Dortmund Nutritional and Anthropometrical Longitudinally Designed. *J Pediatr Gastroenterol Nutr.* 1999; 29:343–349
17. Skinner JD, Carruth BR. A longitudinal study of children's juice intake and growth: the juice controversy revisited. *J Am Diet Assoc.* 2001;101:432–437
18. Skinner JD, Carruth BR, Moran J, Houck K, Coletta F. Fruit juice is not related to children's growth. *Pediatrics.* 1999;103: 58–64
19. Forshee RA, Storey ML. Total beverage consumption and beverage choices among children and adolescents. *Int J Food Sci Nutr.* 2003;54:297–307
20. Riddick H, Kramer-LeBlanc C, Bowman SA, Davis C. *Is Fruit Juice Dangerous for Children? Nutrition Insights.* Washington, DC: US Department of Agriculture, Center for Nutrition Policy and Promotion; 1997
21. Dennison BA, Rockwell HL, Nichols MJ, Jenkins P. Children's growth parameters vary by type of fruit juice consumed. *J Am Coll Nutr.* 1999;18:346–352
22. Kloeblen-Tarver AS. Fruit juice consumption not related to growth among preschool-aged children enrolled in the WIC program. *J Am Diet Assoc.* 2001;101:996
23. American Academy of Pediatrics, Committee on Nutrition. The use and misuse of fruit juice in pediatrics. *Pediatrics.* 2001;107:1210–1213
24. Murphy M, Douglass J, Latulippe M, Barr S, Johnson R, Frye C. Beverages as a source of energy and nutrients in diets of children and adolescents. *FASEB J.* 2005;19:A434. Abstract 275.4
25. Ariza AJ, Chen EH, Binns HJ, Christoffel KK. Risk factors for overweight in five- to six-year-old Hispanic-American children: a pilot study. *J Urban Health.* 2004;81:150–161
26. Berkey CS, Rockett HR, Field AE, Gillman MW, Colditz GA. Sugar-added beverages and adolescent weight change. *Obes Res.* 2004;12:778–788
27. Brewis A. Biocultural aspects of obesity in young Mexican schoolchildren. *Am J Hum Biol.* 2003;15:446–460
28. Giammattei J, Blix G, Marshak HH, Wollitzer AO, Pettitt DJ. Television watching and soft drink consumption: associations with obesity in 11- to 13-year-old schoolchildren. *Arch Pediatr Adolesc Med.* 2003;157:882–886
29. Gillis LJ, Bar-Or O. Food away from home, sugar-sweetened drink consumption and juvenile obesity. *J Am Coll Nutr.* 2003; 22:539–545
30. James J, Thomas P, Cavan D, Kerr D. Preventing childhood obesity by reducing consumption of carbonated drinks: cluster randomized controlled trial. *BMJ.* 2004;328:1237
31. Lin BH, Huang CL, French SA. Factors associated with women's and children's body mass indices by income status. *Int J Obes Relat Metab Disord.* 2004;28:536–542
32. Ludwig DS, Peterson KE, Gortmaker SL. Relation between consumption of sugar-sweetened drinks and childhood obesity: a prospective, observational analysis. *Lancet.* 2001; 357:505–508
33. Mrdjenovic G, Levitsky DA. Nutritional and energetic consequences of sweetened drink consumption in 6- to 13-year-old children. *J Pediatr.* 2003;142:604–610
34. Newby PK, Peterson KE, Berkey CS, Leppert J, Willett WC, Colditz GA. Beverage consumption is not associated with changes in weight and body mass index among low-income preschool children in North Dakota. *J Am Diet Assoc.* 2004; 104:1086–1094
35. Nicklas TA, Yang SJ, Baranowski T, Zakeri I, Berenson G.

Eating patterns and obesity in children: the Bogalusa Heart Study. *Am J Prev Med.* 2003;25:9–16
36. Phillips SM, Bandini LG, Naumova EN, et al. Energy-dense snack food intake in adolescence: longitudinal relationship to weight and fatness. *Obes Res.* 2004;12:461–472
37. Rodríguez-Artalejo F, García EL, Gorgojo L, et al. Consumption of bakery products, sweetened soft drinks and yogurt among children aged 6–7 years: association with nutrient intake and overall diet quality. *Br J Nutr.* 2003;89:419–429
38. Sugimori H, Yoshida K, Izuno T, et al. Analysis of factors that influence body mass index from ages 3 to 6 years: a study based on the Toyama Cohort Study. *Pediatr Int.* 2004;46: 302–310
39. Troiano RP, Briefel RR, Carroll MD, Bialostosky K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. *Am J Clin Nutr.* 2000;72(suppl):1343S–1353S
40. Ebbeling CB, Feldman HA, Osganian SK, Chomitz VR, Ellenbogen SJ, Ludwig DS. Effects of decreasing sugar-sweetened beverage consumption on body weight in adolescents: a randomized, controlled pilot study. *Pediatrics.* 2006;117:673–680
41. Striegel-Moore RH, Thompson D, Affenito SG, et al. Correlates of beverage intake in adolescent girls: the National Heart, Lung and Blood Institute Growth and Health Study. *J Pediatr.* 2006;148:183–187
42. Fisher JO, Mitchell DC, Smiciklas-Wright H, Mannino ML, Birch LL. Meeting calcium recommendations during middle childhood reflects mother-daughter beverage choices and predicts bone mineral status. *Am J Clin Nutr.* 2004;79: 698–706
43. Phillips SM, Bandini LG, Cyr H, Colclough-Douglas S, Naumova E, Must A. Dairy food consumption and body weight and fatness studied longitudinally over the adolescent period. *Int J Obes Relat Metab Disord.* 2003;27:1106–1113
44. Carruth BR, Skinner JD. The role of dietary calcium and other nutrients in moderating body fat in preschool children. *Int J Obes Relat Metab Disord.* 2001;25:559–566
45. Skinner JD, Bounds W, Carruth BR, Ziegler P. Longitudinal calcium intake is negatively related to children's body fat indexes. *J Am Diet Assoc.* 2003;103:1626–1631
46. Williams CL, Bollella M, Wynder EL. A new recommendation for dietary fiber in childhood. *Pediatrics.* 1995;96:985–988
47. Crane NT, Hubbard VS, Lewis CJ. National nutrition objectives and the Dietary Guidelines for Americans. *Nutr Today.* 1998;33:49–58
48. US Department of Agriculture, Agricultural Research Service. *Unpublished Data From the 1994–96 Continuing Survey of Food Intakes by Individuals.* Washington, DC: Agricultural Research Service; 1996. USDA/NFS Publication 96-2
49. Pereira MA, Ludwig DS. Dietary fiber and body weight regulation: observations and mechanisms. *Pediatr Clin North Am.* 2001;48:969–980
50. Chandalia M, Garg A, Lutjohann D, von Bergmann K, Grundy SM, Brinkley LJ. Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. *N Engl J Med.* 2000;342:1392–1398
51. Wolk A, Manson JE, Stampfer MJ, et al. Long-term intake of dietary fiber and decreased risk of coronary heart disease among women. *JAMA.* 1999;281:1998–2004
52. Baron JA, Schori A, Crow B, Carter R, Mann JI. A randomized controlled trial of low carbohydrate and low fat/high fiber diets for weight loss. *Am J Public Health.* 1986;76:1293–1296
53. Brehm BJ, Seeley RJ, Daniels SR, D'Alessio DA. A randomized trial comparing a very low carbohydrate diet and a calorie-restricted low fat diet on body weight and cardiovascular risk factors in healthy women. *J Clin Endocrinol Metab.* 2003; 88:1617–1623
54. Foster GD, Wyatt HR, Hill JO, et al. A randomized trial of a low-carbohydrate diet for obesity. *N Engl J Med.* 2003;348: 2082–2090
55. Yancy WS, Olsen MK, Guyton JR, Bakst RP, Westman EC. A low-carbohydrate, ketogenic diet versus a low-fat diet to treat obesity and hyperlipidemia: a randomized, controlled trial. *Ann Intern Med.* 2004;140:769–777
56. Shah M, McGovern P, French S, Baxter J. Comparison of a low-fat, ad libitum complex-carbohydrate diet with a low-energy diet in moderately obese women. *Am J Clin Nutr.* 1994;59:980–984
57. Lean ME, Han TS, Prvan T, Richmond PR, Avenell A. Weight loss with high and low carbohydrate 1200 kcal diets in free living women. *Eur J Clin Nutr.* 1997;51:243–248
58. Harvey-Berino J. The efficacy of dietary fat vs. total energy restriction for weight loss. *Obes Res.* 1998;6:202–207
59. Samaha FF, Iqbal N, Seshadri P, et al. A low-carbohydrate as compared with a low-fat diet in severe obesity. *N Engl J Med.* 2003;348:2074–2081
60. Jeffery RW, Hellerstedt WL, French SA, Baxter JE. A randomized trial of counseling for fat restriction versus calorie restriction in the treatment of obesity. *Int J Obes Relat Metab Disord.* 1995;19:132–137
61. Harvey-Berino J. Calorie restriction is more effective for obesity treatment than dietary fat restriction. *Ann Behav Med.* 1999;21:35–39
62. Ebbeling CB, Leidig MM, Sinclair KB, Hangen JP, Ludwig DS. A reduced-glycemic load diet in the treatment of adolescent obesity. *Arch Pediatr Adolesc Med.* 2003;157:773–779
63. Stern L, Iqbal N, Seshadri P, et al. The effects of low-carbohydrate versus conventional weight loss diets in severely obese adults: one-year follow-up of a randomized trial. *Ann Intern Med.* 2004;140:778–785
64. Shah M, Baxter JE, McGovern PG, Garg A. Nutrient and food intake in obese women on a low-fat or low-calorie diet. *Am J Health Promot.* 1996;10:179–182
65. Pascale RW, Wing RR, Butler BA, Mullen M, Bononi P. Effects of a behavioral weight loss program stressing calorie restriction versus calorie plus fat restriction in obese individuals with NIDDM or a family history of diabetes. *Diabetes Care.* 1995;18:1241–1248
66. McManus K, Antinoro L, Sacks F. A randomized controlled trial of a moderate-fat, low-energy diet compared with a low-fat, low-energy diet for weight loss in overweight adults. *Int J Obes Relat Metab Disord.* 2001;25:1503–1511
67. Dansinger ML, Gleason JA, Griffith JL, Selker HP, Schaefer EJ. Comparison of the Atkins, Ornish, Weight Watchers, and Zone diets for weight loss and heart disease risk reduction: a randomized trial. *JAMA.* 2005;293:43–53
68. Sondike SB, Copperman N, Jacobson MS. Effects of a low-carbohydrate diet on weight loss and cardiovascular risk factor in overweight adolescents. *J Pediatr.* 2003;142:253–258
69. St Jeor ST, Howard BV, Prewitt TE, et al. Dietary protein and weight reduction: a statement for healthcare professionals from the Nutrition Committee of the Council on Nutrition, Physical Activity, and Metabolism of the American Heart Association. *Circulation.* 2001;104:1869–1874
70. Bravata DM, Sanders L, Huang J, et al. Efficacy and safety of low-carbohydrate diets: a systematic review. *JAMA.* 2003;289: 1837–1850
71. Fleming RM. The effect of high-, moderate-, and low-fat diets on weight loss and cardiovascular disease risk factors. *Prev Cardiol.* 2002;5:110–118
72. Koertge J, Weidner G, Elliott-Eller M, et al. Improvement in medical risk factors and quality of life in women and men with coronary artery disease in the Multicenter Lifestyle Demonstration Project. *Am J Cardiol.* 2003;91:1316–1322

73. Mueller-Cunningham WM, Quintana R, Kasim-Karakas SE. An ad libitum, very low-fat diet results in weight loss and changes in nutrient intakes in postmenopausal women. *J Am Diet Assoc.* 2003;103:1600–1606
74. Ornish D, Scherwitz LW, Billings JH, et al. Intensive lifestyle changes for reversal of coronary heart disease. *JAMA.* 1998; 280:2001–2007
75. Figueroa-Colon R, von Almen TK, Franklin FA, Schuftan C, Suskind RM. Comparison of two hypocaloric diets in obese children. *Am J Dis Child.* 1993;147:160–166
76. Sothern M, Schumacher H, von Almen T, Carlisle L, Udall J. Committed to Kids: an integrated, 4-level team approach to weight management in adolescents. *J Am Diet Assoc.* 2002; 102(suppl):S81–S85
77. Sothern M, Udall JN, Suskind RM, Vargas A, Blecker U. Weight loss and growth velocity in obese children after very low calorie diet, exercise, and behavior modification. *Acta Paediatr.* 2000;89:1036–1043
78. Rolls BJ. The role of energy density in the overconsumption of fat. *J Nutr.* 2000;130(suppl):268S–271S
79. Ello-Martin JA, Roe L, Rolls B. A diet reduced in energy density results in greater weight loss than a diet reduced in fat. *Obes Res.* 2004;12:A23
80. Ludwig DS. The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. *JAMA.* 2002;287:2414–2423
81. Ludwig DS. Dietary glycemic index and obesity. *J Nutr.* 2000; 130(suppl):280S–283S
82. Pawlak DB, Kushner JA, Ludwig DS. Effects of dietary glycemic index on adiposity, glucose homeostasis and plasma lipids in animals. *Lancet.* 2004;364:778–785
83. Spieth LE, Harnish JD, Lenders CM, et al. A low-glycemic index diet in the treatment of pediatric obesity. *Arch Pediatr Adolesc Med.* 2000;154:947–951
84. Slabber M, Barnard HC, Kuyl JM, Dannhauser A, Schall R. Effects of a low-insulin-response, energy-restricted diet on weight loss and plasma insulin concentrations in hyperinsulinemic obese females. *Am J Clin Nutr.* 1994;60:48–53
85. Ebbeling CB, Leidig MM, Sinclair KB, Seger-Shippee LG, Feldman HA, Ludwig DS. Effects of an ad libitum low-glycemic load diet on cardiovascular disease risk factors in obese young adults. *Am J Clin Nutr.* 2005;81:976–982
86. Berkey CS, Rockett HR, Gillman MW, Field AE, Colditz GA. Longitudinal study of skipping breakfast and weight change in adolescents. *Int J Obes Relat Metab Disord.* 2003;27:1258–1266
87. Siega-Riz AM, Carson T, Popkin B. Three squares or mostly snacks: what do teens really eat? A sociodemographic study of meal patterns. *J Adolesc Health.* 1998;22:29–36
88. Dwyer JT, Evans M, Stone EJ, et al. Adolescents' eating patterns influence their nutrient intakes. *J Am Diet Assoc.* 2001;101:798–802
89. Nicklas TA, Morales M, Linares A, et al. Children's meal patterns have changed over a 21-year period: the Bogalusa Heart Study. *J Am Diet Assoc.* 2004;104:753–761
90. O'Dea JA, Caputi P. Association between socioeconomic status, weight, age and gender, and the body image and weight control practices of 6- to 19-year-old children and adolescents. *Health Educ Res.* 2001;16:521–532
91. Ortega RM, Requejo AM, López-Sobaler AM, et al. Difference in the breakfast habits of overweight/obese and normal weight schoolchildren. *Int J Vitam Nutr Res.* 1998;68:125–132
92. Pastore DR, Fisher M, Friedman SB. Abnormalities in weight status, eating attitudes, and eating behaviors among urban high school students: correlations with self-esteem and anxiety. *J Adolesc Health.* 1996;18:312–319
93. Sampson AE, Dixit S, Meyers AF, Houser R. The nutritional impact of breakfast consumption on the diets of inner-city African-American elementary school children. *J Natl Med Assoc.* 1995;87:195–202
94. Sekine M, Yamagami T, Hamanishi S, et al. Parental obesity, lifestyle factors and obesity in preschool children: results of the Toyama Birth Cohort study. *J Epidemiol.* 2002;12:33–39
95. Summerbell CD, Moody RC, Shanks J, Stock MJ, Geissler C. Relationship between feeding pattern and body mass index in 220 free-living people in four age groups. *Eur J Clin Nutr.* 1996;50:513–519
96. Wolfe WS, Campbell CC, Frongillo EA, Haas JD, Melnik TA. Overweight schoolchildren in New York State: prevalence and characteristics. *Am J Public Health.* 1994;84:807–813
97. Locard E, Mamelle N, Billette A, Miginiac M, Munoz F, Rey S. Risk factors of obesity in a five year old population: parental versus environmental factors. *Int J Obes Relat Metab Disord.* 1992;16:721–729
98. Takahashi E, Yoshida K, Sugimori H, et al. Influence factors on the development of obesity in 3-year-old children based on the Toyama study. *Prev Med.* 1999;28:293–296
99. Maffeis C, Provera S, Filippi L, Sidoti G, Schena S, Pinelli L, Tatò L. Distribution of food intake as a risk factor for childhood obesity. *Int J Obes Relat Metab Disord.* 2000;24:75–80
100. Francis LA, Lee Y, Birch LL. Parental weight status and girls' television viewing, snacking, and body mass indexes. *Obes Res.* 2003;11:143–151
101. Thompson OM, Ballew C, Resnicow K, et al. Food purchased away from home as a predictor of change in BMI *z*-score among girls. *Int J Obes Relat Metab Disord.* 2004;28:282–289
102. Pereira MA, Kartashov AI, Ebbeling CB, et al. Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. *Lancet.* 2005;365:36–42
103. Taveras EM, Berkey CS, Rifas-Shiman SL, et al. Association of consumption of fried food away from home with body mass index and diet quality in older children and adolescents. *Pediatrics.* 2005;116(4). Available at: www.pediatrics.org/cgi/content/full/116/4/e518
104. Ebbeling CB, Sinclair KB, Pereira MA, Garcia-Lago E, Feldman HA, Ludwig DS. Compensation for energy intake from fast food among overweight and lean adolescents. *JAMA.* 2004;291:2828–2833
105. French SA, Story M, Neumark-Sztainer D, Fulkerson JA, Hannan P. Fast food restaurant use among adolescents: associations with nutrient intake, food choices and behavioral and psychosocial variables. *Int J Obes Relat Metab Disord.* 2001;25: 1823–1833
106. Kelishadi R, Pour MH, Sarraf-Zadegan N, et al. Obesity and associated modifiable environmental factors in Iranian adolescents: Isfahan Healthy Heart Program: Heart Health Promotion from Childhood. *Pediatr Int.* 2003;45:435–442
107. Mikkilä V, Lahti-Koski M, Pietinen P, Virtanen SM, Rimpelä M. Associates of obesity and weight dissatisfaction among Finnish adolescents. *Public Health Nutr.* 2003;6:49–56
108. Flodmark CE, Ohlsson T, Rydén O, Sveger T. Prevention of progression to severe obesity in a group of obese schoolchildren treated with family therapy. *Pediatrics.* 1993;91:880–884
109. Golan M, Crow S. Targeting parents exclusively in the treatment of childhood obesity: long-term results. *Obes Res.* 2004; 12:357–361
110. Eliakim A, Kaven G, Berger I, Friedland O, Wolach B, Nemet D. The effect of a combined intervention on body mass index and fitness in obese children and adolescents: a clinical experience. *Eur J Pediatr.* 2002;161:449–454
111. Levine MD, Ringham RM, Kalarchian MA, Wisniewski L, Marcus MD. Is family-based behavioral weight control appropriate for severe pediatric obesity? *Int J Eat Disord.* 2001;30: 318–328
112. Nuutinen O. Long-term effects of dietary counselling on nu-

trient intake and weight loss in obese children. *Eur J Clin Nutr.* 1991;45:287–297
113. Chen W, Chen SC, Hsu HS, Lee C. Counseling clinic for pediatric weight reduction: program formulation and follow-up. *J Formos Med Assoc.* 1997;96:59–62
114. Saelens BE, Sallis JF, Wilfley DE, Patrick K, Cella JA, Buchta R. Behavioral weight control for overweight adolescents initiated in primary care. *Obes Res.* 2002;10:22–32
115. Wadden TA, Stunkard AJ, Rich L, Rubin CJ, Sweidel G, McKinney S. Obesity in black adolescent girls: a controlled clinical trial of treatment by diet, behavior modification, and parental support. *Pediatrics.* 1990;85:345–352
116. Maffiuletti NA, De Col A, Agosti F, et al. Effect of a 3-week body mass reduction program on body composition, muscle function and motor performance in pubertal obese boys and girls. *J Endocrinol Invest.* 2004;27:813–820
117. Rolland-Cachera MF, Thibault H, Souberbielle JC, et al. Massive obesity in adolescents: dietary interventions and behaviours associated with weight regain at 2-y-follow-up. *Int J Obes Relat Metab Disord.* 2004;28:514–519
118. Epstein LH, Valoski A, Wing RR, McCurley J. Ten-year follow-up of behavioral, family-based treatment for obese children. *JAMA.* 1990;264:2519–2523
119. Epstein LH, Wing RR, Koeske R, Valoski A. Effects of diet plus exercise on weight change in parents and children. *J Consult Clin Psychol.* 1984;52:429–437
120. Epstein LH, Wing RR, Koeske R, Valoski A. Effect of parent weight on weight loss in obese children. *J Consult Clin Psychol.* 1986;54:400–401
121. Epstein LH, Koeske R, Wing RR. Adherence to exercise in obese children. *J Cardiac Rehab.* 1984;4:185–195
122. Epstein LH, Paluch RA, Raynor HA. Sex differences in obese children and siblings in family-based obesity treatment. *Obes Res.* 2001;9:746–753
123. Epstein LH, Valoski A, Wing RR, McCurley J. Ten-year outcomes of behavioral family-based treatment for childhood obesity. *Health Psychol.* 1994;13:373–383
124. Stettler N, Signer TM, Suter PM. Electronic games and environmental factors associated with childhood obesity in Switzerland. *Obes Res.* 2004;12:896–903
125. Tudor-Locke C, Ainsworth BE, Popkin BM. Active commuting to school: an overlooked source of childrens' physical activity? *Sports Med.* 2001;31:309–313
126. Dowda M, Ainsworth BE, Addy CL, Saunders R, Riner W. Environmental influences, physical activity, and weight status in 8- to 16-year-olds. *Arch Pediatr Adolesc Med.* 2001;155:711–717
127. Goran MI, Treuth MS. Energy expenditure, physical activity, and obesity in children. *Pediatr Clin North Am.* 2001;48:931–953
128. Centers for Disease Control and Prevention. Guidelines for school and community programs to promote lifelong physical activity among young people. *MMWR Recomm Rep.* 1997;46(RR-6):1–36
129. Livingstone MB, Robson PJ, Wallace JM, McKinley MC. How active are we? Levels of routine physical activity in children and adults. *Proc Nutr Soc.* 2003;62:681–701
130. National Institutes of Health, National Heart, Lung, and Blood Institute. *The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults.* Washington, DC: National Institutes of Health; 2000. NIH publication 00-4084
131. Abbott RA, Davies PS. Habitual physical activity and physical activity intensity: their relation to body composition in 5.0–10.5-y-old children. *Eur J Clin Nutr.* 2004;58:285–291
132. Trost SG, Sirard JR, Dowda M, Pfeiffer KA, Pate RR. Physical activity in overweight and nonoverweight preschool children. *Int J Obes Relat Metab Disord.* 2003;27:834–839
133. Berkey CS, Rockett HR, Gillman MW, Colditz GA. One-year changes in activity and in inactivity among 10- to 15-year-old boys and girls: relationship to change in body mass index. *Pediatrics.* 2003;111:836–843
134. Donnelly JE, Jacobsen DJ, Whatley JE, et al. Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. *Obes Res.* 1996;4:229–243
135. McMurray RG, Harrell JS, Bangdiwala SI, Bradley CB, Deng S, Levine A. A school-based intervention can reduce body fat and blood pressure in young adolescents. *J Adolesc Health.* 2002;31:125–132
136. Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. *JAMA.* 1998;280:1231–1232
137. Hayman LL, Williams CL, Daniels SR, et al. Cardiovascular health promotion in the schools: a statement for health and education professionals and child health advocates from the Committee on Atherosclerosis, Hypertension, and Obesity in Youth (AHOY) of the Council on Cardiovascular Disease in the Young, American Heart Association. *Circulation.* 2004;110:2266–2275
138. Nutbeam D, Wise M. Australia: planning for better health: opportunities for health promotion through the development of national health goals and targets. *Promot Educ.* 1993;8:68–75
139. American Cancer Society. Diet, physical activity and cancer: what's the connection? Available at www.cancer.org/docroot/PED/content/PED_3_1x_Link_Between_Lifestyle_and_CancerMarch03.asp. Accessed January 20, 2006
140. American Academy of Pediatrics. Physical fitness and activity in schools. *Pediatrics.* 2000;105:1156–1157
141. Caballero B, Clay T, Davis SM, et al. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *Am J Clin Nutr.* 2003;78:1030–1038
142. Biddle SJ, Gorely T, Marshall SJ, Murdey I, Cameron N. Physical activity and sedentary behaviours in youth: issues and controversies. *J R Soc Health.* 2004;124:29–33
143. Marshall SJ, Biddle SJ, Gorely T, Cameron N, Murdey I. Relationships between media use, body fatness and physical activity in children and youth: a meta-analysis. *Int J Obes Relat Metab Disord.* 2004;28:1238–1246
144. Epstein LH, Paluch RA, Gordy CC, Dorn J. Decreasing sedentary behaviors in treating pediatric obesity. *Arch Pediatr Adolesc Med.* 2000;154:220–226
145. DuRant RH, Baranowski T, Johnson M, Thompson WO. The relationship among television watching, physical activity, and body composition of young children. *Pediatrics.* 1994;94:449–455
146. US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans 2000.* Available at: www.health.gov/dietaryguidelines. Accessed June 5, 2007
147. US Department of Health and Human Services, US Department of Agriculture. *Dietary Guidelines for Americans 2005.* Available at: www.health.gov/dietaryguidelines/dga2005/document. Accessed June 5, 2007
148. Centers for Disease Control and Prevention. Physical activity for everyone: recommendations. Available at: www.cdc.gov/nccdphp/dnpa/physical/recommendations/young.htm. Accessed July 12, 2007
149. Pate RR, Davis MG, Robinson TN, et al. Promoting physical activity in children and youth: a leadership role for schools: a

scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Physical Activity Committee) in collaboration with the Councils on Cardiovascular Disease in the Young and Cardiovascular Nursing. *Circulation.* 2006;114:1214–1224
150. Cawley J, Meyerhoefer CD, Newhouse D. *The Impact of State Physical Education Requirements on Youth Physical Activity and Overweight*. Cambridge, MA: National Bureau of Economic Research; 2005. National Bureau of Economic Research Working Paper 11411. Available at: www.nber.org/papers/w11411. Accessed September 20, 2006
151. Carrel AL, Clark RR, Peterson SE, Nemeth BA, Sullivan J, Allen DB. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. *Arch Pediatr Adolesc Med.* 2005;159:963–968
152. World Health Organization. *Global Strategy on Diet, Physical Activity and Health.* Geneva, Switzerland: World Health Organization; 2004. Available at: www.who.int/dietphysicalactivity/en. Accessed January 7, 2006
153. Safe Routes to School. Promising practices: from whom can we learn? 2004. Available at: www.nhtsa.dot.gov/people/injury/pedbimot/bike/Safe-Routes-2004/pages/section-4_california.htm. Accessed July 12, 2007
154. Burdette HL, Whitaker RC. A national study of neighborhood safety, outdoor play, television viewing, and obesity in preschool children. *Pediatrics.* 2005;116:657–662
155. Powell LM, Slater S, Chaloupka FJ. The relationship between community physical activity settings and race, ethnicity and socioeconomic status. *Evid Based Prev Med.* 2004;1:135–144
156. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics.* 2006;117:417–424
157. Story M, Sherwood NE, Himes JH, et al. An after-school obesity prevention program for African-American girls: the Minnesota GEMS pilot study. *Ethn Dis.* 2003;13(suppl 1):S54–S64
158. Robinson TN, Killen JD, Kraemer HC, et al. Dance and reducing television viewing to prevent weight gain in African-American girls: the Stanford GEMS pilot study. *Ethn Dis.* 2003;13(suppl 1):S65–S77
159. Baranowski T, Baranowski JC, Cullen KW, et al. The Fun, Food, and Fitness Project (FFFP): the Baylor GEMS pilot study. *Ethn Dis.* 2003;13(suppl 1):S30–S39
160. Centers for Disease Control and Prevention. Physical activity levels among children 9–13 years: United States, 2002. *MMWR Morb Mortal Wkly Rep.* 2003;52:785–788
161. Saelens BE, Salllis JF, Frank LD. Environmental correlates of walking and cycling: findings from the transportation, urban design, and planning literatures. *Ann Behav Med.* 2003;25:80–91
162. Boehmer TK, Lovegreen SL, Haire-Joshu D, Brownson RC. What constitutes an obesogenic environment in rural communities? *Am J Health Promot.* 2006;20:411–421
163. Lewis BA, Marcus BH, Pate RR, Dunn AL. Psychosocial mediators of physical activity behavior among adults and children. *Am J Prev Med.* 2003;23(suppl):26–35
164. American Academy of Pediatrics. Basic recommendations for promoting physical activity. Available at: www.aap.org/family/physicalactivity/physicalactivity.htm. Accessed September 23, 2006
165. Henderson VR, Kelly B. Food advertising in the age of obesity: content analysis of food advertising on general market and African American television. *J Nutr Educ Behav.* 2005;37:191–196
166. Kubik MY, Lytle L, Fulkerson JA. Fruits, vegetables, and football: findings from focus groups with alternative high school students regarding eating and physical activity. *J Adolesc Health.* 2005;36:494–500
167. Stahl T, Rutten A, Nutbeam D, et al. The importance of the social environment for physically active lifestyle: results from an international study. *Soc Sci Med.* 2001;52:1–10
168. Riddoch CJ, Bo Andersen L, Wedderkopp N, et al. Physical activity levels and patterns of 9- and 15-yr-old European children. *Med Sci Sports Exerc.* 2004;36:86–92
169. Gordon-Larsen P, Nelson MC, Popkin BM. Longitudinal physical activity and sedentary behavior trends: adolescence to adulthood. *Am J Prev Med.* 2004;27:277–283
170. Epstein LH, Goldfield GS. Physical activity in the treatment of childhood overweight and obesity: current evidence and research issues. *Med Sci Sports Exerc.* 1999;31(suppl):S553–S559
171. Shannon B, Peacock J, Brown MJ. Body fatness, television viewing, and calorie intake of a sample of sixth grade Pennsylvania school children. *J Nutr Educ.* 1991;23:262–268
172. Obarzanek E, Schreiber GB, Crawford PB, et al. Energy intake and physical activity in relation to indexes of body fat: the National Heart, Lung, and Blood Institute Growth and Health Study. *Am J Clin Nutr.* 1994;60:15–22
173. Berkey CS, Rockett HR, Field AE, et al. Activity, dietary intake, and weight changes in a longitudinal study of preadolescent and adolescent boys and girls. *Pediatrics.* 2000;105(4). Available at: www.pediatrics.org/cgi/content/full/105/4/e56
174. Kimm SY, Obarzanek E, Barton BA, et al. Race, socioeconomic status, and obesity in 9- to 10-year-old girls: the NHLBI Growth and Health Study. *Ann Epidemiol.* 1996;6:266–275
175. Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE. Television watching, energy intake, and obesity in US children: results from the third National Health and Nutrition Examination Survey, 1988–1994. *Arch Pediatr Adolesc Med.* 2001;155:360–365
176. Janz KF, Levy SM, Burns TL, Torner JC, Willing MC, Warren JJ. Fatness, physical activity, and television viewing in children during the adiposity rebound period: the Iowa Bone Development Study. *Prev Med.* 2002;35:563–571
177. Dennison BA, Erb TA, Jenkins PL. Television viewing and television in bedroom associated with overweight risk among low-income preschool children. *Pediatrics.* 2002;109:1028–1035
178. Dietz WH, Gortmaker SL. Do we fatten our children at the television set? Obesity and television viewing in children and adolescents. *Pediatrics.* 1985;75:807–812
179. Gortmaker SL, Must A, Sobol AM, Peterson K, Colditz GA, Dietz WH. Television viewing as a cause of increasing obesity among children in the United States, 1986–1990. *Arch Pediatr Adolesc Med.* 1996;150:356–362
180. Saelens BE, Sallis JF, Nader PR, Broyles SL, Berry CC, Taras HL. Home environmental influences on children's television watching from early to middle childhood. *J Dev Behav Pediatr.* 2002;23:127–132
181. Hernández B, Gortmaker SL, Colditz GA, Peterson KE, Laird NM, Parra-Cabrera S. Association of obesity with physical activity, television programs and other forms of video viewing among children in Mexico City. *Int J Obes Relat Metab Disord.* 1999;23:845–854
182. Ruangdaraganon N, Kotchabhakdi N, Udomsubpayakul U, Kunanusont C, Suriyawongpaisal P. The association between television viewing and childhood obesity: a national survey in Thailand. *J Med Assoc Thai.* 2002;85(suppl 4):S1075–S1080
183. Giampietro O, Virgone E, Carneglia L, Griesi E, Calvi D, Matteucci E. Anthropometric indices of school children and familiar risk factors. *Prev Med.* 2002;35:492–498
184. Müller MJ, Grund A, Krause H, Siewers M, Bosy-Westphal A, Rieckert H. Determinants of fat mass in prepubertal children. *Br J Nutr.* 2002;88:545–554

185. Toyran M, Ozmert E, Yurdakök K. Television viewing and its effect on physical health of schoolage children. *Turk J Pediatr.* 2002;44:194–203
186. Krassas GE, Tzotzas T, Tsametis C, Konstantinidis T. Determinants of body mass index in Greek children and adolescents. *J Pediatr Endocrinol Metab.* 2001;14(suppl 5):1327–1333
187. Sekine M, Yamagami T, Handa K, et al. A dose-response relationship between short sleeping hours and childhood obesity: results of the Toyama Birth Cohort Study. *Child Care Health Dev.* 2002;28:163–170
188. von Kries R, Toschke AM, Koletzko B, Slikker W. Maternal smoking during pregnancy and childhood obesity. *Am J Epidemiol.* 2002;156:954–961
189. Buchberger J. The problem of obesity in children from the mountains and the city. *Soz Praventivmed.* 1976;21:209–210
190. Guillaume M, Lapidus L, Björntorp P, Lambert A. Physical activity, obesity, and cardiovascular risk factors in children: the Belgian Luxembourg Child Study II. *Obes Res.* 1997;5:549–556
191. Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch Pediatr Adolesc Med.* 1999;153:409–418
192. Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA.* 1999;282:1561–1567
193. Epstein LH, Valoski AM, Smith JA, et al. Effects of decreasing sedentary behavior and increasing activity on weight change in obese children. *Health Psychol.* 1995;14:109–115
194. Dietz WH, Bandini LG, Morelli JA, Peers KF, Ching PL. Effect of sedentary activities on resting metabolic rate. *Am J Clin Nutr.* 1994;59:556–559
195. Taras HL, Gage M. Advertised foods on children's television. *Arch Pediatr Adolesc Med.* 1995;149:649–652
196. Clancy-Hepburn K, Heckey AA, Nevill G. Children's behavior responses to TV food advertisements. *J Nutr Educ.* 1974;6:93–96
197. Epstein LH, Paluch RA, Consalvi A, Riordan K, Scholl T. Effects of manipulating sedentary behavior on physical activity and food intake. *J Pediatr.* 2002;140:334–339
198. US Department of Health and Human Services. *Healthy People 2010: Understanding and Improving Health*. 2nd ed. Washington, DC: US Department of Health and Human Services; 2000
199. American Academy of Pediatrics. *Television and the Family*. Elk Grove Village, IL: American Academy of Pediatrics; 1986
200. American Academy of Pediatrics, Committee on Public Education. American Academy of Pediatrics: children, adolescents, and television. *Pediatrics.* 2001;107:423–426
201. Wiecha JL, Sobol AM, Peterson KE, Gortmaker SL. Household television access: associations with screen time, reading, and homework among youth. *Ambul Pediatr.* 2001;1:244–251
202. Stanger JD. *Television in the Home 1998: The Third Annual National Survey of Parents and Children*. Philadelphia, PA: Annenberg Public Policy Center; 1998
203. Gortmaker SL, Dietz WH, Cheung LW. Inactivity, diet and the fattening of America. *J Am Diet Assoc.* 1990;90:1247–1255
204. Ching PL, Willett WC, Rimm EB, Colditz GA, Gortmaker SL, Stampfer MJ. Activity level and risk of overweight in male health professionals. *Am J Public Health.* 1996;86:25–30
205. Fung TT, Hu FB, Yu J, et al. Leisure-time physical activity, television watching, and plasma biomarkers of obesity and cardiovascular disease risk. *Am J Epidemiol.* 2000;152:1171–1178
206. Hu FB, Leitzmann MF, Stampfer MJ, Colditz GA, Willett WC, Rimm EB. Physical activity and television watching in relation to risk for type 2 diabetes mellitus in men. *Arch Intern Med.* 2001;161:1542–1548
207. Hu FB, Li TY, Colditz GA, Willett WC, Manson JE. Television watching and other sedentary behaviors in relation to risk of obesity and type 2 diabetes mellitus in women. *JAMA.* 2003;289:1785–1791
208. Gidwani PP, Sobol A, DeJong W, Perrin JM, Gortmaker SL. Television viewing and initiation of smoking among youth. *Pediatrics.* 2002;110:505–508
209. Boynton-Jarrett R, Thomas TN, Peterson K, Wiecha J, Sobol AM, Gortmaker SL. Impact of television viewing patterns on fruit and vegetable consumption among adolescents. *Pediatrics.* 2003;112:1321–1326
210. Anderson DR, Huston AC, Schmitt KL, Linebarger DL, Wright JC. Early childhood television viewing and adolescent behavior: the recontact study. *Monogr Soc Res Child Dev.* 2001;66:1–147
211. Certain LK, Kahn RS. Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 2002;109:634–642
212. Strauss RS, Pollack HA. Epidemic increase in childhood overweight, 1986–1998. *JAMA.* 2001;286:2845–2848
213. Harris JE. Social and economic causes of cancer. In: Bunker J, Gomby DS, Kehrer BH, eds. *Pathways to Health: The Role of Social Factors*. Menlo Park, CA: Henry J. Kaiser Family Foundation; 1989:165–216
214. Miller BA, Gloeckler Ries L, Hankey BF, et al. *SEER Cancer Statistics Review 1973–1990.* Bethesda, MD: National Cancer Institute; 1993. NIH publication 93–2789
215. US Public Health Service. *Healthy People* 2000: National Health Promotion and Disease Prevention Objectives. Washington, DC: US Department of Health and Human Services; 1991. DHHS publication (PHS)91–50212
216. US Public Health Service. *The Surgeon General's Report on Nutrition and Health.* Washington, DC: US Department of Health and Human Services; 1989. DHHS publication (PHS)88–50210
217. Gordon-Larsen P, McMurray RG, Popkin BM. Adolescent physical activity and inactivity vary by ethnicity: the National Longitudinal Study of Adolescent Health. *J Pediatr.* 1999;135:301–306
218. Lowry R, Wechsler H, Galuska DA, Fulton JE, Kann L. Television viewing and its associations with overweight, sedentary lifestyle, and insufficient consumption of fruits and vegetables among US high school students: differences by race, ethnicity, and gender. *J Sch Health.* 2002;72:413–421
219. Gordon-Larsen P, Adair LS, Popkin BM. Ethnic differences in physical activity and inactivity patterns and overweight status. *Obes Res.* 2002;10:141–149
220. Horn OK, Paradis G, Potvin L, Macaulay AC, Desrosiers S. Correlates and predictors of adiposity among Mohawk children. *Prev Med.* 2001;33:274–281
221. Salbe AD, Weyer C, Harper I, Lindsay RS, Ravussin E, Tataranni PA. Assessing risk factors for obesity between childhood and adolescence, part II: energy metabolism and physical activity. *Pediatrics.* 2002;110:307–314
222. Davis SP, Northington L, Kolar K. Cultural considerations for treatment of childhood obesity. *J Cult Divers.* 2000;7:128–132
223. Vandewater EA, Rideout VJ, Wartella EA, Huang X, Lee JH, Shim MS. Digital childhood: electronic media and technology use among infants, toddlers, and preschoolers. *Pediatrics.* 2007;119(5). Available at: www.pediatrics.org/cgi/content/full/119/5/e1006
224. Roberts DF, Foehr UG, Rideout V. *Generation M: Media in the Lives of 8–18 Year Olds: A Kaiser Family Foundation Study*. Menlo Park, CA: Kaiser Family Foundation; 2005. Available at: www.kff.org/entmedia/7251.cfm. Accessed October 2, 2006
225. Dietz WH, Robinson TN. Clinical practice: overweight children and adolescents. *N Engl J Med.* 2005;352:2100–2109
226. Goldfield GS, Epstein LH, Kilanowski CK, Paluch RA, Kogut-

Bossler B. Cost-effectiveness of group and mixed family-based treatment for childhood obesity. *Int J Obes Relat Metab Disord.* 2001;25:1843–1849
227. Braet C, Tanghe A, Decaluwe V, Moens E, Rosseel Y. Inpatient treatment for children with obesity: weight loss, psychological well-being, and eating behavior. *J Pediatr Psychol.* 2004;29:519–529
228. Braet C, Tanghe A, Bode PD, Franckx H, Winckel MV. Inpatient treatment of obese children: a multicomponent programme without stringent calorie restriction. *Eur J Pediatr.* 2003;162:391–396
229. Gately PJ, Cooke CB, Butterly RJ, Mackreth P, Carroll S. The effects of a children's summer camp programme on weight loss, with a 10 month follow-up. *Int J Obes Relat Metab Disord.* 2000;24:1445–1452
230. Warschburger P, Fromme C, Petermann F, Wojtalla N, Oepen J. Conceptualisation and evaluation of a cognitive-behavioural training programme for children and adolescents with obesity. *Int J Obes Relat Metab Disord.* 2001;25(suppl 1):S93–S95
231. White MA, Martin PD, Newton RL, et al. Mediators of weight loss in a family-based intervention presented over the Internet. *Obes Res.* 2004;12:1050–1059
232. Epstein LH, McCurley J, Wing RR, Valoski A. Five-year follow-up of family-based behavioral treatments for childhood obesity. *J Consult Clin Psychol.* 1990;58:661–664
233. Brownell KD, Kelman JH, Stunkard AJ. Treatment of obese children with and without their mothers: changes in weight and blood pressure. *Pediatrics.* 1983;71:515–523
234. Golan M, Fainaru M, Weizman A. Role of behaviour modification in the treatment of childhood obesity with the parents as the exclusive agents of change. *Int J Obes Relat Metab Disord.* 1998;22:1217–1224
235. Golan M, Weizman A, Apter A, Fainaru M. Parents as the exclusive agents of change in the treatment of childhood obesity. *Am J Clin Nutr.* 1998;67:1130–1135
236. Israel AC, Stolmaker L, Andrian CAG. The effects of training parents in general child management skills on a behavioral weight loss program for children. *Behav Ther.* 1985;16:169–180
237. Young KM, Northern JJ, Lister KM, Drummond JA, O'Brien WH. A meta-analysis of family-behavioral weight-loss treatments for children. *Clin Psychol Rev.* 2007;27:240–249
238. Epstein LH, Wing RR, Steranchak L, Dickson B, Michelson J. Comparison of family-based behavior modification and nutrition education for childhood obesity. *J Pediatr Psychol.* 1980;5:25–36
239. Epstein LH, Wing RR, Woodall K, Penner BC, Kress MJ, Koeske R. Effects of family-based behavioral treatment on obese 5- to 8-year-old children. *Behav Ther.* 1985;16:205–212
240. Herrera E, Johnston CA, Steele RG. A comparison of cognitive and behavioral treatments for pediatric obesity. *Child Health Care.* 2004;33:151–167
241. Senediak C, Spence SH. Rapid versus gradual scheduling of therapeutic contact in a family based behavioral weight control programme for children. *Behav Psychother.* 1985;13:265–287
242. Eliakim A, Friedland O, Kowen G, Wolach B, Nemet D. Parental obesity and higher pre-intervention BMI reduce the likelihood of a multidisciplinary childhood obesity program to succeed: a clinical observation. *J Pediatr Endocrinol Metab.* 2004;17:1055–1061
243. Epstein LH, Paluch RA, Kilanowski CK, Raynor HA. The effect of reinforcement or stimulus control to reduce sedentary behavior in the treatment of pediatric obesity. *Health Psychol.* 2004;23:371–380
244. Berkowitz RI, Wadden TA, Tershakovec AM, Cronquist JL. Behavior therapy and sibutramine for the treatment of adolescent obesity: a randomized controlled trial. *JAMA.* 2003;289:1805–1812
245. Israel AC, Silverman WK, Solotar LC. The relationship between adherence and weight loss in a behavioral treatment program for overweight children. *Behav Ther.* 1988;19:25–33
246. Saelens BE, McGrath AM. Self-monitoring adherence and adolescent weight control efficacy. *Child Health Care.* 2003;32:137–152
247. Wrotniak BH, Epstein LH, Paluch RA, Roemmich JN. The relationship between parent and child self-reported adherence and weight loss. *Obes Res.* 2005;13:1089–1096
248. Epstein LH, Paluch RA, Gordy CC, Saelens BE, Ernst MM. Problem solving in the treatment of childhood obesity. *J Consult Clin Psychol.* 2000;68:717–721
249. Graves T, Meyers AW, Clark L. An evaluation of parental problem-solving training in the behavioral treatment of childhood obesity. *J Consult Clin Psychol.* 1988;56:246–250
250. Duffy G, Spence SH. The effectiveness of cognitive self-management as an adjunct to a behavioural intervention for childhood obesity: a research note. *J Child Psychol Psychiatry.* 1993;34:1043–1050
251. Faith MS, Berman N, Heo M, et al. Effects of contingent television on physical activity and television viewing in obese children. *Pediatrics.* 2001;107:1043–1048
252. Ioannides-Demos LL, Proietto J, Tonkin AM, McNeil JJ. Safety of drug therapies used for weight loss and treatment of obesity. *Drug Saf.* 2006;29:277–302
253. Yanovski SZ, Yanovski JA. Obesity. *N Engl J Med.* 2002;346:591–602
254. Yanovski SZ. Pharmacotherapy for obesity: promise and uncertainty. *N Engl J Med.* 2005;353:2187–2189
255. Moyers SB. Medications as adjunct therapy for weight loss: approved and off-label agents in use. *J Am Diet Assoc.* 2005;105:948–959
256. US Food and Drug Administration. Consumer alert: FDA plans regulation prohibiting sale of ephedra-containing dietary supplements and advises consumers to stop using these products. Available at: www.fda.gov/oc/initiatives/ephedra/december2003/advisory.html. Accessed July 12, 2007
257. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. *J Pediatr.* 2007;150:12–17
258. Bray GA, Greenway FL. Current and potential drugs for treatment of obesity. *Endocr Rev.* 1999;20:805–875
259. James WP, Astrup A, Finer N, et al. Effect of sibutramine on weight maintenance after weight loss: a randomised trial: STORM Study Group: Sibutramine Trial of Obesity Reduction and Maintenance. *Lancet.* 2000;356:2119–2125
260. Berkowitz B, Fujioka K, Daniels SR, et al. Effects of sibutramine treatment in obese adolescents: a randomized trial. *Ann Intern Med.* 2006;145:81–90
261. Godoy-Matos A, Carraro L, Vieira A, et al. Treatment of obese adolescents with sibutramine: a randomized, double-blind, controlled study. *J Clin Endocrinol Metab.* 2005;90:1460–1465
262. Zhi J, Melia AT, Guerciolini R, et al. Retrospective population-based analysis of the dose-response (fecal fat excretion) relationship of orlistat in normal and obese volunteers. *Clin Pharmacol Ther.* 1994;56:82–85
263. McDuffie JR, Calis KA, Uwaifo GI, et al. Three-month tolerability of orlistat in adolescents with obesity-related comorbid conditions. *Obes Res.* 2002;10:642–650
264. Chanoine JP, Hampl S, Jensen C, Boldrin M, Hauptman J. Effect of orlistat on weight and body composition in obese adolescents: a randomized controlled trial. *JAMA.* 2005;293:2873–2883

265. Wolfe SM, Barbehenn E, Public Citizens Health Research Group, FDA Non-Prescription and Endocrine and Metabolic Drug Advisory Committees. Hearing on possible switch of orlistat to OTC status, January 23, 2006. Available at: www.fda.gov/ohrms/dockets/ac/06/slides/2006-4201OPH1_01_Wolfe.ppt. Accessed September 20, 2006
266. Inge TH, Krebs NF, Garcia VF, et al. Bariatric surgery for severely overweight adolescents: concerns and recommendations. *Pediatrics.* 2004;114:217–223
267. Dolan K, Creighton L, Hopkins G, Fielding G. Laparoscopic gastric banding in morbidly obese adolescents. *Obes Surg.* 2003;13:101–104
268. Sugerman HJ, Sugerman EL, DeMaria EJ, et al. Bariatric surgery for severely obese adolescents. *J Gastrointest Surg.* 2003;7:102–108
269. Strauss RS, Bradley LJ, Brolin RE. Gastric bypass surgery in adolescents with morbid obesity. *J Pediatr.* 2001;138:499–504
270. Apovian CM, Baker C, Ludwig DS, et al. Best practice guidelines in pediatric/adolescent weight loss surgery. *Obes Res.* 2005;13:274–282
271. Rodgers BM, American Pediatric Surgical Association. Bariatric surgery for adolescents: a view from the American Pediatric Surgical Association. *Pediatrics.* 2004;114:255–256
272. Garcia VF, DeMaria EJ. Adolescent bariatric surgery: treatment delayed, treatment denied, a crisis invited. *Obes Surg.* 2006;16:1–4
273. Zuckerman AM. Annexing the neighbor's backyard: increasing service area. *Healthc Financ Manage.* 2005;59:126–128
274. Tate DF, Wing RR, Winett RA. Using Internet technology to deliver a behavioral weight loss program. *JAMA.* 2001;285:1172–1177
275. Sherwood NE, Jeffery RW, Pronk NP, et al. Mail and phone interventions for weight loss in a managed-care setting: Weigh-to-Be 2-year outcomes. *Int J Obes (Lond).* 2006;30:1565–1573
276. Institute of Medicine. Progress in preventing childhood obesity: how do we measure up? Available at: www.iom.edu/?id=37007 Accessed September 25, 2006
277. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999–2000. *JAMA.* 2002;288:1728–1732
278. Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. *Am J Prev Med.* 2002;22:23–29
279. Drewnowski A, Darmon N. Food choices and diet costs: an economic analysis. *J Nutr.* 2005;135:900–904
280. Caprio S. Treating childhood obesity and associated conditions. *Future Child.* 2006;16:209–224
281. Cooper S, Valleley RJ, Polaha J, Begeny J, Evans JH. Running out of time: physician management of behavioral health concerns in rural pediatric primary care. *Pediatrics.* 2006;118(1). Available at: www.pediatrics.org/cgi/content/full/118/1/e132
282. Story MT, Neumark-Stzainer DR, Sherwood NE, et al. Management of child and adolescent obesity: attitudes, barriers, skills, and training needs among health care professionals. *Pediatrics.* 2002;110:210–214
283. American Medical Association. Report 8 of the Council on Scientific Affairs (A-04): AMA actions on obesity. Available at: www.ama-assn.org/ama/pub/category/13653.html Accessed December 12, 2005
284. Tershakovec AM, Watson MH, Wenner WJ, Marx AL. Insurance reimbursement for the treatment of obesity in children. *J Pediatr.* 1999;134:573–578

PEDIATRICS
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

Recommendations for Treatment of Child and Adolescent Overweight and Obesity

Bonnie A. Spear, Sarah E. Barlow, Chris Ervin, David S. Ludwig, Brian E. Saelens, Karen E. Schetzina and Elsie M. Taveras

Pediatrics 2007;120;S254
DOI: 10.1542/peds.2007-2329F