Position of the American Dietetic Association: Individual-, Family-, School-, and Community-Based Interventions for Pediatric Overweight

ABSTRACT
The American Dietetic Association (ADA), recognizing that overweight is a significant problem for children and adolescents in the United States, takes the position that pediatric overweight intervention requires a combination of family-based and school-based multicomponent programs that include the promotion of physical activity, parent training/modeling, behavioral counseling, and nutrition education. Furthermore, although not yet evidence-based, community-based and environmental interventions are recommended as among the most feasible ways to support healthful lifestyles for the greatest numbers of children and their families. ADA supports the commitment of resources for programs, policy development, and research for the efficacious promotion of healthful eating habits and increased physical activity in all children and adolescents, regardless of weight status.

This is the first position paper of ADA to be based on a rigorous systematic evidence-based analysis of the pediatric overweight literature on intervention programs. The research showed positive effects of two specific kinds of overweight interventions: a) multicomponent, family-based programs for children between the ages of 5 and 12 years, and b) multicomponent, school-based programs for adolescents. Multicomponent programs include behavioral counseling, promotion of physical activity, parent training/modeling, dietary counseling, and nutrition education. Analysis of the literature to date points to the need for further investigation of promising strategies not yet adequately evaluated. Furthermore, this review highlights the need for research to develop effective and innovative overweight prevention programs for various sectors of the population, including those of varying ethnicities, young children, and adolescents. To support and enhance the efficacy of family- and school-based weight interventions, community-wide interventions should be undertaken; few such interventions have been conducted and even fewer evaluated.
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POSITION STATEMENT

The American Dietetic Association (ADA), recognizing that overweight is a significant problem for children and adolescents in the United States, takes the position that pediatric overweight intervention requires a combination of family-based and school-based multicomponent programs that include the promotion of physical activity, parent training/modeling, behavioral counseling, and nutrition education. Furthermore, although not yet evidence-based, community-based and environmental interventions are recommended as among the most feasible ways to support healthful lifestyles for the greatest numbers of children and their families. ADA supports the commitment of resources for programs, policy development, and research for the efficacious promotion of healthful eating habits and increased physical activity in all children and adolescents, regardless of weight status.

Childhood overweight is a growing concern, and dietetics professionals are poised to play a leadership role in prevention and treatment efforts. Dietetics professionals and other practitioners rely on empirical evidence provided by research studies. Rigorous comparative analysis of studies can identify successful and promising approaches, unproductive interventions, and perhaps most importantly, gaps in our collective knowledge. Since 2000, the

Unlike ADA position papers in the past, this is the first paper to draw its conclusions from an extensive review of the literature using a new analytic approach developed by ADA. As a result, this position paper is organized differently from earlier position papers. The use of an evidence-based approach provides important added benefits to earlier review methods. The major advantage of the new approach is the more rigorous standardization of review criteria, which minimizes the likelihood of reviewer bias and increases the ease with which disparate articles may be compared. For a detailed description of the methods used in this position paper, access the ADA's Methodology for Evidence-Based Analysis of Intervention Literature at www.eatright.org/cps/rde/xchg/ada/hs.xsl/8099_ENU_HTML.htm.

Also posted on ADA's Web site are the evidence-analysis summary sheets for all articles reviewed in this position paper (www.eatright.org/ada/files/Appendices_A_B_C.pdf). Furthermore, evidence analysis summaries for other topics, such as critical illness, disorders of lipid metabolism, oncology, and adult weight management, can be found in ADA's Evidence Analysis Library. For a complete listing of topics to date included in the Evidence Analysis Library, go to www.adaevidencelibrary.com.

American Dietetic Association (ADA) has used an evidence-based approach for the development of clinical practice guidelines for nutrition care. This is the first large-scale use of the comparative evidence-based system for a position paper developed by ADA. The approach and format used for this review, consistent with ADA's movement toward embracing evidence analysis, therefore differs from prior ADA position statements.

The present analysis is limited to an examination of programs and structured pediatric intervention studies that included an outcome measure of weight status or adiposity (eg, body weight, body mass index [BMI], skinfold thickness, percent body fat). It does not include pediatric overweight interventions that addressed behavioral, psychological, and medical outcomes such as diet, physical activity, self-esteem, body image, eating disorders, parenting practices, blood pressure, and blood lipids but did not have adiposity as an outcome. Nor were studies reporting the effects of self-initiated dietary restraint included. Some recent reports have suggested that self-generated, unmonitored extreme dieting in childhood is not only ineffective, but may actually be associated with future weight gain (1,2). Also, it does not include observational or epidemiological studies that compared such variables as breastfeeding, dietary intake, food insecurity, physical activity, self-esteem, body image, eating disorders, family feeding dynamics, and parenting practices with measures of adiposity. Finally, the conclusions apply to an otherwise healthy population; studies involving overweight attributed to specific genetic abnormalities (eg, Prader-Willi syndrome) or to a side effect of prescribed medication were beyond the scope of this position statement. These self-imposed limits were essential because of the enormity of the tasks involved in evidence-based analysis and so that the sizeable body of work undertaken could be completed in a timely fashion. ADA is committed to supporting additional evidence-based analyses of topics of interest to members concerning pediatric overweight. For example, ADA is currently in the process of developing an evidence-based practice guide on pediatric overweight management that will provide practical advice that was beyond the scope of this analysis. Other recently released evidence-based analyses of pediatric overweight include treatment in primary care settings (3), prevention interventions (4), and weight-loss surgery (5,6).

In this paper, pediatric overweight interventions were grouped into three levels:

- tertiary prevention: overweight interventions to slow down or reverse the increase in BMI and to prevent the complications of overweight;
- secondary prevention: overweight prevention efforts including identification and intervention of asymptomatic children who are at risk for overweight; and
- primary prevention: prevention efforts occurring before individuals are overweight.

Tertiary prevention efforts target only children who are already overweight, whereas primary and secondary prevention efforts target risk factors for overweight and are typically designed for population-based implementation and include children in various categories of weight status.

When interpreting the results of these studies and the accompanying figures, it is useful to remember that during childhood and adolescence, growth is the norm, therefore weight and body size are constantly changing. Effective overweight prevention programs for children and adolescents can lead to decreases in adiposity without weight loss by means of maintenance or stabilization of weight over time. As children grow taller, maintenance of weight can result in a reduction of BMI percentile. Furthermore, in many studies, the BMI values of the children will increase in both the intervention and the control groups, but relative to the control group, increases in the intervention group will be smaller in successful overweight intervention programs.

EVIDENCE-BASED ANALYSIS

Studies were identified from the PubMed database maintained by the National Library of Medicine as well as through research articles and literature reviews. In addition to overweight and obesity, the following search terms were used: individual-based intervention, family-based intervention, school-based intervention, and community-based intervention. The same limits were applied to all searches: publication date from January 1982 to January 2004, English language, human subjects, and children. For the purposes of this review, children were defined as individuals 2 through 12 years of age and adolescents were defined as individuals 13 through 18 years. Children were also classified as school-age (5 through 18 years old) and preschool-age (2 through 4 years old). Studies of any design were reviewed (eg, randomized controlled trials, nonrandomized and uncontrolled trials), with the exception that meta-analyses or review articles were not used in the present evidence-based analysis because these generally did not use the same criteria for article selection. This evidence-based analysis was not limited exclusively to randomized, controlled trials because the grading system used (described later) allows for taking study design into consideration. Regardless of study design, intervention studies were grouped into one of three categories on the basis of unit of intervention: a) individual- or family-based, b) school-based, or c) community-based. Primary prevention trials were defined as studies including all children in a specified population regardless of risk status. Treatment trials were defined as studies targeting high-risk children (eg, overweight or at risk of overweight) and were considered either tertiary prevention (if individual- or family-based) or secondary prevention (if school-based). There was a natural partition between tertiary, secondary, and primary prevention interventions; all individual- and family-based interventions involved tertiary prevention, whereas the majority of school- and community-based interventions were primary or secondary prevention trials. A few trials discussed in the individual- and family-based intervention section (7,8) did involve activities at schools, but these differ from school-based studies in that they were limited to after-school activities wherein the school was used as a convenient meeting place and school-wide or school-day changes were not instituted.

The following exclusion criteria were applied to all identified studies:

- conducted in developing countries;
- published in journals or books that are not peer-reviewed;
- included no measure of adiposity;
- involved exclusively children younger than 2 years old or adolescents older than 18 years old;
- secondary or tertiary prevention trial conducted for less than 8 weeks (not including duration of follow-up);
- primary prevention trial conducted for less than 6 months (not including duration of follow-up);
- secondary or tertiary prevention trial involved fewer than 30 subjects total (or fewer than 15 in the intervention group);
- primary prevention trial involved fewer than 60 subjects total (or fewer than 30 in the intervention group); and
- tertiary prevention trials involving surgery or pharmacological interventions (because of lack of research in these areas at the time the review was instituted).

Identified research articles that met specified criteria were systematically abstracted onto an article review table. After abstraction, each article was given a quality score (plus [+], neutral [0], or minus [−]), using a quality criteria checklist formulated by ADA. Summaries of all articles may be found online at the Evidence Analysis Library at www.ADAevidencelibrary.org. Abbreviated tables listing the primary characteristics of studies reviewed (individual- or family-based tertiary prevention, school-based primary prevention, and school-based secondary prevention) can also be found online at www.eatright.org/ada/files/Appendices_A_B_C.pdf.

In categorizing the components of interventions, the following definitions were used:

- *dietary counseling/nutrition education*—dietary counseling included the prescription of a specified caloric and/or nutrient content per day; nutrition education involved providing more general information on foods, shopping, and nutrition to promote healthful eating;
- *physical activity counseling/education*—physical activity counseling included the prescription of a specified amount and/or type of physical activity; physical activity education involved providing more general information on physical activity for health and included providing physical education in schools;
- *sedentary activity counseling/education*—same as above but addressed sedentary activities such as television watching and video game playing;
- *behavioral counseling*—involved counseling on self-monitoring of diet and physical activity, cue elimination, stimulus control, goal setting, action planning, modeling, limit setting, and other behavior modification strategies;
- *family counseling*—specific to family-based interventions, involved behavioral counseling in which one or more family members accompanied the patient;
- *parent training*—specific to family-based interventions, involved behavioral counseling targeted at parents to improve their parenting skills, including limit setting, role modeling, and positive reinforcement;
- *parent/family involvement*—specific to school-based studies, included providing parents with information on healthful diet and activity behaviors for their families;
- *physical activity environment*—specific to school-based interventions, included making changes to the physical environment and to the structure of physical education classes to promote physical activity; and
- *school food environment*—specific to school-based interventions, included making policy and school food service changes to promote healthful eating.

Conclusion statements were formulated summarizing the strength of the evidence with respect to each intervention category and intervention components used within each intervention category. The strength of the totality of the evidence was graded using the following elements: quality, consistency across studies, quantity, likely clinical impact, and generalizability. Grades included I (good—evidence is consistent from studies of strong design), II (fair—evidence from studies of strong design is not always consistent or evidence is consistent but based on studies of weaker design), III (limited—evidence from a limited number of studies), and IV (expert opinion only—unsubstantiated by results of any studies, but based on expertise). In the event that an intervention component was not examined in any of the identified studies nor could it be recommended by expert opinion, a conclusion statement was assigned a Grade V. Grading of the evidence (I, II, III, IV, or V) applies to the totality of studies examined with respect to a single topic; it differs from the quality score (+, 0, or −), which is individually assigned to each research article, but takes into account the relative quality scores and the findings of relevant studies. A more detailed description of the methodology used for this evidence-based analysis may be found on ADA's Web site at www.eatright.org/cps/rde/xchg/ada/hs.xsl/8099_ENU_HTML.htm.

RATIONALE

The prevalence of pediatric overweight in the United States is increasing at an accelerated rate (9-14). Current data from the National Health and Nutrition Examination Survey show the prevalence of overweight at 16% among US children 6 to 11 years old and 16% among adolescents 12 to 19 years old, which represent increases of nearly 50% compared with the Third National Health and Nutrition Examination Survey data from 1984-96 and a threefold increase from the 1960s (15). This trend is global and is well documented in other developed nations as well as in numerous developing nations (16-18).

Overweight and obesity are defined as the accumulation of excess adipose tissue. Diagnosing overweight in children is complex and should be performed by a physician or other medical professional trained in appropriate diagnostic techniques (19). For this paper, childhood overweight status is defined using sex- and age-specific growth charts developed by the Centers for Disease Control and Prevention, with normal weight as a BMI >5th percentile and <85th percentile, at risk of overweight as a BMI >85th percentile and <95th percentile, and overweight as >95th percen-

tile (20). An energy imbalance leads to overweight; this imbalance is caused by either excessive caloric intake or inadequate physical activity or both. Thus, most interventions for prevention or treatment target either food consumption or physical activity, either directly (eg, a dietary counseling program) or indirectly (eg, parent training).

Childhood overweight contributes to various health concerns. The metabolic consequences of childhood overweight conditions include atherogenic dyslipidemia, glucose intolerance, type 2 diabetes, metabolic syndrome, nonalcoholic steatohepatitis, and coagulation system abnormalities (21,22). Furthermore, overweight children are at an increased risk for future cardiovascular disease (23). Overweight children may display elevated total cholesterol, low-density lipoproteins, and total body and abdominal fat, and reduced high-density lipoproteins (24-26). In addition, fatty streaks have been found in the arteries of adolescents as young as 13 years of age (27). Several studies indicate that in children with primary risk factors, the metabolic disorders that promote chronic diseases, such as diabetes and heart disease, most likely originate early in childhood (27-30).

Childhood overweight, especially when severe, promotes advanced maturation (31). Overweight children have advanced bone age, higher bone density and area, and increased levels of sex hormones (32). Precocious puberty (33) and premature pubarche (34,35) have been associated with insulin resistance (34,36), long-term changes in body composition (33,37), increases in insulin-like growth factors, exaggerated adrenal response, and polycystic ovary syndrome (38). In girls, early puberty increases lifetime exposure to estrogen, which may elevate the risk for breast cancer and possibly ovarian cancer. Furthermore, excess body weight and hormonal imbalance during puberty have been associated with growth plate (epiphysis) injuries (39).

In addition to physiological effects, overweight children may experience adverse psychological consequences including lowered self-esteem and increased depression ratings (40-42). Overweight children are targets of early and systematic discrimination by peers, family members, and teachers. Moreover, the early maturation associated with childhood overweight is linked to low self-esteem (43).

The most serious and prevalent long-term consequences of childhood overweight may be obesity and consequent morbidity in adulthood. Adult obesity frequently originates during childhood (44-46). Whitaker and colleagues (47) found that the overweight status of children over 6 years of age was shown to be a strong predictor of adult obesity. Dietz (44) has suggested that there are three critical periods for the development of overweight in children. These include: a) the intrauterine environment or early infancy, b) 5 to 7 years of age (adiposity rebound), and c) adolescence. Approximately one third of overweight preschool children, one half of overweight school-age children, and three quarters of overweight teenagers grow up to be obese as adults (47,48).

Given the increasing number of children who are overweight and the consequences associated with the long-term tracking of adiposity, it is critical to identify the most promising intervention strategies for preventing pediatric overweight, especially because dietetics professionals are often asked for their recommendations on pediatric overweight interventions. Individual- and family-based interventions will be discussed first, followed by school-based interventions, and finally community-based interventions.

INDIVIDUAL- AND FAMILY-BASED INTERVENTION STUDIES: TERTIARY PREVENTION

Interventions reviewed include 42 family-based interventions, one individual-based intervention (49), and one individual- vs family-based intervention (50,51). Individual-based interventions were defined as one-on-one counseling in a nongroup setting, whereas family-based interventions were conducted in group settings with family participation within at least one intervention group. All individual- and family-based interventions involved tertiary prevention in overweight youth rather than prevention of excessive weight gain in nonoverweight individuals and were conducted in clinical or after-school settings. Of the 44 studies evaluated, 29 were randomized controlled trials and 15 were studies of other design. Forty-three of the 44 studies were classified as multicomponent programs based on including two or more of the following components: dietary counseling, physical activity counseling, sedentary activity counseling, behavioral counseling, family counseling, and parent training. One study by Epstein and colleagues (52) duplicated an earlier report (53), and therefore the two were combined and treated as one intervention. The same was true of two studies reported by Nuutinen (50,51). One meta-analysis by LeMura and Maziekas (54) was reviewed but not included in the final report because of differing study exclusion criteria. No studies involving children or adolescents were identified that evaluated the efficacy of popular weight-loss programs (eg, meal-replacement programs and programs available on the Internet, in self-help formats, and in nonmedical commercial settings). This is not surprising given that few evaluation studies of commercial programs have been conducted among adults either (55).

Individual-Based Counseling

Of the 29 randomized controlled trials evaluated, only one trial (49) examined individual counseling vs standard care in a clinical setting. The study's investigators evaluated the posttreatment and short-term follow-up efficacy of a 4-month behavioral counseling weight control program for overweight adolescents 12 to 16 years old in a primary care setting. The results indicated that a physician-based, computer-interactive individual counseling program including nutrition and physical activity education was superior to a standard care approach in overweight adolescents. One study of other design examined the long-term results of group, family-based counseling vs individual counseling in 6- to 16-year-old subjects (50,51). After 12 months of treatment and 2 and 5 years of follow-up, there were no significant differences between the groups. This study, however, was limited because of low participant retention rates and initial selection bias.

Conclusion Statement. Limited evidence is currently available to support rou-

tinely recommending individual-based intervention for overweight children and adolescents *(Evidence Grade III)*. Because only two studies involving individual-based counseling were identified, more research is needed in this area.

Family-Based Interventions—Multicomponent Programs

Twenty-one of the 29 randomized controlled trials and 13 of 15 studies of other design examined multicomponent, group, family-based interventions including diet, physical activity, behavior, and family counseling. Family counseling is behavioral counseling in which at least one family member accompanies the child. All but one of the randomized controlled trials and seven of nine of the studies of other design received plus ratings. In 28 of these studies, children significantly reduced weight status/adiposity. Studies in children <13 years of age consistently showed significant reductions in weight status/adiposity over 6-month to 2-year time periods when parents were included in behavioral counseling. In one study (56), children significantly decreased percent overweight and triceps skinfold measurements at 6 months; however, weight loss was not maintained at the 3-year follow-up measure. Five studies, four randomized controlled trials with plus ratings and one controlled, clinical observation with a neutral rating (50,52,53,57,58), provided evidence of maintenance of reduction in weight status/adiposity over 5 to 10 years. One study of 3 years' duration with a 7-year follow-up showed no changes in weight status/adiposity; however, its goal was to reduce serum lipids, not adiposity (59,60). Only two randomized controlled trials, both with plus ratings, evaluated family-based interventions in adolescents 13 years of age and older (61,62). Six studies of varied designs, four with plus ratings and two with neutral ratings, evaluated family-based interventions in children and adolescents combined. All of these family-based intervention studies found reductions in weight status/adiposity at postintervention and follow-up. No studies were identified that included children under the age of 5 years, and therefore no conclusions were made for this age group.

Conclusion Statement. Of the studies examining multicomponent, family-based group interventions including diet, physical activity, behavior, and parent training, all but two found a significant reduction in weight status/adiposity in the children and/or adolescents at postintervention and, in the majority of studies, also at follow-up. There is sufficient evidence to recommend a multicomponent, family-based intervention including diet, physical activity, behavior, and family counseling for reducing overweight in 5- to 12-year-old children *(Evidence Grade I)*. Because only two of the studies enrolled children ≥13 years of age, there is only fair evidence to routinely recommend a multicomponent, family-based group intervention including diet, physical activity, behavior, and family counseling for reducing overweight in adolescents *(Evidence Grade II)*.

Parent Training within Multicomponent Interventions

Parent training is a behavioral counseling method in which parents are guided through a series of specific techniques to improve their parenting skills, including but not limited to positive reinforcement, role modeling, and limit setting. Twenty of 29 randomized controlled trials and 13 of 15 studies of other design examined the inclusion of parent training in group family-based interventions. Of these, 18 of 20 randomized controlled trials and nine of 13 studies of other design received plus ratings; of these, 13 randomized controlled trials included children <13 years and only five enrolled adolescents 13 years or older. Ten of the 27 randomized controlled trials and studies of other design examined child only vs parent only or parent-and-child combined counseling. Results were not consistent across studies. Epstein and colleagues (58) compared the change in weight status of children with that of their parents after 6 months and again after 10 years. Children maintained the original reduction in weight status/adiposity, whereas parents did not. Golan and colleagues (63) showed enhanced weight loss when the parents, as opposed to the overweight children, were targeted with counseling and education. Eliakim and colleagues (64) found differences in the maintenance of weight loss in overweight children 6 to 16 years of age as a result of variations in parental overweight. Weight loss was more likely to be maintained by children whose parents were both normal weight. Twenty-three of the 27 randomized controlled trials and studies of other design including a parent training or modeling component showed positive changes in children's weight status/adiposity. In summary, 27 randomized controlled trials and studies of other design including parent training or modeling showed positive changes in children's weight status/adiposity. Three of these studies in children <13 years old and one in adolescents >12 years old showed no difference in weight status reduction between child-only vs child-plus-parent interventions. No studies were identified that included children under the age of 5 years.

Conclusion Statement. Limited evidence is currently available to support the use of parent training in the absence of a multicomponent program *(Evidence Grade III)*. Sufficient evidence exists to support parent training techniques as part of a multicomponent, family-based group intervention including diet, physical activity, behavior counseling, and family counseling for reducing overweight in school-age children *(Evidence Grade I)*. The results of studies in adolescents were limited and inconsistent, thus there is less evidence to support parent training techniques as part of a multicomponent, family-based group intervention including diet, physical activity, behavior counseling, and family counseling for reducing overweight in adolescents *(Evidence Grade II)*.

Individual Psychotherapy

No studies reported using individual psychotherapy as an intervention to reduce weight status/adiposity in children and adolescents.

Conclusion Statement. No studies examined individual psychotherapy, and therefore no conclusion can be made at this time about the use of individual psychotherapy for reducing overweight in children or adolescents *(Evidence Grade V)*.

Dietary Counseling and Nutrition Education

Numerous studies have examined dietary counseling and/or nutrition education alone or in conjunction with physical activity. Two randomized controlled trials examined dietary counseling alone vs dietary counseling combined with physical activity and/or exercise with mixed findings. Epstein and colleagues (65) examined the effect of dietary counseling plus lifestyle exercise vs dietary counseling only over 6 months. Both treatment groups had significant reductions in weight status/adiposity compared with control subjects. However, there were no significant differences in the reduction of weight status/adiposity between diet-only and diet-plus-exercise groups at 6 months or 12-month follow-up. In contrast, in a subsequent study, Epstein and colleagues (66) showed that interventions with diet plus structured exercise resulted in a significantly greater reduction in weight status/adiposity than those with diet alone at 6 months and 1 year of follow-up. Thirty-eight studies examined dietary counseling in conjunction with behavior modification/counseling and/or physical activity/exercise and found significant reductions in weight status/adiposity. Of these, 24 were randomized controlled trials and 14 were studies of other design. The majority of studies used techniques such as portion control and recommendations to reduce access to higher-density foods. Twelve of these studies prescribed the Traffic Light Diet, which involves foods grouped in broad categories based on recommended frequency of consumption. Seven studies specified diets with daily caloric recommendations based on current ADA age-appropriate standards. Five of these studies prescribed balanced hypocaloric diets. With few exceptions, regardless of the dietary counseling approach implemented, both short-term and long-term follow-up reductions in weight status/adiposity in children and adolescents were significant and similar across studies.

Twenty-nine studies evaluated nutrition education interventions in conjunction with dietary counseling, exercise and/or physical activity, and behavioral counseling. Twenty of these 29 studies were randomized controlled trials. Only one study examined nutrition education alone without dietary counseling. Kirschenbaum and colleagues (67) evaluated the effect of cognitive behavioral counseling and nutrition education on weight status/adiposity in 9- to 13-year-old subjects. Significant reductions were observed at 9-week, 3-month, and 12-month follow-up visits.

Conclusion Statement. Limited evidence is currently available to support using dietary therapy and/or nutrition education alone for reducing overweight in children *(Evidence Grade III)*. There is sufficient evidence to support including dietary therapy and/or nutrition education within a multicomponent, family-based group intervention along with physical activity, behavior counseling, and family counseling for reducing overweight in school-age children *(Evidence Grade I)*, but less evidence is available for adolescents *(Evidence Grade II)*.

Dietary Counseling on Altered Macronutrient Composition within a Multicomponent Program

Two randomized controlled trials and seven nonrandomized clinical observations evaluated reduced-calorie diets with altered macronutrient compositions within multicomponent programs including structured exercise, increased physical activity, behavior modification, and nutrition education. Both randomized controlled trials and four of the seven studies of other design received plus ratings. In the two randomized controlled trials, adolescents following a low-carbohydrate or low-glycemic-load diet showed a greater reduction in weight status/adiposity than those in the control group (68,69). In a clinical observation, Brown and colleagues (25) showed improvements in the lipid profiles and weight status/adiposity of 53 children 7 to 17 years of age after a very-low-calorie diet, nutrition education, structured exercise, increased physical activity, and behavior modification. In a series of three studies, Sothern and colleagues (26,70,71) examined the change in weight status/adiposity in children and adolescents 7 to 17 years of age after participation in behavior modification, nutrition education, structured exercise, increased physical activity, and a high-protein or balanced nutrient hypocaloric diet (based on initial weight status). Subjects had significantly reduced weight status at 10 weeks and 1 year. None of the studies using altered macronutrient dietary counseling approaches were more than 1 year in duration. Diets such as those reported above have been used primarily with adolescents at medical risk for the complications of obesity, and only for limited periods of time ($\leq$1 year).

Conclusion Statement. Limited evidence is currently available to support the use of any particular altered macronutrient approach as opposed to standard dietary therapy for reducing overweight in children or adolescents *(Evidence Grade III)*.

Physical Activity

Twenty-four randomized controlled trials and 13 studies of other design included physical activity in interventions to reduce weight status/adiposity in children and adolescents. Ten randomized controlled trials and one controlled clinical observation examined the independent contribution of differing types of exercise and/or physical activity in group counseling interventions. Only one of the 24 randomized controlled trials reported no additional advantage of adding increased physical activity to the weight management intervention. Epstein and colleagues (65) examined the effect of diet plus lifestyle exercise vs diet only, with a waiting list control (eg, delayed intervention control) for 6 months. Both treatment groups had significant reductions in weight status/adiposity compared with control subjects. However, there were no significant differences in the reduction of weight status/adiposity between diet-only and diet-plus-exercise groups at 6 months or 12 months of follow-up. In contrast, in a later study, Epstein and colleagues (66) reported that exercise enhances the outcome of the short-term treatment of childhood overweight and encouraged improvements in fitness when compared with diet-only approaches. The efficacy of three different types of exercise treatment programs was also compared. No differences in the weight maintenance of overweight children participating in aerobic exer-

cise, calisthenics, or lifestyle exercise during the first year of treatment were found. However, during the second year of follow-up, the lifestyle exercise group maintained the weight loss and the other subjects participating in calisthenics and aerobic exercise gained significant amounts of weight. Gutin and colleagues (7) evaluated the feasibility of implementing a physical training program in 80 overweight 13- to 16-year-old adolescents. They participated in a standard aerobic exercise program at an intensity >70% of maximal heart rate for approximately 30 minutes per session, 5 days per week. The program resulted in a significant reduction in total and visceral body fat. Owens and colleagues (8) reported that overweight children participating in 40 minutes of vigorous (70% to 75% of age-predicted maximum heart rate) exercise 5 days per week had a significantly greater decline in weight status/adiposity than control subjects. Becque and colleagues (72) reported significant reduction in multiple cardiovascular risk factors using an exercise intensity of 60% to 80% of maximum heart rate and progressively increasing durations of walking, jogging, swimming, and aerobic dancing over 8 weeks in conjunction with dietary counseling vs an intervention of dietary plus behavior counseling. Sothern and colleagues (70) examined the inclusion of regular resistance training in a pediatric overweight intervention program for preadolescent children and concluded that it can be safe, is feasible, and may contribute to increased subject retention at 1 year. Rocchini and colleagues (73) examined the effect of exercise alone vs exercise plus diet and behavior modification and control. Both the exercise alone and the exercise plus diet and behavior groups had significant reductions in weight status/adiposity vs control subjects. In summary, all but a few studies receiving plus scores included programs to increase physical activity. Eight of these studies showed an independent positive effect of different types of physical activity on weight status/adiposity in children and adolescents. Short-term studies were mixed concerning the effect of structured vs lifestyle exercise. Only two long-term studies examined different physical activity/exercise approaches in children 12 years of age or younger. Results suggest that nonstructured approaches may be more effective, but this needs further investigation.

Conclusion Statement. There is fair evidence to support using physical activity alone for reducing overweight in children or adolescents *(Evidence Grade II)*. There is sufficient evidence to routinely recommend the inclusion of physical activity within a multicomponent, family-based group intervention along with dietary counseling, behavior counseling, and family counseling for reducing overweight in school-age children *(Evidence Grade I)*, but less evidence for adolescents *(Evidence Grade II)*.

Sedentary Behaviors

Only one study examined an intervention that included reducing sedentary behaviors (television watching). In a 4-month plus 1-year follow-up study by Epstein and colleagues (74), reducing sedentary behaviors was shown to be superior over increasing physical activity in promoting maintenance of weight loss in overweight children.

Conclusion Statement. Limited evidence is currently available to support reducing sedentary behaviors as opposed to increasing physical activity for reducing overweight in children and adolescents *(Evidence Grade III)*. More studies are needed in this area.

Behavioral Counseling

Thirty-nine of the 44 studies reviewed contained a behavioral counseling component. Twenty-five were randomized controlled trials, and 14 were studies of other design. All but one of the randomized controlled trials and nine of the studies of other design received plus ratings. Family behavioral counseling was a well-developed and well-described part of the majority of the studies that illustrated successful reductions in adiposity. In seven randomized controlled trials with plus ratings (56,59,60,63,75-77), when behavioral counseling was compared with standard care or diet plus exercise alone, significant differences were observed between groups, with greater decreases in weight status/adiposity in groups that included behavior counseling. Many of these behavioral counseling interventions were based on well-established theories, including the social cognitive theory and transtheoretical model. Behavioral counseling techniques commonly used in these childhood overweight programs included self-monitoring of diet and physical activity, cue elimination, stimulus control, goal setting, action planning, modeling, and limit setting. However, it is difficult to determine the independent impact of these techniques in a clinical environment because there were only two studies that examined the separate influence of a single technique (problem solving) compared with others. Graves and colleagues (75) examined the independent contribution of problem solving in 5- to 12-year-old children enrolled in a multidisciplinary weight management intervention, including games and stories, Traffic Light Diet, self-monitoring, diet and exercise information, stimulus control, family support, cognitive restructuring, peer relations, and maintenance strategies. The addition of problem-solving techniques in the intervention significantly enhanced initial weight loss and maintenance 3 and 6 months later. In a later study, Epstein and colleagues (76) found no differences between groups when problem solving was added to parent and child behavioral counseling or child-only behavioral counseling after 6 months. However, at a 2-year follow-up, the BMI scores were significantly lower in parent/child problem-solving vs child-only problem-solving and no problem-solving groups.

Conclusion Statement. Limited evidence is currently available to support using behavioral counseling alone for reducing overweight in children or adolescents *(Evidence Grade III)*. There is sufficient evidence to routinely recommend the inclusion of a behavior component within a multicomponent, family-based group intervention along with dietary counseling, family counseling, and physical activity for reducing overweight in school-age children *(Evidence Grade I)*, but less evidence for adolescents *(Evidence Grade II)*.

Summary and Recommendations on Individual- and Family-Based Interventions

Figure 1 summarizes the recommendations for individual- and family-

Intervention type or component	Intervention recommendation
Individual-based intervention	Limited evidence to support routine recommendation
Family-based intervention	Multicomponent interventions should be routinely recommended
• Parent training	Recommended as part of a multicomponent program
• Individual psychotherapy	Lack of evidence to base any recommendation
• Dietary counseling/nutrition education	Recommended as part of a multicomponent program
• Altered macronutrient approaches	Limited evidence to support routine recommendation
• Physical activity	Recommended as part of a multicomponent program
• Sedentary behaviors	Recommended in conjunction with methods to increase physical activity within a multicomponent program
• Behavioral counseling	Recommended as part of a multicomponent program

Figure 1. Recommendations for individual- and family-based tertiary prevention of overweight in 5- to 12-year-old children.

based interventions for the tertiary prevention of overweight in children. Family-based group counseling interventions including a combination of dietary counseling, nutrition education, the promotion of physical activity, behavioral counseling, and family counseling can be used effectively in clinical settings to reduce pediatric overweight among children 5 to 12 years of age. Single-component programs have not been shown to be as effective or have not been studied adequately. More long-term randomized controlled trials should be conducted to determine the contribution of family-based group counseling in both preschool and adolescent children. In addition, more research is needed to evaluate the effectiveness of one-on-one counseling interventions. Long-term interventions designed for diverse populations are lacking in the literature; generalizability of tertiary prevention studies is limited by the fact that most studies are conducted on a convenience sample of self-selected, motivated participants who are primarily white middle-to-upper-class families.

In summary, individual- and family-based studies contained several common elements; most studies used a combination of dietary counseling, physical activity, and behavioral counseling. The inclusion of the family in counseling sessions improved both short- and long-term outcomes in school-age children 5 to 12 years of age. Currently there is a need for tailored, developmentally appropriate overweight interventions for adolescents and young children; however, there are limited data on which to recommend an effective approach.

SCHOOL-BASED INTERVENTIONS: PRIMARY AND SECONDARY PREVENTION STUDIES

Forty-four articles describing school-based interventions were reviewed. Of the 44, 37 described primary prevention studies; all students were included in the intervention and outcomes were measured on the entire population. Twenty-three of the primary prevention articles reported results from randomized controlled trials, and the remaining primary prevention studies (n=14) were of other design. The remaining seven school-based studies were secondary prevention, targeting high-risk students through the school setting (51,78,80-82,99,100). Although some of the components of the secondary prevention interventions may have been applied to the entire school, only the overweight children were specifically targeted and measured. For the school-based secondary prevention studies, only one was a randomized controlled trial, and the remaining were of other design.

Several of the articles reviewed for this analysis were outcomes of the same intervention study, most notably among the elementary school primary prevention, randomized controlled trial programs. Multiple-outcome articles were noted for the Child and Adolescent Trial for Cardiovascular Health (CATCH) (83-85); Sports, Play, and Recreation for Kids (86,87); Know Your Body in New York (88-91); Know Your Body in Washington, DC (92,93); Know Your Body in Crete (94,95); and the Zuni Diabetes Prevention Program (96,97). Because the results are similar for the multiple articles, for the primary prevention studies, the 23 randomized controlled trial articles will be counted as 16 separate studies and the 14 articles of other design will be counted as 12 separate studies, for a total of 28 separate primary prevention studies.

The school-based studies included studies in which overweight prevention was the primary research goal, as well as studies that targeted cardiovascular or diabetes prevention, but attempted to change weight status as well as diet and/or physical activity behaviors associated with overweight prevention. Of the school-based primary prevention programs reviewed, seven of the 16 randomized controlled trials targeted prevention of cardiovascular risk factors or general physical activity and healthful diet; the remaining nine targeted overweight prevention. Only three of the primary prevention studies of other design had a main outcome of pediatric overweight, whereas seven studies targeted cardiovascular disease prevention outcomes and two targeted diabetes prevention outcomes. All seven of the school-based secondary prevention programs targeted weight status as a main study outcome.

Significant decreases in some measure of adiposity were found in 12 of 28 primary prevention studies (five were plus-rated randomized controlled trials) and six of seven secondary prevention studies (one was a plus-rated randomized controlled trial), but the results were not consistent across all measures of weight status/adiposity. Thus, a study might have found significant changes in BMI, but only among female subjects, or significant changes in skinfold measurements, but not BMI.

The great majority of school-based

studies were conducted using elementary-age children (ages about 5 to 11 years), with 27 of the school-based studies beginning in children ages 5 to 11; five in middle school children, ages 12 to 14; and three in high school youth, ages 15 and above. No studies were identified that focused on preschool-age children. Because children vary in developmental levels across the grades, different intervention techniques may be more effective for different age groups (98). As a result, conclusion statements specify the relevant age range when applicable. As with tertiary prevention, no conclusion statements were made for preschool-age children because of a lack of any studies that met review criteria.

School-Based Secondary Prevention Studies

Only seven secondary prevention school-based studies were identified, five of which were multicomponent programs. Although all (two of which were rated plus and four of which were rated neutral) but one (which was rated neutral) showed significant effects on weight status/adiposity, only one was a randomized controlled trial, and in this study the schools involved were not thoroughly described (78). Although two were in US public schools, one was in a parochial school in the United States (99) and four were conducted outside of the United States in Taiwan (81), Japan (82), Finland (51), and Belgium (100), limiting generalizability to the public school system that most children in the United States attend. Assessment of stigmatization and the potential for adverse psychological/self-esteem effects on children who may be labeled as "fat kids" as a result of separating them from their peers for special treatment in school were not addressed in any of the studies.

Conclusion Statement. Limited evidence supports using a multicomponent school-based secondary prevention program to decrease overweight in elementary or secondary school students *(Evidence Grade III)*.

School-Based Primary Prevention Studies

Multicomponent Overweight Prevention Program. Multicomponent school-based programs were defined as interventions with multiple coordinated units that included both nutrition and physical activity components. Although many multicomponent programs have been implemented in schools, few were designed to identify the specific program components that are most effective at preventing weight gain or change in weight status. Of the 28 school-based primary prevention studies reviewed, the majority (n=23) described multicomponent school-based programs: 12 were randomized controlled trials, with nine of those rated as positive and three rated as neutral. Of the randomized controlled trials, one of the seven conducted in elementary school settings reported significant reductions in some measure of adiposity, whereas four of the five conducted in secondary school settings reported significant reductions in adiposity outcome. For trials of other design, all but one were multicomponent programs, with four of 10 of the elementary school programs and one of the two secondary school programs having significant effects on weight status/adiposity.

Of the multicomponent programs, one was rigorously evaluated in various settings and regions: the Know Your Body curriculum (88-95,101-104). The CATCH program (83-85) also had multiple articles describing outcomes. Although most of these studies were of strong design, the effect of these primary prevention studies on child overweight has been mixed, with most showing no significant effect on weight status. The most successful of these programs were the Know Your Body adaptations in Europe and Israel (94,95,101,103,104) and the Stanford Adolescent Heart Health program, a high school cardiovascular health program (105). Many of these studies, developed with funding from the National Heart, Lung, and Blood Institutes of the National Institutes of Health, were designed for prevention of cardiovascular risk factors, with prevention of overweight usually a secondary goal.

Conclusion Statement. There is fair evidence to support using a multicomponent school-based primary prevention program to effect changes in weight status/adiposity in elementary and particularly in secondary school students *(Evidence Grade II)*.

Behavioral Counseling. Behavior-based strategies include the use of theories of individual health behavior change, such as Social Cognitive Theory, the Transtheoretical Model, and the Theory of Reasoned Action. Constructs from these models are operationalized using different strategies, such as goal setting, use of role models, vicarious learning, and changing norms. Of the school-based primary prevention studies that were randomized controlled trials, 11 of 16 had a behavioral component; most used social cognitive theory. Six of the studies were conducted with elementary school populations, and five were implemented in secondary school settings. One of the elementary school studies and four of the middle or high school studies showed a decrease in some measure of adiposity. Over half of the prevention studies of other research design (n=7) used behavior-based strategies, and four had a significant impact on weight status/adiposity. Of those that found significant changes, three were conducted in elementary school and one in secondary school.

Conclusion Statement. There is fair evidence to support using behavioral counseling as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary and particularly in secondary school students *(Evidence Grade II)*.

Media Influences. One primary prevention study conducted in secondary schools addressed the awareness of weight-related media messages (106). Two prevention studies (107,108) limited television viewing time, which is one method of controlling media influences, and both studies were successful in changing weight status. Of these two studies, one was conducted in elementary school students (107) and the other was conducted in secondary school students (108). It may be that interventions to decrease television viewing work by either decreasing sedentary activity, or by decreasing media influences of food-related advertising, or both. None of the other studies specifically targeted different types of media (eg, Internet or print advertising, magazine articles). Thus, media influence as an individual factor in changes in weight

status/adiposity has not been well elucidated in the literature.

Conclusion Statement. Limited evidence is currently available to support limiting media influences as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary or secondary school students *(Evidence Grade III)*. More studies are needed in this area.

Nutrition Education. Nutrition education is defined as instruction focusing on knowledge of nutrient composition of foods, changes in dietary intake, and influencing food preferences. It can include, for example, messages advising lower fat content in the diet or recommending changes in dietary patterns such as encouraging breakfast consumption. Of the 16 primary prevention, randomized controlled trials reviewed, 12 reported using nutrition education and seven were conducted in elementary school settings. The content of the nutrition education lessons was not fully clarified in these studies, but many were focused on dietary habits linked to cardiovascular disease, such as lowering fat and saturated fat (83-85,88-93,99). Most of the nutrition education components were behaviorally based, as in the Know Your Body program (88-93), CATCH (83-85), and Planet Health (108). The majority of studies used Social Cognitive Theory (109), although some programs, such as the Middle School Physical Activity and Nutrition program (110), used social marketing techniques for the nutrition intervention. Nine of the 12 randomized controlled trials with nutrition education were rated plus, and three were rated neutral. Five of the randomized controlled trials with a nutrition education component had an effect on measures of adiposity, with four of the five randomized controlled trials in secondary school level studies reporting an effect on weight status/adiposity. All 12 trials of other design included nutrition education as the sole component or as one of many components. Six of these were rated neutral, five were rated plus, and one was rated minus. Seven of the studies of other design had no effect, and five showed significant results in some measure of body adiposity. The one study that used nutrition education without a physical activity intervention (111) had no significant results on weight status, but this study received a neutral rating.

Many of the studies that included nutrition education were well designed, and several of the studies found significant effects on adiposity, especially among secondary school students; however, the effects were not consistent across all studies. This may be in part because many of the studies included nutrition education as only one part of a multicomponent program. It is assumed that a coordinated school health model in which all components deliver the same message is synergistic and more effective (112,113). However, one major disadvantage of multicomponent school-based studies is that current designs make it difficult to evaluate which component of the program is most effective (eg, health education, physical education, nutrition, health services). In addition, virtually none of the studies furnished enough detail about the content or focus of the nutrition education program, so it is impossible to determine whether these interventions should focus on nutrient composition vs a change in food composition, or changes in eating behaviors and food patterns. Extent of the exposure of the nutrition education program also was not consistent across studies. Future research should incorporate designs in which individual components are evaluated separately as well as collectively. Furthermore, future studies should try to elucidate and compare the relative effectiveness of different nutrition education messages.

Conclusion Statement. There is fair evidence to support using nutrition education to change the type of food eaten, food preferences, or eating patterns as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary school and particularly in secondary school students *(Evidence Grade II)*.

School Food Environment. For school-based studies, the major food environment change involved targeting the availability of foods sold at school, through the cafeteria, in school stores, in vending machines, or as a la carte items. Changing the availability or types of foods in the school setting was targeted in several studies (83-85,96,95,114), but an intervention to determine how the types and availability of school meals alone affected weight status or adiposity has not been reported. Studies that have examined school food interventions have generally looked at nutrient intake as the major outcome (115-118), rather than changes in weight status. Of the 28 school-based primary prevention studies reviewed, nine included changes in the school food environment, and all of these were coupled with other intervention components. Six were randomized controlled trials, and three were studies of other design. Of the six randomized controlled trials, three were rated plus and three were rated neutral, with only two reporting a significant change in measures of adiposity. The two studies that reported changes in measures of adiposity were conducted in secondary schools. Among the three other trials, none showed an effect on weight status; however, two were studies of neutral rating.

Conclusion Statement. Limited evidence is currently available to support altering the school food environment as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary or secondary school students *(Evidence Grade III)*. More studies are needed in this area.

Physical Activity Education. A physical activity education component has been included in the majority of school-based primary prevention studies reviewed (26 of 28). Three evaluated a physical activity component only (86,87,119,120) and the remaining studies evaluated physical activity as part of a multicomponent program or with a dietary component. Fifteen of 16 randomized controlled trials included a physical activity component, and six of these showed significant decreases in some measure of adiposity. Of the three studies that evaluated physical activity only, two were rated plus and one was rated neutral; all were randomized controlled trials. The only one to show significant results on weight status was a study conducted in Australia in elementary school students, ages 10 to 12 (120). In this study, students in the intervention group received a total of 1 1/4 hours of physical activity per school day compared with three 1/2-hour periods of

physical activity per week in the control schools. Virtually all of the studies that targeted physical activity made environmental changes through physical education or other classes, as well as providing physical education knowledge and skills. Unfortunately, there is a paucity of research that indicates the optimum level of physical activity per day or week for significant effects on weight status or adiposity.

Conclusion Statement. There is fair evidence to support increasing physical activity dose or altering physical activity patterns as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary or secondary school students *(Evidence Grade II)*.

Physical Activity Environment. Most studies that targeted physical activity included changes in the environment as well, such as increasing physical activity opportunities at school, increasing time spent in physical activities, or restructuring physical education classes to provide more time spent in moderate-to-vigorous physical activity. Of the 15 primary prevention, randomized controlled trials that included physical activity as an intervention component, 12 linked an environmental component to the physical activity component. Of these 12, five found a decrease in some measure of adiposity. For studies of other design, six involved an environmental component; two of the six found a decrease in some measure of adiposity.

Conclusion Statement. There is fair evidence to support changing the physical activity environment as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary or secondary school students *(Evidence Grade II)*.

Sedentary Behaviors. Three primary prevention studies have been conducted that have targeted home television and video watching (79,107,108), two as part of a multicomponent program (79,108). All three studies were rated plus and resulted in decreases in BMI. In one of the studies, a television monitoring unit was used to control television and video time at home (107), and the other two focused on behavior-based messages to reduce television and video watching (79,108). The results from these studies are promising, but need to be replicated in more diverse populations and more studies. No studies were identified that addressed reduction in other sedentary behaviors, such as homework, reading, and/or computer use, as a prevention strategy for reduction of overweight in children.

Conclusion Statement. There is fair evidence to support decreasing television/video watching as part of a school-based primary prevention program to effect changes in weight status in elementary or secondary school students *(Evidence Grade II)*. Studies are not available to assess the degree to which altering other sedentary behaviors such as homework, reading, or computer use is associated with changes in weight status/adiposity in elementary and secondary school settings *(Evidence Grade V)*.

Parent/Family Involvement. Several school-based studies included a parent/family component. Of the 11 elementary school randomized controlled trials, five included a parent/family component, and only one of those found significant effects on weight status. Two of the five secondary school interventions included a parent/family component, and one of those reported a significant decrease in weight status/adiposity. For studies of other design, nine of the 10 elementary school primary prevention programs and both secondary school programs included parent/family components; of these studies, four of the elementary school studies and one of the secondary school studies found significant effects on weight status/adiposity. For most of the parent/family components of the interventions, specifics of the intervention were not described, so it is difficult to identify the effective elements of the intervention. Likewise, it is difficult to determine the extent to which parent/family involvement was actually achieved.

Conclusion Statement. There is fair evidence to support the use of a parental component as part of a school-based primary prevention program to effect changes in weight status/adiposity in elementary or secondary school students *(Evidence Grade II)*.

Delivery of Program: Personnel. School-based programs can be delivered by: a) trained personnel who are not normally involved in instruction, such as dietetics professionals or researchers; b) teachers and school staff who are trained to implement program elements that are not usually included in schools; or c) a combination (teachers/school staff plus trained personnel). For the school-based prevention, randomized controlled trial studies, two were conducted by trained personnel other than teachers and an additional three were conducted by a combination of trained personnel and teachers. Of these five studies, three found significant changes in adiposity and two of the three received a plus rating. For the remaining 11 randomized controlled trials that were administered by teachers and/or school staff, four found significant reductions in some measure of adiposity. Of the studies of other design, seven were administered by trained personnel or teachers plus additional personnel and three of the seven found significant changes in adiposity measures. However, none of the studies were designed specifically to compare delivery of the program.

Conclusion Statement. No studies have been conducted to compare the efficacy of conducting intervention trials with teachers vs trained intervention specialists, and therefore no conclusion can be made at this time *(Evidence Grade V)*.

Delivery of Program: Length of Time of Intervention/Maintenance of Results. Of the seven school-based, randomized controlled trial, primary prevention studies that showed significant results, three were 1 year or less, three were 2 years long, and one was 14 weeks with a 2-year follow-up period. Among the elementary school primary prevention, randomized controlled trial studies that found significant results (n=3), all three reported results from 1 year or less of intervention; among secondary school primary prevention, randomized controlled trials that showed significant results, duration ranged from 7 weeks in one study to 2 years in the remaining three studies. For the five studies of other design that reported significant decreases in weight status, all were 1 to 3 years in duration. No studies evaluated the impact of length of intervention on change in adiposity. In addition, only two studies (84,120) examined long-term follow-up results (3 and 2 years postintervention, respectively) from any of the programs.

Conclusion Statement. Because no studies have been designed that specifically targeted length of intervention as a study outcome, no conclusion can be made at this time *(Evidence Grade V)*.

Delivery of Program: Grade Level. Of the 28 primary prevention school-based studies reviewed (both randomized controlled trial and other studies), 21 were conducted in elementary schools (age 12 or younger), and seven were conducted in middle or high schools. A total of seven of the elementary school studies (33%) had some effect on measures of adiposity, whereas five (71%) of the prevention studies conducted in secondary schools reduced adiposity. It is not surprising that interventions are twice as likely to be successful at higher grade levels, with their increased snack food and beverage offerings and less frequent physical activity classes. Studies in preschool settings were notably lacking.

Conclusion Statement. Although no studies have been identified that specifically compared intervention efficacy as function of grade level, evidence suggests that prevention efforts are more likely to be successful at the secondary level; however, successful interventions can be found in primary school settings as well *(Evidence Grade II)*. Evidence is lacking for preschool settings *(Evidence Grade V)*.

Delivery of Program: Individual vs Multicomponent. Although all of the multicomponent programs included physical activity components, only three of the primary prevention studies evaluated the effects of increasing physical activity in the school setting without other components (86,87,119,120). Only one study targeted dietary behaviors or eating patterns as a single program component (111). Most school-based population and high-risk approach programs included a parental component, but no program focused solely on parental or peer modeling or media influences as intervention techniques. Eighteen of the studies included some physical activity environmental change (ie, change or addition of physical education class), and nine included some school nutrition environmental change (ie, changing the nutrient content or availability of food in the cafeteria); however, none of the studies were designed specifically to target these components. Thus, it is not possible to assume effectiveness of any one individual intervention component without further research.

Conclusion Statement. Because no studies have been designed that specifically compared individual intervention components, coordinated multicomponent interventions are recommended *(Evidence Grade III)*. Studies designed to test the relative efficacy of individual intervention components are needed.

Summary and Recommendations on Primary and Secondary School-Based Interventions

In summary, a large number of school-based primary prevention programs to prevent overweight in children have been conducted and evaluated, about half of those with strong designs showing a positive impact on some measure of adiposity. This percentage is of particular interest because unlike in treatment programs, success is not measured solely in highly motivated persons who volunteer to participate. Although logistical problems in implementation of interventions in secondary schools have been noted (121), which may account for the limited number of studies conducted in the secondary school setting, a greater percentage of prevention studies in secondary schools as compared with elementary schools reported effects on reduction of adiposity (71% vs 33%). Interestingly, many of the school-based interventions have been effective in changing behaviors (diet and physical activity), which would be expected over time to result in positive health effects beyond just weight. Some of the nonsignificant findings may be attributable to the relatively low prevalence of overweight in populations at the time the studies were conducted or inadequate dose or length of intervention. A critical area for further research is to replicate the more successful programs using study designs that allow for identification of the components that contribute most to program impact. Research is also needed to determine the optimal dose and duration of intervention, the most effective mode of delivery, and how program components should be tailored to meet the needs of various age, cultural, and socioeconomic groups.

School-based secondary prevention trials, although far fewer in number, have been as effective as (and at times more effective than) school-based primary prevention studies. There are two reasons, however, why this approach may be contraindicated. First, the most recent National Health and Nutrition Examination Survey (1999-2002) shows continually increasing rates of overweight impacting a greater proportion of the population, thus making a school-wide approach well suited for population-based programs for children. Further, pull-out programs for overweight students make children vulnerable to teasing, body dissatisfaction, and embarrassment. Children who participate in these programs may be stigmatized because of their size or the perception that they are participating in a "fat farm" program. To prevent this stigmatization, it is essential to frame the treatment or secondary prevention program within a primary prevention program, in which the school environment and health education promote healthful dietary and exercise habits that are beneficial for the child who is of normal size, as well as for the child who is overweight (80,122). Another method of approaching this issue is to conduct a population-based program, but to base the outcome on analysis of changes in adiposity of the high-risk population only (79).

Recommendations for school-based interventions are summarized in Figure 2.

COMMUNITY-BASED INTERVENTIONS: PRIMARY PREVENTION

Community, and likewise community-based interventions, can be defined in numerous ways. For example, programs conducted in community-based organizations [eg, social clubs such as scout troops (123); after-school programs at community centers, Young Men's Christian Associations, or commercial fitness facilities (124,125); and government agencies such as the Special Supplemental Nutrition Program for Women, Infants, and Children and Head Start programs (126)] are often referred to as community-based interventions. In nearly all cases reviewed, however, such interventions did not include an outcome measure of adiposity in youth. One exception was the study

Intervention type or component	Intervention recommendation
Secondary prevention intervention	Limited evidence to support routine recommendation
Primary prevention intervention	Multicomponent prevention interventions recommended
• Behavioral counseling	Recommended as part of a multicomponent program
• Nutrition education	Recommended as part of a multicomponent program
• Physical activity education	Recommended as part of a multicomponent program
• Physical activity environment changes	Recommended as part of a multicomponent program
• Parental/family involvement	Recommended as part of a multicomponent program
• Media influences	Limited evidence to support routine recommendation, but promising area for future research
• Food environment changes	Limited evidence to support routine recommendation, but promising area for future research
• Sedentary behaviors	Recommended to decrease TV/video watching as part of a multi-component program
• Homework/reading/computer use	Lack of evidence to base any recommendation
• Delivery of program	Lack of evidence to base any recommendation
• Length of program	Lack of evidence to base any recommendation
• Grade level	Recommend secondary and elementary school settings
• Individual vs multicomponent	Recommend coordinated multicomponent interventions

Figure 2. Recommendations for school-based primary and secondary prevention of child and adolescent overweight.

by Resnicow and colleagues (127), in which low-income girls were recruited from public housing facilities. Because this program was administered to individuals in a small-group format rather than on a community-wide basis, this study was reviewed in the section on family- and individual-based interventions along with other studies of similar design. School-based interventions involving parents and other adults also have been referred to by some as community-based. However, because schools were the primary vehicle of such interventions, those that included adiposity measures were included in the section on school-based interventions.

For the purposes of this review, a community-based intervention was defined as an intervention to prevent overweight that was implemented within one or more community groups (ad hoc or formal), that promoted change through policy, social marketing, and/or environmental change, and that targeted members of certain groups or community members at large (excluding schools). Explicitly, only those interventions that facilitated outreach to populations with emphasis on structural change beyond the level of the individual were considered community-based. Several comprehensive community interventions that fit this designation have aimed to improve a spectrum of diet and physical activity behaviors. However, the majority of those completed to date were designed to reduce cardiovascular or diabetes disease risk rather than risk of overweight per se, and have focused on adults rather than children or adolescents. Notable examples in the United States and Canada include the Heart to Heart Project (128), the Minnesota Heart Health Program (129,130), the Pawtucket Heart Health Program (131), the Salud para su Corazon (Health for Your Heart) project (132), the Sandy Lake Health and Diabetes Project (133), the Stanford Five-City Project (134), and the Stanford Three-Community Study (135). Several other community-based studies that have recently been completed or are currently underway have not included adiposity measures. Examples include CardioVision 2002, a comprehensive intervention in the community of Olmsted County, MN (136); the five-state overweight intervention program, FitWIC, designed for children participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (137); and Hearts N' Parks, a national program supported by the National Heart, Lung, and Blood Institute and the National Recreation and Park Association (138). For additional information on these and other similar interventions, the reader is referred to several thorough reviews: the Institute of Medicine Report on the influence of food marketing on children (139); King (140) for a review of interventions to improve physical activity; Yancey and colleagues (141) for a review of interventions targeting communities of color; Pate and colleagues (142) for a review of interventions involving youth; and Alcalay and Bell (143) for a review of social marketing campaigns.

Although the above interventions provide evidence showing that community-based interventions are feasible and can potentially alter some aspects of healthful eating and physical activity behaviors, only one was identified that involved an outcome measure related to adiposity, and this was assessed only in adults. The Heart to Heart Project, conducted from 1986 through 1990 in Florence, SC, targeted reduction of cardiovascular disease risk and involved a total of nearly 600 community elements (eg, walkathons, social marketing, restaurant food labeling, and cooking seminars). In addition to a favorable intervention effect on blood cholesterol, the prevalence of overweight increased by only 0.3% between baseline and follow-up in a random sample of approximately 1,100 intervention adults, compared with a 3.2% increase in an equal number of comparison adults, a difference that was statistically significant ($P=0.0002$) (128).

Several community-based interventions aimed at youth that include a measure of adiposity are currently planned or in progress. For example, the Kahnawake Schools Diabetes Prevention Project, an 8-year intervention that targets a small community of approximately 7,000 Mohawk people near Montreal, Canada, is underway. Although a school-based health education curriculum for 6- to

12-year-old children is the centerpiece of the program, a variety of complementary community-based activities have also been incorporated, including healthful food preparation contests, healthful food tastings, sale of traditional foods and recipe books, creation of a recreation path, and the promotion of a wide array of physical activity events, programs, and clubs (144). An intervention that will target the home as well as the larger environment (eg, schools, grocery stores, parks, restaurants) of Latino school-age children in South San Diego County, CA, is also underway (145).

An innovative 4-year community intervention, the Healthy Eating Active Communities program, began in 2005 in six diverse California communities (146). Program grantees will be intervening in the following sectors: schools, after-school programs, neighborhood environments, and health care systems. Interventions will also address marketing and advertising in each community. Several additional projects are currently being piloted: one organizes school and community coalitions to facilitate environmental changes that will increase walking and biking to school among youth in Chapel Hill, NC (147); another targets preschool children in the child-care setting and involves social marketing and collaboration with community organizations and food establishments in a rural New York community (148). Numerous children and weight community coalitions throughout the country are also implementing community-wide nutrition and physical activity changes (149). Unfortunately, final outcome data of these many interventions are not yet available. In addition, many new national and state-level policies have been passed that address child and adolescent overweight, but there are virtually no data on the effects of these mandates on the overweight status of children in the community.

Therefore, presently there is insufficient evidence to evaluate a community-based intervention approach to modifying the weight status of children. Considering the extent of obesity among the population, a community approach is conceptually appealing in that its benefits have the potential to reach a much larger portion of the population than might be reached through individual health behavior change programs. Furthermore, health-related behaviors of individuals have been shown to be amendable by community approaches such as systematic environmental changes and comprehensive social marketing. Clearly, community-based interventions must be developed and their efficacy evaluated for overweight prevention.

Conclusion Statement. Presently there are no published studies identified that establish a relationship between community-based interventions and the weight status of children. Additional trials that include adiposity outcomes in children are necessary and justified. Inasmuch as community-based trials can be effective in altering diet and physical activity behaviors and may be the only way to reach substantial numbers of children, community-based overweight prevention efforts are recommended *(Evidence Grade IV)*.

RECOMMENDATIONS FOR INTERVENTION

Research studies on interventions with overweight children and adolescents are not easily categorized and compared because of the complexity of the causes of overweight, the variety of substantive approaches, and diverse research methodologies. Current literature can provide general guidelines for developing programs. However, the evidence-based analysis of the literature to date points to the need for further investigation; many strategies that seem to be promising have not yet been adequately evaluated. Childhood overweight is a growing national problem; systematic research on its treatment and prevention is a crucial area and a relatively new field for which increased funding is recommended.

For recommendations to be based on the most up-do-date literature, using the evidence-based approach to ADA position papers necessitates dividing broad and complex topics such as pediatric overweight into manageable-sized sections. The focus of this position statement was pediatric overweight intervention programs. Observational studies that examined associations between lifestyle factors and adiposity were beyond the scope of this analysis. Also not included were pediatric interventions that did not include an outcome measure of adiposity. Further, outcome measures such as self-esteem, body image, eating disorders, parenting practices, and metabolic measures were not part of the present analysis. Finally, because very few published trials involving youth were available at the time this review was initiated, surgical and pharmacological trials also were not included. These limitations do not imply that other outcome measures besides adiposity, other study designs besides intervention trials, or other intervention strategies besides the ones considered herein are not important to furthering our understanding of the etiology and prevention of pediatric overweight. ADA is committed to supporting evidence-based analyses of other relevant topics, and as resources permit and results from new studies are published, additional papers and practice guides will be forthcoming.

This evidence-based analysis of nearly 100 recent and ongoing interventions to prevent overweight shows surprisingly large gaps in the literature. In particular, with the exception of school-based studies, there is a paucity of data on community programs and policies that will impact the greatest numbers and potentially improve health behaviors for all children, including those currently overweight and at high risk. Because an increasing proportion of the population is overweight or at risk for overweight, community-wide intervention strategies are the most feasible way to reach the largest populations.

Based on our systematic review of programs, additional research is recommended for:

- individual-based interventions;
- identification of the most effective components of interventions;
- optimal dose and duration of interventions;
- promising components for which little research is currently available (eg, school media influences, school food environment);
- community-based programs, including studies of the impact of changes in the built environment, marketing, and policy on children's eating and physical activity patterns;
- popular weight-loss programs available in commercial settings;

- intervention studies in ethnically diverse populations;
- intervention programs with adolescents;
- prevention programs with preschool-age children;
- long-term effects of intervention programs;
- reviews of overweight prevention programs with outcomes other than adiposity (ie, behavioral, psychological, and medical outcomes);
- development of effective assessment tools and intervention materials for use by practitioners; and
- comparisons of costs and cost-benefit analyses of intervention programs.

In summary, although it is appropriate that not all children will fall within a normal weight range, overweight is a significant nutritional problem for many children and adolescents in the United States. This review clearly points to the benefit of providing multicomponent interventions for families when children are young (5 to 12 years old) and to the benefit of providing school-based multicomponent interventions when youth are older (ie, in secondary schools). However, school-based interventions at all grade levels have shown effectiveness in changing student knowledge, attitudes, and behaviors around food and activity, and these positive efforts should be encouraged. To support and enhance the efficacy of family and school-based interventions, community-wide interventions are recommended. Although community programs are limited and have not been evaluated, they have the potential to reach the greatest numbers of people. Resources must be committed to support policies, programs, and research for the promotion of healthful eating habits and increased physical activity in children and adolescents of all ages and body weights.

ROLES AND RESPONSIBILITIES OF DIETETICS PROFESSIONALS

In a landmark report, the Institute of Medicine recently emphasized that the prevention of childhood overweight is a national priority and that health care professionals are critical in addressing and ameliorating the obesity epidemic (150). With increasing attention being given to pediatric overweight, dietetics professionals in particular are and should continue to be increasingly involved in intervention efforts. The literature reviewed here highlights the importance of multicomponent overweight interventions that address both diet and physical activity among school-age children. Although it is tempting to compare the efficacy of tertiary/secondary with primary prevention efforts, dietetics professionals must recognize that this can be done only with caution. It is reasonable to expect a greater impact over a shorter period of time on weight status/adiposity among self-selected highly motivated groups than among a population sample, regardless of the nature of the intervention. Therefore, it is not surprising that a greater proportion of tertiary prevention trials, which generally involve volunteers motivated to make behavior changes to alter weight status, would have a higher rate of success in altering weight status than the general population measured in primary prevention trials. In this light, changes resulting from school-based and larger community-based primary prevention interventions in children's attitudes, knowledge, and behaviors around diet and physical activity may be considered positive even in the absence of short-term change in weight outcomes.

It must be further emphasized that body weight is but one rather imprecise surrogate measure of health. Positive changes in dietary intake and/or nutrient status and physical activity will improve health even in the absence of changes in body fatness. Overreliance on measures of weight can put an emphasis on changing our children's bodies rather than changing their food and activity behaviors. Recent increases in disordered eating are believed to be in part caused by youth trying to control their weight at the expense of other health behaviors. Although this review focuses on weight outcomes as a marker for health risks associated with overweight, it is critical that dietetics professionals communicate behavioral, psychosocial, and medical end points to their colleagues and clients:

- dietary intake/nutritional status;
- physical and sedentary activity levels;
- self-esteem, body image, and other psychological markers of health;
- blood pressure;
- blood lipids; and
- blood glucose concentration.

These targeted health-related outcomes must be included in more pediatric obesity research. They are concrete, actionable outcomes appropriate for behavioral interventions in clinical, school, and community settings.

Dietetics professionals are critically positioned to promote healthful behaviors in children who are overweight, at risk for overweight, and not overweight. Recommendations from this review include family-based, multicomponent programs and behaviorally based, multicomponent programs in the school-wide setting with a parent/family component for younger children. More research is needed on overweight prevention programs for young children, adolescents, and ethnically diverse populations. Furthermore, research is critically needed on community-wide overweight intervention strategies. In the end, families, schools, and the community should work in a coordinated way to support consistent messages and healthful environments for our nation's youth. ADA urges society to commit resources to support research programs and policies to prevent obesity through the promotion of healthful eating and physically active lifestyles for children regardless of age, sex, ethnicity, and body size.

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