 Obesity Prevention

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WHY PREVENTION?

Obesity has become one of the most important public health problems facing both developed and developing countries throughout the world (1). Recent surveys suggest a rapidly increasing rate of obesity among children and adolescents (1,2). In the United States, more than 50% of adults are overweight, defined as a body mass index (BMI) of 25 or greater (3). Therefore at least half of American children can already be considered at risk of future overweight and its associated morbidities. However, known risk factors—such as child overweight, parental overweight, parental morbidity, and the timing of the adiposity rebound—are not sufficiently sensitive or specific to identify which children will go on to develop obesity-related clinical complications, persistent obesity into adulthood, or adult-onset obesity (4).

There is also evidence of substantial undetected obesity-associated morbidity in children. Data from the Bogalusa (Louisiana, USA) Heart Study suggest that about 60% of overweight children already manifest at least one additional physiologic cardiovascular disease risk factor—hypertension, hyperlipidemia, or hyperinsulinemia (5)—and are at increased risk of early atherosclerotic lesions in the aorta and coronary arteries (6). Finally, although some intensive behavioral obesity treatment programs have shown long-term success in up to one-third of obese children (7), most available treatments have produced disappointing long-term results, including some significant adverse effects (7–9), and we are unable to identify accurately which children are most likely to benefit from treatment (4). Adult treatment results have generally been even more disappointing (10). Therefore a population-based prevention approach—one that targets the entire population of children and adolescents—is likely to hold the greatest promise in addressing the current worldwide epidemic of obesity.

PREVENTION APPROACHES

In theory, obesity prevention may be achieved by any intervention that results in a balance between energy intake and energy expenditure. Of course there are many
possible ways to achieve such a goal. Examples of some different approaches are included in Fig. 1. Simple thermodynamics would suggest that only small changes in diet or activity levels are needed to achieve a balance for most children. For example, if all else is held constant, adding or subtracting a single small 10 kcal piece of hard candy in the diet every day would result in a weight difference of approximately ±1 lb (about 0.5 kg) over the course of a year. Similarly, a single 12 oz (355 ml) soft drink usually contains about 150 kcal, or the equivalent of about 15 lb (7 kg) when consumed daily over the course of a year. Thus prevention programs should only need to promote small shifts in behavior to produce substantial effects on the prevalence of obesity in the population. Despite this, however, producing sufficient behavior changes to prevent excessive weight gain has proven to be a formidable challenge. Many questions remain over how and where to deliver prevention programs to maximize their effectiveness. The three main venues suggested for childhood obesity

**FIG. 1.** Examples of potential targets for child and adolescent obesity prevention (nonexhaustive).
primary care clinical settings, community settings, and schools.

**PRIMARY CARE–BASED PREVENTION PROGRAMS**

Primary care settings include primary care physicians' offices, public health clinics, public hospitals, and school-based clinics. Primary care–based assessment and counseling about obesity, nutrition, and physical activity have been widely endorsed (11). Because primary care encounters provide attractive opportunities for such counseling, recent interest has increased in designing and implementing clinical preventive interventions. However, research is lacking on the current prevalence and efficacy of diet and activity counseling for preventing obesity in children and adolescents. Data from other areas of prevention suggest that primary care clinicians often do not provide the recommended preventive services. Identified barriers include inadequate reimbursement, insufficient time, lack of clinical skills, lack of clinician or patient interest, uncertainty or doubt about efficacy, and lack of organizational or medical care system support to facilitate the delivery of preventive care (12). In addition, primary care encounters may not be of sufficient duration and frequency to deliver an adequate “dose” of an intervention to produce sustained changes in behavior.

One recent example of a primary care intervention is the patient-centered assessment and counseling for exercise plus nutrition (PACE+) project from San Diego State University, California (Patrick K, Sallis JF, personal communication). This project was designed to address many of the previously identified barriers to improving primary care–based preventive counseling about diet and physical activity for adolescents. It uses an interactive computer-based assessment, primary care provider counseling at the time of the medical visit, and extended follow-up phone and mail counseling from nonclinician staff. The preliminary evaluation of PACE+ suggested the feasibility of this approach in several primary care offices. However, the efficacy of the approach is still unknown because it has not yet been tested against a control group.

Although the existing research does not yet support the efficacy of primary care interventions for preventing obesity, it may be possible to suggest appropriate strategies for preventive counseling based on research from other settings. Effective behavioral interventions for children have generally included the following: frequent counseling over a prolonged period, including parents in the process; simple and explicit behavioral targets (e.g., targeting single foods or types of food, physical activities, and sedentary behaviors that are easy to identify, count, and track over time); short- and long-term self-monitoring; goal setting and contracting with appropriate rewards; providing children with some input and choice regarding their targeted behaviors; altering the home and family environment to support the child's changes (e.g., removing targeted foods from the home, decreasing eating out, instituting family walks every morning or after dinner); strategies for dealing with lapses; and training of parents in basic parenting skills to promote and reward their children's behavior change (13).
COMMUNITY-BASED PREVENTION PROGRAMS

Community settings—such as churches, community centers, parks and recreation programs, and after-school and weekend athletic leagues—have also been receiving increased interest as potential venues for obesity prevention programs. As with primary care-based programs, however, research is lacking on what types of program are effective in these settings. One of the few examples of a community-based program that has been evaluated was a 12-week, culturally specific obesity prevention program for low-income African-American mothers and daughters living in public housing. However, while the intervention resulted in statistically significant improvements in mothers’ self-reported diets, daughters’ self-reported behaviors changed “only minimally” and there were no significant changes in body weight (14).

We have recently started a randomized controlled pilot study of a community-based intervention for 8- to 10-year-old African-American girls. In this pilot study we are comparing two 12-week interventions: (a) a traditional health education intervention promoting a low-fat diet and increased physical activity, through monthly community meetings and weekly newsletters for girls and their parents; and (b) after-school dance classes at community centers and a family-based intervention to reduce television viewing. The goal of the dance and television reduction intervention is to provide activities that increase activity and decrease sedentary behavior sufficiently to produce meaningful changes in energy balance and adiposity. In this project we are also working with three other sites across the United States, each with its own interventions, to test a variety of approaches to community-based obesity prevention for African-American girls. Despite the recent interest in community-based programs, there are as yet few data to support the feasibility and efficacy of these approaches.

SCHOOL-BASED PREVENTION PROGRAMS

The vast majority of prevention programs have been implemented in schools, mainly because “that’s where the kids are.” In addition to providing a captive audience of children, however, many schools already include some form of health education and physical education in their standard curriculum, and provide meals or snacks during the school day, making them particularly appropriate settings for obesity prevention programs. Schools can also be a convenient avenue through which to reach parents, so as to try to influence the home environments of children.

To examine the overall efficacy of school-based obesity prevention programs we can look to the cardiovascular disease prevention literature. In a recent review, Resnicow and Robinson identified 19 controlled, school-based studies that were published from 1980 to 1997, assessed at least one major physiologic risk factor for cardiovascular disease (e.g., adiposity, blood lipids, blood pressure), and intervened on at least two different behaviors (e.g., physical activity and diet) (15). Of the 19 studies identified, 12 were from the United States, two were from Australia, and one each was from Greece, Russia, Israel, Finland, and Norway. Three intervened solely in either physical education classes or school lunch. When results were pooled across
studies, there were varying success rates according to the targeted outcome. Across these 19 studies, there were statistically significant improvements in 80% of the smoking outcomes reported, 36% of the physical fitness outcomes, 34% of the diet outcomes, 31% of the blood lipid outcomes, 30% of the physical activity outcomes, 18% of the blood pressure outcomes, and only 16% of the adiposity outcomes (15). In other words, the success of school-based obesity prevention programs has been relatively modest. Although adiposity was not the primary outcome of most of these studies, it appears that obesity may be a more difficult problem to prevent than smoking and other risk factors. This is an important observation to acknowledge, because ineffective strategies should be avoided in the rush to provide prevention programs to address the obesity epidemic. However, those programs that have proven successful in the past—such as those reviewed below—can serve as useful models for the development of more effective future programs.

**Classroom Curriculum Interventions**

Most school-based prevention programs have included a classroom curriculum designed to help children and adolescents make more healthful diet and activity choices, and ultimately prevent obesity (15–17). Although many of these curricula have resulted in increased knowledge and improved attitudes about healthful behaviors, and many have successfully affected self-reported diet and activity behaviors, they have generally not been successful in reducing adiposity (15,17).

One exception to this was the Stanford Adolescent Heart Health program (18,19). This study involved all tenth graders in four high schools from two ethnically diverse school districts near San Jose, California. Within each district one school was randomly assigned to receive a 20-session cardiovascular disease risk reduction intervention (targeting smoking prevention/cessation, adoption of a low-fat diet, increased aerobic physical activity, and stress reduction) and the other school served as a control. The intervention was based on social cognitive theory (20) and social inoculation theory (21). Two months after the end of the intervention, the treatment group showed significant increases in regular aerobic activity and heart-healthy food choices, and significant reductions in experimental cigarette smoking, resting heart rate, body mass index (BMI), and triceps and subscapular skinfold thickness measurements compared with controls (19). What appears to differentiate this program from most other classroom-based programs is that it was conceived from the start as a "behavior change" intervention instead of a "health education" intervention. It was not designed by health education or nutrition education curriculum writers; instead, it was designed by behavioral scientists and physicians, and was strongly based in theory.

One of the major challenges in classroom curriculum interventions has been providing a sufficient "dose" of the intervention. School curricula are already crowded, and suggestions to squeeze in an additional 15 to 20 hours or more of new content are often met with resistance by teachers and administrators. A recent study attempted to address this by integrating its intervention content into existing major subject areas.
and physical education courses that were already being taught in the standard middle school curriculum. In a 10-school randomized controlled trial, Gortmaker and colleagues examined the effects of their intervention for sixth to eighth grade (11- to 13-year-old) children in Boston, Massachusetts (22). The 2-year intervention focused on decreasing television viewing as well as decreasing high-fat food intake, increasing fruit and vegetable intake, and increasing moderate and vigorous physical activity. Over the course of the study, boys and girls in the intervention schools reported reducing their television viewing more than controls, and girls in the intervention schools reported increasing their fruit and vegetable intakes more, and increasing their total energy intakes less, than girls in the control schools. The prevalence of obesity (defined by age- and sex-specific thresholds, using a combination of both BMI and triceps skinfold thickness) decreased significantly among intervention girls compared with control girls, but there were no significant effects on the prevalence of obesity among boys. There were also no effects on the entire sample distributions of BMI or triceps skinfold thickness. However, this study suggests that the integrated, interdisciplinary curriculum approach may be a useful strategy for increasing the intervention “dose” in school-based obesity prevention programs.

Classroom curriculum interventions generally attempt to create perceived incentive value for behavior change, alter social norms to favor healthful behaviors, teach skills to facilitate behavior change, and enhance self-efficacy for specific changes in behavior (19). As such, they require active individual behavior change. Another strategy has been to try to alter the school environment to promote behavior change passively. The two main environmental approaches have been changing the content of school meals and altering physical education.

School Food Service Interventions

Because many schools serve breakfast, lunch, and/or snacks to students during the school day, the content of school meals has been an attractive target for prevention programs. In fact, several interventions have successfully changed the content of school meals. These studies show that changes in the school food service can passively influence children’s consumption of fat while at school (23–27). To date, however, these interventions have failed to show any beneficial effects on body fatness.

Physical Education Interventions

Physical education (PE) classes have been another environmental target for school-based obesity prevention efforts. Studies in the United States suggest that many standard PE classes may average as little as 10 minutes of moderate to vigorous physical activity a week (28,29). Alterations to standard PE have been somewhat effective at improving physical activity and fitness levels (26,30–32) but have not produced changes in adiposity (15). In contrast, the few PE interventions shown to have had significant effects on body fatness have made more radical changes to PE content itself. For example, in the Adelaide Heart Study in Australia, lengthening the standard
30-minute, 3-days-a-week PE to 75 minutes, 5 days a week did not improve fitness or reduce adiposity significantly. However, substituting endurance training for 75 minutes a day, 5 days a week produced significant improvements in cardiorespiratory fitness and decreased skinfold thickness measurements (33). Similarly, in our Dance for Health study—a small, randomized controlled pilot study—low-income Latino and African-American seventh-grade (12-year-old) children in northern California were randomized to either a hip-hop dance class or their usual physical education, for 40 to 50 minutes, 3 days a week. At the end of the 12-week intervention there were no significant differences between groups among the boys. However, the girls in the Dance for Health classes reduced their BMI and resting heart rates significantly compared with girls in regular PE classes (34). The main difference between these two successful PE interventions and most others appears to be the change in the content of the physical education lessons themselves. Traditional physical education activities may not lend themselves as well to the increases in intensity and duration required to prevent obesity. Compared with the traditional PE content, activities like dance and competitive sports may be more motivating for children.

"INDIRECT" INTERVENTIONS: REDUCING TELEVISION VIEWING

Most obesity prevention strategies have made a direct attempt to increase physical activity and improve the diet (Fig. 1). However, there has been recent interest in exploring other behavioral targets as well, particularly those that may indirectly influence physical activity levels and dietary intake. Examples are as varied as adding sidewalks to neighborhoods and building housing around local shopping areas to facilitate walking; slowing the speeds of elevators or escalators; enhancing stairwells with music and art (Dietz WH, personal communication); and taxing junk food (35).

Another target has been sedentary behavior, and television viewing in particular. Although all sedentary behaviors may displace more active behaviors with greater energy expenditures, television viewing may also influence energy intake through eating while watching, and through the effects of food advertising on food preferences and diets (36,37). To test the causal nature of the television and obesity link, and to examine the potential benefits of reducing children’s television viewing in preventing obesity, we performed a small randomized controlled trial (37). It involved all third- and fourth-grade (8- to 10-year-old) children in two public elementary schools in San Jose, California. The schools were selected by school district personnel to be sociodemographically and scholastically comparable. One school was randomly selected to receive an 18-lesson social cognitive theory-based intervention to decrease television, videotape, and video game use, without specifically promoting other behaviors, to isolate the effects of reduced media use alone. The lessons were taught by the regular classroom teachers as part of their standard curriculum. The other school served as an assessments-only control. Assessments took place in the autumn and spring of a single school year. Over the course of the school year, children in the treatment group reported reducing their television, videotape, and video game use by about 8 hours a week, or about one third more than the controls. In addition,
the intervention resulted in substantial and statistically significant relative reductions in body fatness. Over the course of the 7-month study, the children in the intervention school gained an average of 0.45 kg/m² less in BMI than the controls, the equivalent of nearly 2 lb (around 1 kg) less for a child of average height in the sample, an average of about 1.5 mm less in triceps skinfold thickness, and nearly 1 inch (2.3 cm) less in waist circumference. These results show that television viewing is a cause of increased adiposity in children and that reducing television viewing is a promising approach for obesity prevention—particularly because of the large changes seen in adiposity, larger than most interventions directly targeting physical activity and diet changes. These conclusions are also consistent with results from the Planet Health Study, in which reductions in television viewing were associated with changes in obesity (22), and from experimental studies of reducing sedentary behavior as part of weight control treatment for obese children (38,39).

CONCLUSIONS AND FUTURE DIRECTIONS

Dramatic increases in obesity have resulted in a rush to develop and disseminate obesity prevention programs. Facing a worldwide obesity epidemic, it will be difficult for medical and public health professionals to resist the urge to respond with traditional health and nutrition education interventions. Unfortunately, as illustrated previously, health status will suffer as a result. Instead, the successes and failures of past interventions should be used to help guide the development of more effective future programs. Based on the research to date, are there characteristics that help to define successful interventions?

Although sufficient detail about interventions is often lacking from published reports, it appears that the most successful interventions are those that are most strongly based in theories of behavior change. Faithful application of theory has been one of the major challenges in this field. The real-world concerns of primary care practices, community organizations, and schools present formidable obstacles to designing and implementing theoretically sound interventions that are also feasible. For example, classroom teachers may be more focused on teaching their students “facts” about diet and physical activity—things that can be assessed on a multiple-choice test—than providing opportunities for children to invent and practice strategies to overcome barriers to consuming low-fat foods and increasing physical activity. Primary care providers may not have sufficient training and may not believe they have the time to provide effective behavioral counseling with multiple follow-up visits. After-school programmers may feel compelled to focus only on homework and improving academic performance or violence prevention.

The most successful interventions appear to be those that focus on obesity as a behavioral problem, not just a nutritional one. Both eating and activity need to be targeted as behaviors rather than purely as energy values. Traditional nutrition education interventions—which teach children the importance of exercise and eating the proper number of servings from the food pyramid, foods high in vitamins and minerals, the energy content of foods, and so on—have never worked for preventing
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obesity. Unfortunately, that is still the model that is most commonly applied in health education programs. In contrast, the most successful interventions have focused more on the personal, social, and environmental contexts of eating and activity.

One of the key elements to address in intervention design is motivation—identifying intervention approaches and goal activities that are, in themselves, motivating to children. It sometimes appears that intervention developers assume that as soon as children, adolescents, and parents hear about the important health benefits of physical activity, a low-fat diet, and weight control, they will be sufficiently motivated to change their behavior. That is clearly not the case for most people. In fact, health benefits may be some of the weakest motivators for behavior change in well populations. In many of the successful prevention programs reviewed earlier, health and weight benefits were not promoted as the primary motivators for behavior change.

To produce behavior change, behavioral targets or their associated benefits must be sufficiently motivating for children to adopt them. For example, in our community-based intervention for African-American girls, instead of trying to persuade 8- to 10-year-old girls that they should be exercising at least 60 minutes a day because it is good for them or because it will make them feel good (the typical health education approach), we are establishing after-school African dance and hip-hop dance classes to help them become much more active, but without ever having to promote physical activity or health as a goal. The use of young adult African-American women as dance group leaders, a focus on African heritage and African-American culture, the promise of performing for their friends and family, the creation of a girls-only group, and the choice of dance as an activity make participation highly valued and enjoyable for the girls. As a result, they are excited about participating in an activity that they like (motivating for the girls), regardless of its potential health benefits (motivating for the investigators).

Once motivational strategies are identified, another key element of this approach is choosing target behaviors that are discrete and measurable, subject to monitoring and change. To make changes and track successes and failures, children must be able to recognize and count the target behavior they are attempting to change. For example, eating five fruits and/or vegetables each day (versus "servings," which are much more difficult to measure), switching to low-fat milk or nonfat milk, and reducing meals eaten at fast food restaurants are more discrete and measurable target behaviors than reducing dietary fat or energy intake, which is often the typical public health and health education message. Accumulating at least 5,000 steps a day on a pedometer, walking or biking to school each day, and going to dance class each day are more discrete and measurable target behaviors than being physically active for 60 minutes a day.

The biological and social sciences are making important advances toward understanding the etiologies and correlates of obesity. However, much less investment has been devoted to the translation of these findings into effective prevention interventions. To prevent obesity and significantly improve the health of our populations we need to focus much more attention on theory-based experimental intervention research. This includes development and testing of innovative methods of behavior
change in small-scale “efficacy” trials, followed by large-scale “effectiveness” trials to translate efficacious methods into public health interventions.

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DISCUSSION

**Dr. Birch:** Can you comment on the sex differences? What is going on here?

**Dr. Robinson:** We did not see sex differences in the TV reduction study, although it was a small study and there was limited power to detect a sex by treatment interaction. Although there were significant sex by treatment interactions in the Stanford Adolescent Heart Health study, there were significant effects in both sexes. The one study where we did see effects in girls only was a study of dance in 12-year-olds. My guess is that dance is probably not the behavior of choice for 12-year-old boys in terms of their motivation to participate.

**Dr. Uady:** The question of effectiveness relates to what else is going on in the schools. One of the issues is snacks. How did you address the problem of snacking in school in your trials?

**Dr. Robinson:** To date, we haven’t, although I agree it is a big problem. The snacks and à la carte foods that are now available did not become popular until after the high school study was done. Dr. Dietz may have some comments in his presentation on methods to change the school environment to try and reduce the effect of snacks obtained from vending machines and so on. There is room for creative approaches to try to change the food environment in schools,
especially regarding what people are calling “competing foods”—that is, competing for what is normally served.

Dr. Endres: In some of your studies, especially in that using aerobics, it appeared that the control groups showed an increase in BMI. Why was that?

Dr. Robinson: I do not believe that any of the control groups increased their BMI in any way that was out of the ordinary. Children are naturally expected to increase in BMI as they grow. Therefore an effective prevention program is one that reduces excessive weight gain.

Dr. Gortmaker: Going back to your focus on shifting population distributions, I liked that perspective very much, and yet I feel that that the model should perhaps be modified a bit. Particularly in the context of, for example, China or some other countries where undernutrition is still a major issue, we would not want to move the entire distribution down and increase the underweight population. You might want to modify the model and think how to decrease obesity without moving the tail of the distribution to the left. Any comments on that?

Dr. Robinson: Those were hypothetical distributions, and there is nothing in the real world that actually looks like a true bell curve. I agree that you want to see larger changes at the higher levels. However, when countries change their distributions over time, the distributions really do move together, so while you may see a blunting of a tail at one end or another, in general the distribution does move as a whole.

Dr. Dietz: One of the points that has not been made here is that the distribution of obesity is skewed. We are really talking about maybe reducing this skew, which would lower the mean somewhat without affecting the median. Then the bottom half of the distribution would not change. Maybe that’s the way to think about it.

Dr. Robinson: I may not have been as clear as I could have been in terms of describing the process. The idea is that most of the morbidity and mortality that occurs is really in those people to the left of (below) the cutoff, because problems like cardiovascular disease and cancer are so common. For example, in sheer numbers, most of the people who die from heart disease do not have high cholesterol levels. Thus moving the entire distribution by a small amount has a greater effect on morbidity and mortality than taking the small group of high-risk people and reducing their cholesterol levels.

Dr. Shi: How long is a suitable time for children to watch TV per day?

Dr. Robinson: Several expert groups have suggested that no more than 1 to 2 hours a day is recommended in the United States. I’m not sure we really know how much time children do watch TV because I don’t necessarily believe the self-reports or the parental reports. Our approach was to ask what happens if you reduce television viewing, no matter where the starting point is. So I would say that if your child is watching what you think is an excessive amount of television, then first of all try to halve it.

Dr. Gortmaker: I can’t resist following up on that. I’d just like to point out to everybody that there is no evidence whatsoever that watching more than an hour of TV a day is good for anybody, anywhere!