International Journal of Obesity (1999) 23, Suppl 2, S43–S51
 0307–0565/99 $12.00
http://www.stockton-press.co.uk/ijo

School-based approaches for preventing and treating obesity

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Schools have the potential to make valuable contributions to both the prevention and treatment of childhood obesity. This article reviews the research on school-based interventions to prevent and treat obesity. A literature search from 1965 to the present on school-based treatment of obesity, identified 11 controlled experimental studies. The results show positive, though modest short-term results. Relatively few primary prevention research studies, targeted specifically to preventing obesity, have been conducted. Therefore, efficacy has not been established. Both primary and secondary obesity interventions have a role in schools. A comprehensive, integrated model for school-based obesity prevention is presented. This model, building upon the comprehensive school health program model, consists of eight interacting components: health instruction; health services; school environment; food service; school-site health promotion for faculty and staff; social support services; physical education classes; and integrated and linked family and community health promotion efforts. While multi-faceted community-wide efforts are needed to address the growing problem of obesity, schools are in a unique position to play a pivotal role in promoting healthy lifestyles and helping to prevent obesity.

Keywords: schools; obesity; prevention; children; adolescents

Introduction

In the last two decades, obesity has become a serious national health problem among children and adolescents. The most recent national estimates on the prevalence of overweight in the US is derived from the Third National Health and Nutrition Examination Survey (NHANES III, 1988–1994). These data show that approximately 14% of children and 12% of adolescents are overweight (based on age- and gender specific 95th percentile body mass index (BMI) cutoff points).[1] The findings also indicate that the prevalence of overweight in the US has continued to increase. Overweight is particularly high among African-American girls and Mexican-American and American Indian boys and girls.[1,2]

Longitudinal studies of children followed into young adulthood, suggest that overweight children may become overweight adults, especially if obesity is present in adolescence.[3] Childhood obesity is accompanied by significant morbidity and is acknowledged as a precursor to several risk factors for adult chronic disease.[4] The most widespread consequences of childhood obesity may be psychosocial. Social stigmatization, poor self-image and discrimination have been associated with significant obesity.[4] The effects of childhood obesity on morbidity and mortality, indicate that effective prevention and treatment during childhood, are likely to have a significant impact on immediate health, as well as adult disease.[5] It is well established that obesity in adults is difficult to treat. Programs aimed at treatment of overweight children, appear to have a substantially better long-term success rate, than similar programs in adults.[6] Furthermore, because of the refractory nature of obesity, preventing childhood obesity, may be an effective way to prevent adult obesity.[6]

Most obesity interventions have taken place in clinical settings, however schools provide an excellent opportunity for preventing and treating obesity. More than 95% of American youth, aged 5–17 y are enrolled in school, and no other institution has as much continuous and intensive contact with children during their first two decades of life.[7] In contrast to clinical programs, school programs can be delivered at little or no cost to families and can reach low income children who otherwise may not receive treatment. Since children eat one to two meals per day in school, the school cafeteria can provide a natural environment where children are exposed to and learn healthful eating patterns.[7] Schools also have other necessary resources, such as gyms, equipment and outdoor playing fields, and physical education programs. Schools also have access to school nurses who can provide screening, counseling and continuum of care. Currently, more than half (59%) of all states fund school-based or school-linked health clinics, which provide primary care and preventive services to students.[8] These clinics offer potential for serving overweight youth. The combination of classroom health

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education, physical education programs, food service and health services, as well as qualified personnel, make schools a viable forum for providing obesity interventions in a cost-effective manner.

The article reviews the research on school-based interventions to treat or prevent obesity. School-based approaches for childhood obesity can be categorized as either primary or secondary interventions. Primary prevention efforts focus on the prevention of the onset of obesity and target the whole population (for example, all students) or high-risk groups who are more likely to become overweight. Secondary prevention applies to the early identification of existing obesity to prevent the worsening of the condition or the development of related morbidities and thus targets youth who are already overweight. Both primary and secondary obesity interventions will be reviewed in this article. In addition, a comprehensive model for school-based obesity interventions is discussed.

Secondary prevention efforts

A search of the literature on school-based treatment of childhood obesity identified 12 controlled experimental research studies,[9–20] conducted between 1966–1996 in the US and Canada. Of these 12 studies, four were with children aged 5–10 y,[10,12,14,18] six were with adolescents aged 12–15 y,[9,11,15–17,20] and two were with youth aged 8–15 y.[13,19] The majority of studies compared the intervention group with a no-treatment control group; one study compared the intervention with a standard health education program as the comparison group. The programs were administered only to overweight children and interventions lasted from nine weeks[20] to 18 months[19] to six months,[13] with sessions ranging from once a week[9,16,17] to five times a week.[18,20] Almost all of the studies included both physical activity and nutrition education components. Nine of the 12 studies included behaviour modification strategies, such as goal setting, stimulus control, self-monitoring, problem solving and reinforcement of behaviour changes. About one-third of the studies included parental involvement.[11,13,14,17,19] One study[10] provided a special school meal program for the overweight children of the study. One study[13] used a protein-sparing modified fast and a hypocaloric balanced diet, in a medically supervised school clinic-based program for superobese children. The programs were conducted either after school or during school hours or a combination of both. Programs were administered in a group setting by a range of professionals, including physicians, nurses, physical education teachers and classroom teachers. One study[14] with children aged 7–10 y trained adolescents as preadolescents trained eighth grade students as peer counselors. Program efficacy was generally evaluated by net change in percent overweight in relation to age, gender and height. Table 1 summarizes the characteristics and results of the studies.

The results of the school-based interventions for the treatment of obesity are encouraging. In 11 of the 12 studies, the intervention group had a significantly greater reduction in percentage of overweight compared with the control group. The exception was the study by Jette *et al*,[15] which showed no difference between the control and treatment group. This intervention consisted solely of a extracurricular lacrosse program, held twice a week after school, for five months and did not involve a dietary component or behaviour modification strategies as did most of the other studies. The mean reduction in percent overweight across the studies, was about 10%. The Brownell and Kaye[10] study, had one of the largest intervention effects among all the studies (15% reduction in overweight) and also used the most intervention components, including physical activity, nutrition education, behaviour modification, food service and parental involvement. The study by Figueroa-Colon *et al*,[13] had the largest intervention effect (a decrease of 24% ideal body weight for height). In this study, 12 superobese children were placed on a 600–800 calorie protein sparing modified fast diet, during the first nine weeks. The diet was then increased by 100 calories every two weeks for three months, until a 1200 calorie per day balanced diet was attained.

Overall, interventions aimed at younger children were more successful than those with adolescents. Treatment effects were also generally larger for the heavier children. In the studies, where the impact of the parental involvement component was assessed, effects were mixed. Two studies showed a parental participation effect,[10,17] whereas the other study[14] showed no effect.

Although positive, albeit modest, short-term treatment effects have been consistently observed for school-based high risk interventions, several methodological issues are apparent. Only two of the studies[14,20] had follow-up data of at least six months. Only in the Zarkus *et al* study[20] did children maintain weight loss at follow-up. Therefore, the long-term effects of school-based treatments remain unknown. A few of the studies also had small sample sizes and in some cases, subjects or their parents volunteered for the program and nonparticipants were used as controls. Thus, motivational and personality factors may have influenced study outcomes.[7]

Further research in the area of school-based obesity interventions, is needed to examine the contributions of specific program components and determine the most effective types of treatment. Long-term follow-up should be included in the evaluation. Schools may be an effective vehicle to reach low-income overweight youth, and more research is needed with both low-income and minority populations. Several studies conducted during the past decade in clinic settings, have shown positive results in reducing obesity in

Table 1 Summary of school-based obesity treatment studies[a]

Study	Subjects	Intervention Components					Duration	Design	Major findings
		NE	BM	PA	PI	FS			
Botvin *et al.*, 1979[9]	T: 50 C: 69 (12–14 y)	x	—	x	—	—	10 weekly classes	Random assignment of 4 schools	70% of treatment *vs* 43% control students decreased skinfolds.
Brownell and Kaye, 1982[10]	T: 63 C: 14 (5–12 y)	x	x	x	x	x	10 weeks	Self-selection	T: 95% lost weight mean = − 4.4 kg C: 21% lost weight (mean = 1.2 kg)
Christakis *et al.*, 1966[11]	T: 49 C: 33 (boys, 13–14 y)	x	—	x	—	—	18 months	Random selection	T: net wt change 3.5 kg; treatment effects limited to obese (> 130%)
Collipp, 1975[12]	T: 25 (9–10 y)	x	—	x	—	—	12 weeks	Phase I: 6 weeks PA Phase II: 6 weeks PA and diet	Phase I: no effect Phase II: weight loss (mean = 10 lbs)
Figueroa-Colon *et al.*, 1996[13]	T: 12 C: 7 (8–13 y)	x	x	x	x	—	6 months	Random assignment of 2 schools	at 6 months the superobese children on protein-sparing modified fast diet had lost − 5.6 kg, and the control group gained weight (mean 2.8 kg)
Foster *et al.*, 1985[14]	T: 48 C: 41 (7–11 y)	x	x	x	x	—	12 weeks	Random assignment of 2 schools	T: lost 0.15 kg and reduced % overweight by 5.3% C: gained 1.3 kg and increased % overweight by 0.3%
Jette *et al.*, 1979[15]	T: 11 C: 10 (15 y)	—	—	—	x	—	Twice/week for 5 months	Random assignment of 2 schools	No significant changes in skinfold measures or body composition
Lansky and Brownell, 1982[16]	T: 71 (12–15 y)	x	x	x	—	—	15 weeks	3 schools BM or PA and NE No untreated controls	64% of children in the BM group and 63% of PA and NE groups decreased % overweight
Lansky and Vance, 1983[17]	T: 30 C: 84 (12–14 y)	x	x	x	x	—	12 weeks	Random assignment	T: decreased % overweight mean = 5.7% C: decreased % overweight mean = 2%
Ruppenthal and Gibbs, 1979[18]	T: 14 C: 28 (5–10 y	x	—	x	—	—	5 months	Self-selected	T: 13/14 decreased % overweight C: 3/28 decreased % overweight
Seltzer and Mayer, 1970[19]	T: 189 C: 161 (8–15 y)	x	x	x	—	—	5–6 months	Self-selected	T: − 11% overweight C: − 2% overweight
Zakus *et al*, 1981[20]	T: 10 C: 12 (girls, 14 y)	x	x	x	—	—	9 weeks	Random assignment of 2 schools	T: − 9% overweight C: − 1% overweight

NE = nutrition education; BM = behavior modification; PA = physical activity; PI = parent involvement; FS = food service; T = treatment group; C = control group.
[a]Modified from Parcel GS, Green LW, Bettes BA. School-based programs to prevent or reduce obesity. In: Krasnegor NA, Grave GD, Kretchmer N (eds). Childhood obesity: a biobehavioral perspective. Jedford Press, Inc.: Caldwell, 1988.[24]

children.[21–23] Such programs, with adaptations for specific ethnic and cultural subgroups, could be replicated in schools to see if similar results can be achieved.

Parcel *et al*[24] noted that school-based programs for overweight children should be concerned with the potential harmful effects of interventions, such as labeling, coercion and stigma. The possible negative psychosocial impact of school-based treatment programs were rarely discussed in any of the studies.[25] It is interesting that few studies on school-based treatment of obesity were identified after 1985. The reasons for less research in school settings is unclear, as there have been several clinic-based studies conducted since 1985. Sallis *et al*[25] speculate that perhaps greater awareness of the stigma attached to participating in school-based treatments, may have decreased enthusiasm for the programs, even though they appear to be effective.

The issue of stigmatization and labeling is of importance and more effort is needed to assess the acceptability of and possible negative effects of school-based interventions for overweight youth. Recently, in-depth interviews were conducted with 61 overweight adolescents, primarily white and African-American, from inner city public schools, to determine their level of interest in participating in school-based weight control programs and to gather their recommendations for developing such programs.[26] The majority of overweight adolescents expressed interest in participating in a school-based weight-control program, provided it was undertaken in a supportive and respectful manner, offered fun activities, was informative, was sensitive to the needs

of overweight youth and did not conflict with other activities. They stressed the importance of having a leader who understands the difficulties that overweight youth face. Many students did not want others to know they were participating in a weight-loss program, for fear of being teased or embarrassed. Some indicated the program should not be labeled as a weight-control program for overweight youth, but rather as a nutrition program. Most of the students preferred having a program during school hours, as many worked after school or had competing activities. They suggested offering the program for credit. Adolescents also felt strongly that they be involved in all stages of the planning process and development of program content and activities. They felt that their individual success and that of the program was dependent on their involvement in the intervention's design.

Primary prevention efforts

The strategy of secondary prevention for obesity, addressed in the previous section, targets children and adolescents who are overweight. An alternative approach is to provide obesity prevention interventions to all children, independent of their risk status. The rationale for this broader approach is that even though obese children represent a high-risk group, most people who will eventually become obese, are not overweight as children.[27] Little attention has been paid to a population-based approach, which would use the schools to attempt to reduce the number of children who become obese, or to modify behavioural and environmental conditions which might be contributory to developing or maintaining obesity in children.[24] Three major components within schools have potential for contributing to the prevention of obesity: the physical education program, classroom health education and the school food service.[24]

Obesity-specific prevention programs

Only a few research studies have targeted interventions specific to obesity prevention. Donnelly *et al*[28] recently conducted a two-year obesity primary prevention study among students in children aged 8–10 y, using classroom nutrition education (nine sessions), enhanced aerobic-type physical education (three times a week) and a modified (lower fat) school lunch program. Two schools in rural Nebraska matched for ethnicity and socio-economic status (SES) participated in the study; one serving as the control school and the other as the intervention school. At the end of the two years, obesity was unchanged in the intervention school compared to the control school, as were all components of metabolic fitness, except high density lipoprotein (HDL) cholesterol, which was greater for the intervention school than the control school. Positive intervention effects were found for lowering fat in school lunches and increases in student nutrition education knowledge. This study had small sample sizes with only 200 students in the control school and 100 students in the intervention school. At the end of the two years, there were only complete data on 64 students in the control school and 44 students in the intervention school. Thus, there may have been insufficient statistical power to detect an intervention effect. Another potential explanation of the limited effectiveness, is that the intervention was not powerful enough in intensity or duration to produce changes in eating and physical activity behaviours and percent body fat. The nutrition education component was knowledge-based general nutrition and the physical-activity intervention did not extend outside the classroom.

An ongoing study, called Pathways,[29–31] funded by the National Heart Lung and Blood Institute, is expected to demonstrate the efficacy of school-based primary prevention of obesity. Pathways is a multicenter school-based intervention, aimed at reducing the alarming increase in the prevalence of obesity in American Indian children. It is designed as a randomized trial, involving about 2000 third grade children in 41 schools (21 intervention schools and 20 control schools) in seven different American Indian communities. Pathways is an eight-year, two-phase study. The three-year feasibility phase was to plan, develop, pilot test and assess the feasibility of conducting the full-scale study. The full-scale study phase began in 1996 and will be completed in 2001. The primary objective of the Pathways intervention is to implement a culturally appropriate school-based intervention program, that promotes healthy eating and increases physical activity to prevent obesity. It consists of four components: physical activity, food service, classroom curriculum and family involvement. The three-year intervention (3rd, 4th and 5th grades) began for 3rd grade children in the Fall of 1997, following baseline data collection. The primary aim is to reduce average percent body fat in intervention school children. Secondary outcomes include physical activity, dietary intake and knowledge, attitudes, and behaviour. The results of this study should answer a number of questions about the effectiveness of school-based, obesity primary prevention programs.

Broad-based cardiovascular disease (CVD) prevention programs

Several school-based studies have targeted reduction of CVD risk through multiple risk-factor interventions.[32–35] These studies deserve attention, because the behaviours they target are similar to those which would be targeted in obesity prevention. Specifically, consuming a lower fat diet, increased physical activity and modifying the school food service by lowering fat in school meals. Recently, Resnicow and Robinson[36] reviewed 16 major school-based CVD prevention

trials from 1985–1995, and synthesized the results through semiquantitative meta-evaluation, using computed weighted and unweighted effect ratios. The weighted effect ratio was computed by adding the number of positive intervention effects (defined as any comparison with a reported P value < 0.05 in the direction favoring the intervention group) and dividing this by the number of total comparisons made. In the unweighted effect ratios, cell averages by study outcome (for example, diet, lipids, BMI) were first computed, from which a mean of the cell averages was generated. Only studies that used a comparison group and assessed at least one major CVD physiological risk factor or two non-physiological CVD risk factors, were included in the analysis. All the studies included a classroom health education component and roughly half incorporated food-service and/or physical-education interventions. For the results, the weighted and unweighted effect ratios were averaged and then ranked to provide a relative comparison of intervention effects by outcome. Positive effects were observed more frequently for smoking (80%), cognitive (65%), fitness (36%), diet (34%) and lipid (31%) outcomes, with lower rates observed for blood pressure (18%) and adiposity measures (16%). Of all the outcomes, the lowest rates were observed for adiposity measures. These results indicate that broad-based programs of school health education that target multiple health behaviours aimed at CVD risk factor reduction, have not proved effective in reducing obesity in children. It may be that more specific obesity prevention strategies or multiple level interventions (for example, food service, physical education, parent involvement, classroom education) are needed to make dietary changes, increase energy expenditure and reduce body fat in children.

A comprehensive, integrated model for obesity prevention

Two key interventions for preventing or treating obesity are, increasing physical activity and consuming a healthy, lower fat and calorie diet. Within schools, efforts to promote physical activity and healthy eating among students, should be part of a coordinated, comprehensive program for school health. The comprehensive health program model for schools, developed by Allensworth and Kolbe,[37] consists of eight interacting components: school health instruction (curriculum); school-health services; school-health environment; school food service; school-site health promotion programs for faculty and staff; school counseling and psychology programs; school physical education; and integrated and linked community and school health-promotion efforts. This model lends itself well to obesity prevention efforts in the school. Key components of the model are shown in Figure 1, and implications for obesity prevention and treatment are discussed below.

Health education

The primary goal of health education for obesity prevention, should be to help children and adolescents adopt healthy eating behaviours and engage in regular physical activity. Emphasis should be on helping students develop the knowledge, attitudes and behavioural skills they need, to establish and maintain healthy eating and a physically active lifestyle.[38,39] Key learning concepts include the physical, social and mental health benefits of physical activity and healthy eating; social influences on eating and physical activity; components of health-related fitness and a healthy diet; portion-size estimation; healthy and safe weight management techniques; and the development of safe and effective individualized physical activity programs. Students should also be taught how to apply behavioural skills, such as how to assess and monitor diet and exercise behaviours, how to set goals for change, and techniques for initiating and maintaining behaviour change.[24] Characteristics of teaching methods found to be most effective in school health-education curricula include, use of discovery learning; use of student learning stations; cooperative groups; situation analysis; cross-age and peer teaching; use of personal commitment to change and goal setting; and provision of opportunities to increase self-efficacy in modifying health behaviours.[40] Teacher training is needed on the key eating and physical activity concepts, and active learning and behaviour change strategies. Teacher training is likely to result in increased time spent on teaching nutrition and physical activity in the classroom.[38]

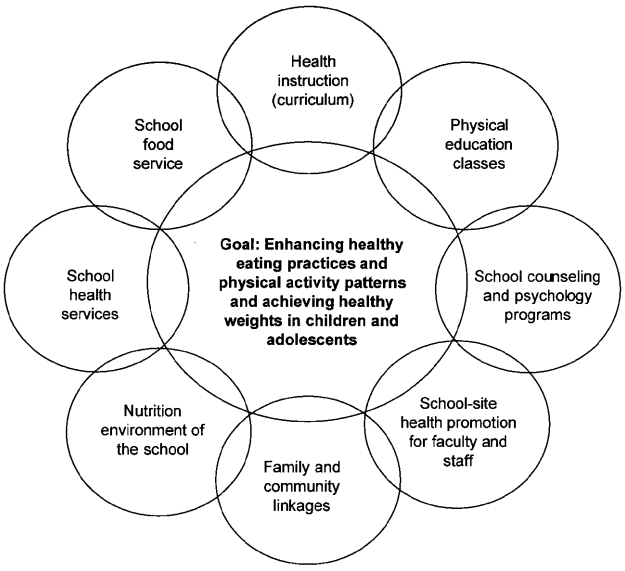

Figure 1 Components of an integrated comprehensive model for school-based obesity prevention.

Health services

School health services for obesity prevention and treatment, potentially include screening for overweight, preventive counseling, weight management asessment and treatment or referral. The school nurse could serve as a central figure to coordinate programs in the school, and serve as the liaison with the child's family and health care providers. Schools that have school-based clinics or school-linked health centers, may have access to a multi-disciplinary team that could provide services to overweight youth and also provide preventive counseling services. While school clinics have been increasing in numbers, the reality is that few schools have the personnel to conduct high-risk interventions.

The School Health Policies and Programs Study (SHPPS)[41] assessed a wide variety of school health services at the state, district and school levels, in a nationally representative sample that included all 50 states. Currently, about half (57%) of all middle/junior high and senior high schools have at least one registered nurse. Relatively few states (27%) require screening for height and weight, although most districts (71%) require height and weight screening in at least one grade. If the screening indicates a potential problem, 47% of all states and 70% of districts require follow-up. Less than half (46%) of middle/junior high and senior high schools conduct height and weight screening programs. Only about one third (37%) of middle/junior high schools and senior high schools (38%) provide nutrition/weight management services. It does not appear that screening or counseling services are incorporated into most school health services.

School food service

In 1993, the National School Nutrition Dietary Assessment Study[42] documented that school lunches were high in fat, with the average percentage of calories from fat being 38%, compared with the recommended goal of 30%. Furthermore, only 1% of schools offered lunches that provided an average of 30% calories from fat. This study, coupled with research on the relationship between diet and chronic disease risk, spurred drastic changes in the national school meal program. In 1994, the US Congress passed legislation,[43] which required that meals served through the National School Lunch Program (NSLP) and National School Breakfast Program (NSBP), comply with the Dietary Guidelines for Americans.[44] Thus, meals offered through NSLP and NSBP are required to meet the guidelines for fat and saturated fat.

The new legislation for school meals applies only to United States Department of Agriculture (USDA)-reimbursable breakfast and lunch meals. Junior and senior high school students, however, have a variety of options for lunch in which high-fat and high-sugar foods are easily accessible, such as *à la carte* food in the cafeteria, school stores and vending machines. The number of branded fast foods (for example, pizza and hamburgers) being served *à la carte* in school cafeterias, has increased dramatically in recent years. High-fat cookies, potato chips and other snack chips (savoury snack food), french fries, malts and nachos are best-selling items in junior and senior high school cafeterias.

Nutrition environment

The school environment provides multiple food and nutrition activities, experiences and exposures. These include not only school meals and classroom curricula, but also food sold in vending machines, school stores and snack bars; fund-raising events; classroom snacks and parties; use of food to reward or discipline; corporate-sponsored nutrition education materials; and in-school advertising of food products. Wolfe and Campbell[45] found that the nutrition and food experiences provided in schools are fragmented, multicomponent and often unplanned, with multple people involved in decisions about them. The result can be inconsistent nutritional messages and messages that are in direct conflict with the goals of healthy eating.

Vending machines and school stores are commonly found in high schools. A recent study [46] found that healthy food choices or lower-fat alternatives were often not available or were less prevalent in these venues. For example, although more than half the vending machines had potato, corn or taco chips, only one quarter had pretzels, a lower-fat choice. Only 8% of the schools with vending machines offered fruit. Soft drinks were widely available. Almost 80% of the school stores sold candy and candy bars, and none sold fruit.

There is also a growing trend of commercialism and marketing in schools. A study by Consumers Union Education Services[47] found that direct advertising in schools has mushroomed. Examples include school bus advertising for soft drinks and fast food restaurants; 'free' textbook covers advertising candy, chips and soft drinks; ads for high-sugar/high fat products on school walls, in student publications (such as newspapers and yearbooks); and product giveaways in coupons. Written nutrition policies are needed for all food and nutrition activities and promotions in schools. Local and district policy initiatives can be instrumental in creating a supportive and integrated school environment with consistent health-promoting messages. Schools should also consider the Consumer's Union[47] recommendation for making the school an ad-free zone, where young people can pursue learning without commercial influences and messages.

School physical education

Physical activity and nutrition, must be integrally linked to achieve and maintain healthy weights. Physical education classes could be a major resource for

increasing energy expenditure in students, as well as creating expectations and social norms for frequent and regular physical activity.[24] Concern has been expressed about the quality and amount of physical education in schools.[39] While progress is slowly shifting the focus of physical education away from sports and atheletic ability, toward the goal of health-related fitness, relatively little time is devoted to moderate or vigorous physical activity.

Recently, the Centers for Disease Control and Prevention (CDC) published *Guidelines for School and Community Programs to Promote Lifelong Physical Activity Among Young People*.[39] One of the recommendations is to require comprehensive, daily physical education for students in kindergarten to grade 12 (ages 5–18 y). Less than two thirds (60%) of high school students are enrolled in physical education classes and only 25% take physical education daily.[39] Establishing policies to require daily physical education, and increasing moderate and vigorous activities during class time, could greatly increase the energy expenditure of young people.

Children and adolescents who are obese, may need instruction and programs in which they can develop motor skills, improves fitness and experience enjoyment and success. Young people who are obese or who have other disabilities, are often overtly or unintentionally discouraged from engaging in regular physical activity.[39] By providing modified physical activity programs and extracurricular sports programs, schools can help these young people acquire the benefits and joys of physical activity. Research is needed to document the effects of intensive activity physical education programs on percent body fat and the weight status (24).

School worksite health promotion

There has been strong interest in worksite health promotion. A 1992 USDA national survey of worksite health promotion activities, found that 78% of large worksites (those with >750 employees) and 22% of small worksites (those with 50–100 employees) offered nutrition education.[48] Almost one quarter (24%) of worksites offered weight control programs. The literature on school-based worksite interventions for school personnel is sparse.[48] A health promotion program for school personnel (teachers, staff, coaches, and food service workers) that includes healthy eating, participation in physical activity and weight management techniques, may have several benefits. In addition to personal benefits, worksite health promotion can be a potentially important and powerful strategy to increase the value of teachers and staff, regarding healthy eating and physical activity, commitment to adopting and implementing obesity prevention programs, as well as role modeling positive eating and exercise behaviours.

School commitment and support

The development of effective comprehensive school-based programs for prevention and treatment of obesity, requires administrative support and commitment, at the school site and at the district level. Price *et al*[49] found a relatively low level of interest among elementary school principals, with only 28% strongly agreeing with the statement that schools would be an ideal place to prevent weight problems among children and 35% strongly agreeing that schools are not doing enough to help alleviate childhood obesity. However, in a more recent survey[50] of administrators and school nurses in Minnesota, 66% of the administrators and 82% of the school nurses indicated that they felt it was the role of the school to offer weight management services. Barriers to providing school-based weight management education and services identified by the nurses were: lack of time (97%), lack of training (53%), lack of education materials (42%) and lack of administrative support (29%). The top barriers identified by administrators were lack of trained personnel (49%), lack of materials (42%), lack of classroom time (40%), lack of funds (40%) and lack of staff time (34%). This study confirms there are numerous barriers to developing and implementing obesity prevention and intervention programs.

Integrated community and school efforts

The success of obesity interventions, is contingent upon the degree to which the intervention incorporates a variety of individuals in the child's environment (for example, parents, peers, teachers and health professionals), as well as all the contexts in which the child functions (for example, school, home and community).[24] Therefore, effectively changing the eating and physical activity behaviours of children will require parental and community involvement. Involvement of community agencies may contribute to school program effectiveness, by providing a support base of prevention and treatment services, initiatives, campaigns and sharing of resources. For example, collaborations could be developed between health departments or managed care organizations (MCOs) and schools in providing services to overweight youth.

Parental involvement in obesity prevention and treatment programs is key to the development of a psychosocial environment that promotes healthy eating and physical activity among young people. Epstein and Wing[51] cite three reasons for having parents involved in obesity interventions: 1) obesity runs in families and it may be unrealistic to intervene with one member of a family, while other family members are modeling and supporting behaviours that may counteract the interventions' effectiveness; 2) specific parental behaviours, such as prompting overeating and underexercising, may be important in the development and maintenance of unhealthy behaviours; and 3) to produce maximal behaviour change in children, it may be necessary to include specific

behaviour-change strategies for parents to use (for example, positive reinforcement). While it appears family involvement is crucial, especially for young children, challenges exist for recruiting and sustaining parent involvement for school-based programs. Parents are usually more receptive to activities that can be undertaken at home, than those that require attendance at school. Perry *et al*[52] found that a home-based correspondence approach for children and parents was effective in changing eating and exercise behaviours among third grade children.

Summary

Schools have the potential to make valuable contributions to both the prevention and treatment of childhood obesity. School-based obesity interventions include both primary prevention approaches, which are aimed at all youth or high risk groups, and secondary intervention programs, which target overweight youth, for weight control. The results of school-based treatment studies, with overweight youth, are encouraging and have shown positive, but modest, short-term results. Interventions with younger students appear more successful than those with adolescents. There has been little research on school-based high risk interventions since the mid 1980s. The advantages and disadvantages of treatment programs in schools, need to be explored and further research with longer-term follow-up is clearly needed.

Only a few primary prevention research studies targeted specifically to obesity prevention have been conducted. Therefore, efficacy has not been established. However, school-based primary prevention programs, that target reduction of CVD risk factors, have not proved effective in reducing the percentage of overweight in children or adolescents. Additional research on specific programs directed at primary prevention of obesity should be developed.

Conclusion

The key interventions for preventing and treating obesity, are increasing physical activity and consuming a healthy diet. Within schools, efforts to promote physical activity and healthy eating, should be part of a comprehensive, coordinated school health program. Both primary and secondary obesity interventions fit into a comprehensive program of school health. However, the role of the school in preventing and treating childhood obesity, must be conceptualized as only one part of broader community and health care interventions.[24] Parents of school children also need to be involved in obesity intervention efforts to make healthy changes in the home, and reinforce and support healthy eating and regular physical activity. The challenge of helping young people adopt healthy eating patterns and regular physical activity to achieve and maintain healthy weights cannot be effectively met through the sole efforts of the school or any other organization—it requires a multifaceted community-wide effort, but schools are in a unique position to play a pivotal role in promoting healthy lifestyles and helping to prevent obesity.

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