Integrative Review of School-based Childhood Obesity Prevention Programs

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ABSTRACT

Childhood and adolescent overweight and obesity in the United States are rapidly becoming a major pediatric health concern. Schools are a critical part of the social environment that shape children's eating and physical activity patterns. While school-based programs may affect a student's perception of physical activity and the influence of dietary practices on overall health, the current variability in the theoretical underpinnings and methodological approaches used to implement these programs makes them difficult to evaluate for quality and evidence of effectiveness of the outcomes achieved across programs. The purpose of this study is to conduct an integrative research review using Cooper's framework to provide an overview of the degree of variability in the methodological approaches and theoretical frameworks of school-based obesity prevention programs that utilize one or more of the following interventions: dietary, physical activity, healthy lifestyle education, and/or parental involvement. This review will examine the variations in the duration of the interventions; whether the interventions were guided by the use of a theoretical framework; the strength of evidence supporting the studies; and whether the interventions demonstrated a reduction in body mass index or weight loss. A total of 16 articles were found based on the inclusion criteria for this study. Eight of the 16 studies (50%) applied theoretical frameworks. Significant variability was found in the duration of intervention between the studies analyzed. The range of duration was 5 weeks to 8 years, with an average of 16.8 months. Fourteen of 16 studies (88%) implemented dietary habit interventions. Fourteen of 16 studies (88%) implemented physical education programs. All 16 studies applied healthy lifestyle education. Nine of 16 studies integrated family involvement into the obesity intervention. Nine of 16 studies (56%) evaluated the effect of their intervention on body mass index. J Pediatr Health Care. (2009) *23*, 242-258.

Key words: Obesity, childhood, adolescence, school programs, integrative review

Childhood and adolescent obesity in the United States is rapidly becoming a major pediatric health concern. According to the most recent data reported by the National Center for Health Statistics (2002), an estimated 16% of Americans aged 6 to 19 years are obese. These numbers represent an alarming 45% increase from just a decade ago. Body mass index (BMI) is the ratio of weight in kilograms to the square of height in meters. BMI between the 85th and 95th percentile for age and gender is considered at risk of overweight, and BMI at or above the 95th percentile is considered overweight or obese (Centers for Disease Control and Prevention [CDC], 2007). In addition, BMI accurately reflects the proportion of excess body fat and correlates with markers of secondary complications of obesity and long-term mortality (Barlow & Dietz, 1998).

American children and adolescents today are less physically active than were previous generations. According to the American Academy of Pediatrics (AAP) (2001), children spend an average of 4 hours watching television daily. Less active children are more likely to be overweight and to have higher blood pressure, higher insulin and cholesterol

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concentrations, and more abnormal lipid profiles (Freedman, Dietz, Srinivasan, & Berensen, 1999). It is unclear which modifiable health behaviors are contributing to the vast increase in childhood and adolescent obesity. Whether it is sedentary lifestyle, poor dietary habits, limited health education, genetics, socioeconomics, or the breakdown of the family unit, additional research is warranted as the numbers continue to rise significantly. Based on the research, one may conclude that the increase in the incidence of childhood obesity is multifactorial, with both genetic and lifestyle factors contributing to its development (AAP, 2003).

The development and reinforcement of healthy diets, physical activity, and other healthy behaviors that prevent or decrease the incidence of obesity are paramount during the childhood and adolescent years. Promotion of these behaviors has become an important public health initiative as the numbers of children who are overweight or obese continues to grow. Establishing healthful dietary behaviors should begin in early childhood (CDC, 1996). Schools are a critical part of the social environment that shape children's eating and physical activity patterns and therefore can play an integral role in a positive change in attitude. Developing healthy dietary and physical activity patterns may decrease or prevent the incidence of childhood obesity (Dietz & Gortmaker, 2001). In addition, parental involvement in the intervention is also an integral component if the desired outcome of long-lasting healthy lifestyle is to be achieved (Pyle et al., 2006).

While school-based programs may affect a student's perception of physical activity and the influence of dietary practices on overall health, the current variability in the theoretical underpinnings and methodological approaches used to implement these programs makes them difficult to evaluate for quality and evidence of effectiveness of the outcomes achieved across programs. A pressing need exists to determine a unified approach to evaluating the evidence.

PURPOSE

The purpose of this review is to describe the degree of variability in the methodological approaches and theoretical frameworks of school-based obesity prevention programs that utilize one or more of the following interventions: dietary, physical activity, healthy lifestyle education, and/or parental involvement. This review will examine the variations in the duration of the interventions; whether the interventions were guided by the use of a theoretical framework; the strength of evidence supporting the studies; and whether the interventions demonstrated a reduction in BMI or weight loss.

SIGNIFICANCE TO NURSING

The prevention, treatment, and long-term management of childhood and adolescent obesity pose serious challenges for advanced practice nurses (APNs). APNs, in collaboration with a multidisciplinary team, are in a unique position to implement school-based obesity prevention programs. Through focused nursing interventions, elucidating modifiable health behaviors early in childhood development may decrease the incidence of obesity and ultimately prevent the comorbidities that are associated with obesity, such as cardiovascular disease, type II diabetes, and psychiatric disorders (Freedman et al., 1999; Manus and Killeen, 1995).

The use of evidence-based practice in nursing is a valuable tool for the augmentation of the APN's expertise and experience. The APN is able to provide the most advantageous care possible by employing a synthesis of research on a given topic. This integrative review should provide the practicing nurse with a basis to formulate a decision-making process in order to develop, implement, and evaluate a school-based childhood obesity prevention program that is supported by the most current literature.

CONCEPTUAL FRAMEWORK

The systematic approach developed by Cooper (1984) was the guiding framework for this integrative review. Cooper identifies the process of conducting an integrative review as encompassing the following five stages: (a) problem formulation, (b) data collection or literature search, (c) data evaluation, (d) data analysis and interpretation, and (e) public presentation of results.

The integrative literature review provides several contributions to the scholarly reviewer, which include evaluating the strength of scientific evidence, identifying gaps in past and current research, identifying the need for future research, bridging between related areas of inquiry, identifying central issues in an area, and identifying whether theoretical or conceptual frameworks are utilized (Cooper, 1998). According to Whittemore and Knafl (2005), "Well-done integrative reviews present the state of the science, contribute to theory development, and have direct applicability to practice and policy" (p. 546).

BACKGROUND

As mentioned previously, the causes of obesity are extremely complex and multifaceted; consequently, prevention approaches must be comprehensive and engage communities, schools, and families in supporting healthy diets, increased physical activity, and healthy lifestyle behaviors for all children. Schools play an integral role in helping children adopt and maintain healthy eating and physical activity behaviors (CDC, 1996). According to Dietz and Gortmaker (2001), "Coordinated school health

programming provides a strong basis for implementing a range of effective school-based activities and environments to improve diet and increase physical activity" (p. 346).

Veugelers and Fitzgerald (2005) examined the effectiveness of school programs in preventing childhood obesity and concluded that "school based healthy eating and physical activity programs provide a great opportunity to enhance the future health and well-being of children because they can reach almost all children and may (1) enhance learning and provide social benefits, (2) enhance health during critical periods of growth and maturation, (3) lower the risk for chronic diseases in adulthood, and (4) help to establish healthy behaviors at an early age that will lead to lifelong healthy habits" (p. 434).

The success of nutrition and physical activity programs, interventions, and practices relies greatly on the methodological approaches and theoretical underpinnings that are utilized when implementing interventions aimed at preventing childhood obesity. Schools and school districts are diverse and pose unique challenges when adopting the "right" method of improving dietary habits, increasing physical activity, and enhancing overall healthy lifestyle behaviors. Comprehensive interventions necessitate evaluation models that measure appropriate outcomes. The CDC Guide to Community Preventative Services Task Force reviewed the evidence for the efficacy of school-based interventions in preventing and controlling obesity (Truman, Smith-Akin, & Hinman, 2000). The Task Force utilized comprehensive and explicit measures to increase the reliability and validity of literature reviews as a foundation for recommending models for implementation and recognizing those that require further research (Katz et al., 2005).

Although dietary habits, physical activity, healthy lifestyle education, and parental involvement have been recognized as modifiable variables that are linked to the incidence of childhood obesity, a true understanding of all contributing factors presently is unclear. This is made evident by the continual increase in the incidence of childhood obesity. The degree of variability in the methodological approaches and theoretical underpinnings among school-based childhood obesity prevention programs makes the evaluation of the effectiveness of outcomes across programs difficult.

A number of studies conclude that parental involvement is essential to achieve intervention success (Barlow & Dietz, 1998; Blom-Hoffman, 2004; Rich, 2004). Enhancing certain parental skills has been found to supplement the benefits of school-based obesity programs. These skills include setting daily meal and snack times, praising behavior, and having parents decide the food choices and when they are eaten (Barlow & Dietz). Lindsay, Sussner, Kim, and Gortmaker, (2006) concluded that successful interventions "must involve and work directly with parents from the earliest stages of child development to support healthful practices both in and outside the home" (p. 169). Parents are in a unique position to alter sedentary behavior as well, such as by decreasing the amount of television watched or video games played and increasing the amount of family-centered activity (Barlow & Dietz).

DEFINITIONS

Dietary habits, physical activity, and healthy lifestyle education have been identified as modifiable variables that contribute to the development of childhood obesity (Barlow & Dietz, 1998). Healthy lifestyle education provides youth with "the capacity to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health" (U.S. Department of Health and Human Services, 2004). Physical activity is defined as "any bodily movement produced by skeletal muscles that result in an expenditure of energy" (U.S. Department of Health and Human Services, 1996). Dietary habits refer to a prescribed course of eating and drinking in which the amount and type of food and time at which one drinks and eats are regulated (Stedman, 2002). Parental involvement can be defined as the participation of parents in all aspects of their children's development and well-being and recognizing that they are the most constant influence in the lives of their children.

METHODS

The design selected for this research is an integrative review. According to Cooper (1982), integrative reviews summarize and synthesize information from various sources that highlight the most relevant issues. The inclusion of both experimental and nonexperimental research to more fully understand a phenomenon of concern makes the integrative review one of the broadest types of research reviews (Whittemore & Knafl, 2005).

The target population consisted of the written discourse regarding school-based childhood obesity prevention programs. The accessible population included both electronic and library resources. The criteria for inclusion of the studies was: (a) publication between 2000 and 2007; (b) publication in the English language; (c) the program involved children ages 4 to 18 years or in grades kindergarten through high school; (d) school-based curriculum programs for obesity prevention; and (e) a manipulation of at least one of the variables of dietary habits, physical activity, healthy lifestyle education, and/or parental involvement.

The majority of the studies for this review were obtained through online computer searches utilizing

the following databases: PsycINFO, MEDLINE, and CINAHL. The following key words were used: childhood, obesity, schools, interventions, parents, education, and programs. In addition to computer searches, the ancestry approach was utilized, in which the reviewer extrapolates information by reviewing bibliographies of related research studies (Cooper, 1984). Every attempt was made to include all subjects that meet the inclusion criteria. After retrieval of all studies, they were reviewed on two separate occasions to ensure adequate sampling. Sixteen studies met the inclusion criteria.

A data extraction tool developed for the purpose of this study utilizing the frameworks of Cooper (1984), and Stetler and colleagues (1998) was used to ensure accurate and consistent retrieval of data. To ensure rigor, unitizing reliability was tested by two reviewers. Intra-rater reliability was verified by investigator re-analysis of selected data (Crabtree & Miller, 1992). Developing a clear and concise system for data collection greatly improves the reviewer's capacity to ascertain reliable information from all information sources (Cooper, 1998).

Stetler and colleagues (1998) describe six different levels of research. Level I refers to a meta-analysis of multiple controlled studies and is the strongest type of research. Level II illustrates an individual experimental study. Level III indicates a quasi-experimental study, such as nonrandomized controlled single group pre-post test, time series, or matched case-controlled studies. Level IV describes nonexperimental study, such as correlational descriptive and qualitative or case studies. Level V indicates a case report or program evaluation data. Lastly, Level VI describes reviewed evidence, based on the opinions of respected authorities. Additionally, "quality from any level can range from A to D and reflects basic scientific credibility of the overall study/project. An A reflects a very well-designed study/project. If quality is rated as a D, it is automatically eliminated from consideration" (Stetler et al., 1998, p. 202). These levels will be presented later in the result section.

RESULTS

The research synthesis tables are presented in Tables 1 and 2. Table 1 is a summary of the reviewed articles with intervention, duration, outcome measures, theoretical framework, and outcomes. Table 2 provides a summary of the use of dietary habits, physical activity, healthy lifestyle education, and parental involvement. A total of 16 articles were found based on the inclusion criteria for this study. Fourteen of the reviewed articles focused on dietary habit intervention in a school-based obesity program. Fourteen studies implemented physical activity programs. All sixteen studies applied healthy lifestyle education. Nine of the reviewed studies employed parental involvement as a key element in their obesity prevention intervention. Of the 16 articles, nine used all four intervention modalities.

Theoretical Framework

Eight of the 16 studies (50%) applied theoretical frameworks. Four studies (25%) explicitly stated the use of constructs from the Social Cognitive Theory, which is also known as the Social Learning Theory. The Social Cognitive Theory is a behavioral prediction theory that represents a clinical approach to health behavior change (Bandura, 1986). Four studies (25%) utilized the Transtheoretical Model. The Transtheoretical Model is conceptualized as a process in which change in behavior transitions through five stages: precontemplation, contemplation, preparation for action, action, and maintenance (Prochaska & Norcross, 2001). Pender's Health Promotion Model was applied to both studies by Frenn and associates (2003). The Health Promotion Model is based on nursing and behavioral approaches that are meant to assist individuals in making positive behavioral changes (Pender, Murdaugh, & Parsons, 2002). The Theory of Planned Behavior was used in the study by Haerens and colleagues (2006). The Theory of Planned Behavior is an expectancy-value model that is based on behavioral, normative, and control beliefs that affect the person's intention and subsequent behavior (Azjen, 1991). Lastly, the study by Wheling-Weepie and McCarthy (2002) applied a theory presented by Gillespie (1981), which provides a framework for developing school nutrition education programs.

Duration

Significant variability was found in the duration of intervention between the studies analyzed. The range of duration was 5 weeks to 8 years, with an average of 16.8 months. This average, however, is statistically skewed because of one outlying study of 8 years' duration. If the duration of this study is not included the average duration drops by more than 6 months to 10.4 months. This duration does not appear to be adequate, especially in studies looking for outcomes related to changes in BMI.

Dietary Habits

Fourteen of 16 studies (88%) implemented dietary habit interventions. These programs were diverse and included classroom-based nutritional education sessions, reducing the percentage of energy from fat to less than 30%, and introduction of dietary practices aimed at increasing the use of lower-fat foods and fruits and vegetables (Caballero et al. 2003; Warren, Henry, Lightowler, Bradshaw, & Perwaiz, 2003), using the Kid's Activity Pyramid and MyPyramid for Kids (Cason & Logan., 2006), low-fat Jeopardy games (Frenn, Malin, & Bansal, 2003), focus on healthy

TABLE 1. Summary of school-based programs

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
#1 Agron et al. (2002); Food on the Run	High school (average 10th grade, 16 years old); N = 220; California, USA	Training for 9 wks basics of nutrition and physical activity; working with food service to increase healthful food options, school-wide taste tests, lunchtime demonstrations	9 mo	(a) Physical activity knowledge, attitude and behavior (b) Nutrition knowledge, attitude, and behavior	III B	None identified	(a) Significant increase in knowledge ($P < .01$) and positive attitudes ($P < .01$) toward physical activity; no significant change or increase in behavior (b) Significant increase in knowledge about ($P < .05$) and positive attitudes ($P < .001$) toward nutrition; significant change in healthful eating behavior ($P < .001$)
#2 Caballero et al. (2003); Pathways	3rd to 5th grades, N = 1704; Arizona, New Mexico, and South Dakota, USA	Three 30-minute physical education sessions per week during school time (based on SPARK curriculum); two 10-minute exercise breaks performed inside or outside of the classroom; two 45-minute sessions delivered by teachers each week for 12 wks in 3rd and 4th grade and 8 wks during 5th grade; family involvement program	3 y	(a) BMI (b) Triceps and subscapular skin fold measures (c) Percentage of body fat (d) Motion sensor (e) Self-reported activity questionnaire (f) Knowledge, attitudes, and behavior questionnaire (g) Direct observation of lunches	II B	SCT	(a, b, c) No statistically significant difference in anthropometric variables at baseline and follow-up between the control and intervention groups (d) No significant difference between control and intervention groups (e) Self-reported physical activity levels were higher among intervention group than control group (f) Knowledge increased significantly in the intervention group compared with control group; self-efficacy to be physically active higher in the intervention group; self-efficacy to choose healthy foods no difference between groups; greater healthy food choice intentions in the intervention group vs. control (g) Lower fat intake, but no difference in energy intake 58% families attending events

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
#3 Cason & Logan (2006); JIFF	4th grade; N = 130; South Carolina, USA	Seven 1-hr lesson units; JIFF content includes food and physical activity pyramid; the lessons address science, math, physical education, & health education standards	14 weeks	(a) Physical activity knowledge/behavior questionnaire (b) Nutrition knowledge/ behavior questionnaire	III B	None identified	(a, b) Significant improvement in all food-related behaviors and physical activity in the intervention group in comparison with pre- and post-intervention (a, b) The intervention group demonstrated improvement in 13 out 21 items on the questionnaire more than the control group
#4 Coleman et al. (2005); El Paso CATCH	3rd grade; low socioeconomic (93% Hispanic); N = 896; 4 CATCH, 4 control schools; Texas, USA	Diet and physical activity classroom lessons; physical activity intervention; school food service intervention; family involvement	2 school years	(a) Risk for and overweight (BMI) (b) Height, weight, and waist circumference (c) 9-minute run (d) Cafeteria meal quality	III B	None identified	(a) Rate of increased risk significantly lower in CATCH groups (b) No effect (c) 3rd grade: control = CATCH; 4th grade: control > CATCH; 5th grade: control < CATCH; 6th grade: control = CATCH (d) CATCH schools met fat content goals in second year
#5 Frenn, Malin, & Bansal (2003)	6th-8th grade; N = 182; low income (African American, White, Hispanic); Midwest, USA	Classroom and small group sessions that emphasized low-fat diet; increase in physical activity	4 intervention sessions; 4 small group sessions	(a) Food habits questionnaire to measure percentage of fat in food (b) Child and adolescent activity log used to collect physical activity data	III B	Pender's HPM and TTM	(a) Post-test percentage of fat in food was significantly less ($t = 2.06$, $P = .04$) (b) Duration of exercise in the intervention group significantly higher in the intervention group than in the control group ($t = 2.925$, $P = .004$)
#6 Frenn, Malin, Bansal, Delgado, and associates (2003); Internet and video	7th-8th grade; N= 130; 2 schools; Midwest, USA	4 session (Internet and video) intervention with healthy snacks; gym lab in 1 school	4 sessions in 1 academic year	(a) Food habits questionnaire to measure percentage of fat in food (b) Child and adolescent activity log used to collect physical activity data	III B	HPM and TTM	(a) No significant decrease in dietary fat intake between intervention and control; significant mean differences demographic variables; girls in the intervention decreased their dietary fat in comparison with the control group ($P = .018$)

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
							(b) Both control and intervention groups decreased their amount of moderate and vigorous activity; the level of decrease was less in the intervention group (−8.58 min) compared with control group (−37.61 min); those with peer-led gym lab increased their total physical activity
#7 Haerens et al. (2006)	7th and 8th grade; 15 schools; N = 5 intervention with parental involvement; N = 5 intervention; N = 5 control; West Flanders, Belgium	3 behavioral changes: increasing fruit consumption to at least 2 pieces/day, reducing soft drink consumption, and increasing water consumption to 1.5 L a day, and reducing fat intake; computer-tailored intervention for fat intake; increasing MVPA to at least 60 min/day; extra sports materials were made available; physical fitness test and computer-tailored intervention for physical activity; cycle for 10 minutes on a computerized cycle ergometer; interactive meetings on healthy food, physical activity, and the relationship with overweight and health; CD was given for fat intake and physical activity	2 school years	(A) Physical Activity Questionnaire (B) Physical Activity measured via accelerometers; MVPA (c) Fat Intake Questionnaire	II B	TPB and TTM	(a) Boys demonstrated significant effects on levels of physical activity, but not on eating behaviors; school- related physical activity increased significantly more in the intervention group ($P < .05$) than in the control group (b) Accelerometer data demonstrated significantly lower decreases in physical activity of light intensity in the intervention groups (−6 min/day) compared with control groups (−39 min/day, $P < .001$); moderate to vigorous physical activity remained stable in the intervention group while significantly decreasing in the control group ($P < .05$); girls' time spent in physical activity of light intensity decreased less in the intervention groups (−2 min/day) compared with the control groups (−20 min/day, $P < .05$)

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
							(c) Decreases in fat intake and percent energy from fat were significantly higher in the intervention groups (−20 g/day) compared with control groups (−10g/day, $P < .05$)
#8 Hawley et al. (2006)	6th grade; N = 65; rural Kansas, USA	Five 40-mnute sessions during physical education class; improving nutrition knowledge through food pyramid and lowering fat intake; family fun night	6 wks	(a) Self-reported physical activity (student & family) (b) Self-reported eating behavior (student & family)	II B	TTM & SCT	(a) Significant increase in self-reported behavior of level of physical activity over the course of the intervention, from a mean of 5.73 METs pre-test to a mean of 7.56 METs at post-test ($P < .01$) (b) No significant improvement in their knowledge of nutrition and goal setting; changes occurred in families; goal of eating healthy as significantly more higher post-intervention, from a mean of 5.73 pre-test to a mean of 6.10 post-test ($P < .05$); shift in the families' readiness to change in the areas of nutrition and exercise; no significant changes in students' individual health attitudes and behaviors from intervention pre- post-test
#9 James et al. (2004); CHOPPS	Ages 7-11 y; N = 644; 29 classes Southern United Kingdom	Educational sessions aimed at reducing carbonated beverage consumption and increasing water consumption	3 sessions (1 per term)	(a) BMI (b) Carbonated drink and water consumption using diaries	II B	None identified	(a) BMI no difference between control and intervention; % of overweight and obese children increased in control by 7.5% compared with decrease in intervention of 0.2%

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
							(b) Carbonated drink consumption decreased in the intervention group (0.6 glasses fewer) compared with an increase in control group (0.2 glasses), 95% CI: 0.1 to 1.3; water consumption no differences between control and intervention
#10 Kain et al. (2004)	1st-8th grade; N = 3086; 5 schools; Chile	Nutrition education for children and parents supported by ''healthier food kiosks''; 90 min of additional physical activity weekly (3rd-8th grade) and 15 min of activity during recess/day for the last 3 mo	6 mo	(a) BMI (b) Triceps skinfold (c) Waist circumference (d) Physical fitness (shuttle run test and lower back flexibility) (e) Food frequency questionnaire	II B	None identified	(a) BMI: no difference between intervention and control group (b) Skin folds: no difference between intervention and control group (c) Waist circumference: decreased significantly in intervention group by a mean of 0.9 cm and increased in control groups by 0.9 cm (d) Shuttle run and lower back flexibility demonstrated improvement for both boys and girls in the intervention group compared with the control group (e) Outcome not reported

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
#11 Muller et al. (2001); KOPS	Ages 5-7 y; N = 1640; 6 schools; Kiel, Germany	Nutrition education taught by nutritionist and teachers to emphasize eating more fruit and vegetables daily; reduce the intake of high-fat foods; keep active at least 1 h/day and decrease TV watching to less than 1 h/day; structured sports program was offered to families with overweight or obese children twice weekly for 6 mo	8 years	(a) BMI (b) Triceps skin fold thickness (c) Nutrition knowledge (d) Daily fruit and vegetable consumption (e) Daily intake of low fat food (f) Daily physical activities (g) TV watching	II/III B	None identified	(a) BMI: no significant differences between intervention and control groups (b) Triceps skin fold demonstrated significant improvement in the intervention group whereas no difference in changes in the control group at 1-year follow-up (c) Nutrition knowledge: significant increase from 48% to 60% (d) Daily fruit and vegetable consumption: increased from 40% to 60% (e) Daily intake o f low-fat foods increased from 20% to 50% (f) Daily physical activities: significant increase from 58% to 65% (g) Decrease in TV watching: significant decrease from 1.9 h/d to 1.6 h/day
#12 Nuemark-Sztainer et al. (2003); New Moves	9th-12th grade; N = 201; 3 schools; Minnesota, USA	Physical activity 4×/wk; community guest instructors 1 d/wk; healthy lifestyle education that included nutrition and social support offered every other week; parental support by receiving postcard that pertained to various health topics	16 wks	(a) BMI (b) Behavioral change, personal change, and socioenvironmental change assessed utilizing various questionnaires	II B	SCT	(a) BMI: no difference between control and intervention (b) All did not achieve significance with the exception of progression in the stage of change for physical activity ($P = 0.004$)

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
#13 Pangrazi et al. (2003); PLAY	4th grade N = 606 35 schools Arizona, US	4 groups: PLAY, PE, PLAY and PE, and no treatment groups; intervention consisted of 3 steps facilitated by the classroom teacher: Step 1—Promote play behavior; Step 2— Introduce teacher-directed activities; Step 3—Encourage self-directed activity; incorporated 15 min of daily activity during school and encouraged 30 min outside of school	12 wks	(a) BMI (b) Physical activity: pedometer measuring steps/day	II B	None identified	(a) BMI: no difference between control and intervention groups (b) All students in the PLAY and PE and PLAY only groups were significantly more active than the control group; girls in the PLAY and PE and PE only groups were significantly more active than control groups
#14 Sahota et al. (2001); APPLES	Ages 7-11 y; N = 634; 10 schools Leeds, United Kingdom	Nutrition education incorporated into curriculum; healthy eating class sessions delivered by a dietician; healthy assemblies; school meals offering healthy food choices; healthy tuckshops (small retail shops found in schools or youth clubs, common in Britain); Fit is Fun program incorporated into PE lessons	1 academic year	(a) BMI (b) Dietary intake (24-h recall and 3-day food diaries) (c) Physical activity (measured by questionnaire) (d) Psychological measures (Self-perception Profile for children, questionnaire to determine global self-worth from competence and a measure of dietary restraint) (eNutrition knowledge	II B	None identified	(a) BMI: no significant difference between intervention and control (b) Dietary intake: vegetable consumption was significantly higher in the intervention group (0.3 portions d^{-1}, 95% CI 0.2-0.4) (c) Sedentary behavior increased by one third in the overweight children in the intervention group compared with overweight control children (d) Psychological measures demonstrated a small increase in global self-worth for obese children in the intervention schools

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TABLE 1. Continued.

Authors/year/program	Sample Age/grade/size	Intervention	Duration of program	Outcome measures	Level of evidence	Theoretical framework	Outcome
							(e) Nutrition knowledge: children in the intervention schools demonstrated higher levels of self-reported behavior change, understanding, and knowledge
#15 Warren et al. (2003); Be Smart	Ages 5-7 y; N = 218; 3 schools; Oxford, United Kingdom	Promotion of physical activity in the playground; TV reduction; healthy nutrition was delivered during lunchtime clubs	4 school terms (14 mo)	(a) BMI (b) Skin fold measurements at 5 sites (biceps, triceps, subscapular, supra-iliac and calf) (c) Nutrition knowledge (validated questionnaire) (d) Physical activity: parents and children were asked basic questions regarding habitual activity (e) Dietary assessment consisted of 24-h diet recall and food frequency questionnaire, which was completed by the parents	II B	SCT	(a, b) No significant differences in BMI between groups at baseline and overall; during the final stage, there were no significant changes in the rate of overweight and obesity noted (c) Nutrition knowledge scores improved in all children between baseline and final stage, no gender differences (d) No intervention effect was noted in the parental questionnaire on physical activity outside of school (e) Improvement in nutrition knowledge ($P < .01$), significant improvement in fruit ($P < .01$) and vegetable consumption ($P < .05$)
#16 Wheling-Weepie & McCarthy (2002)	4th-5th grade; N = 36 (no control group); Midwest, USA	Nutrition in foods; classification of foods into groups/food pyramid; role of physical activity in keeping the body healthy; calculate the percent of fat in foods; media influences in food selection and body image	5 lessons (5 wks)	Nutrition and healthy lifestyle knowledge (questionnaire)	III C	Gillespie	Significant increase in post-test scores ($P < .001$); demonstrated improved scores on the questions that were related to the concepts of the Food Pyramid, composition of a balanced meal and healthy snack, purposes of commercial advertisements, knowledge of the nutrition label, process of digestion and taste, and healthy goal setting

APPLES, Active Program Promoting Lifestyle in Schools; BMI, body mass index; CATCH, Child and Adolescent Trial for Cardiovascular Health; CHOPPS, Christian Church Obesity Prevention Project in Schools; HPM, Health Promotion Model; JIFF, Jump into Foods and Fitness; KOPS, Kiel Obesity Prevention Program; METs, metabolic equivalent scores; MVPA, moderate to vigorous physical activity; PE, physical education; PLAY, Promoting Lifestyle Activity for Youth; SCT, Social Cognitive Theory; TPB, Theory of Planned Behavior; TTM, Trans-theoretical model.

TABLE 2. Interventions utilized in school-based childhood obesity prevention programs

Subjects	Intervention: dietary	Intervention: physical activity	Intervention: healthy lifestyle education	Intervention: parental involvement
#1 Agron et al.	Yes	Yes	Yes	No
#2 Caballero et al.	Yes	Yes	Yes	Yes
#3 Cason & Logan	Yes	Yes	Yes	Yes
#4 Coleman et al.	Yes	Yes	Yes	Yes
#5 Frenn, Malin, Bansal, Delgado, and associates	Yes	Yes	Yes	No
#6 Frenn, Malin, Bansal, Delgado, and associates	Yes	Yes	Yes	No
#7 Haerens et al.	Yes	Yes	Yes	Yes
#8 Hawley et al.	Yes	Yes	Yes	Yes
#9 James et al.	Yes	No	Yes	No
#10 Kain et al.	Yes	Yes	Yes	Yes
#11 Muller et al.	No	Yes	Yes	Yes
#12 Nuemark-Sztainer et al.	Yes	Yes	Yes	Yes
#13 Pangrazi et al.	No	Yes	Yes	No
#14 Sahota et al.	Yes	Yes	Yes	No
#15 Warren et al.	Yes	Yes	Yes	Yes
#16 Wheling-Weepie & McCarthy	Yes	No	Yes	No

snacks (Frenn, Malin, Bansal, Delgado, et al., 2003; Kain et al., 2004; Neumark-Sztainer, Story, Hannan, & Rex, 2003), increased fruit consumption and reduction in soft drink consumption (Haerens et al., 2006; James, Thomas, Cavan, & Kerr, 2004), school meals offering healthy food choices (Sahota et al., 2001), and developing healthy meals (Wheling-Weepie & McCarthy, 2002).

Physical Activity

Fourteen of 16 studies (88%) implemented physical education programs. While the inclusion of physical fitness interventions into the studies was fairly ubiquitous, the approaches differed significantly. Fitness programs ranged from broad-spectrum basic physical activity to specifically tailored programs. Caballero and associates (2003) incorporated three 30-minute physical education sessions per week as well as two 10-minute exercise breaks inside the classroom. Haerens and colleagues (2006) implemented a program of at least 60 minutes per day of moderate to vigorous activity in which children wore accelerometers to measure activity levels. Hawley, Beckman, and Bishop (2006) assigned metabolic equivalent scores to each activity to quantify activity levels and implemented five 40-minute sessions consisting of "adventure based/experimental games and tasks." Muller, Asbeck, Mast, Lagnase, and Grund (2001) offered structured sports programs to families with overweight or obese children two times per week for 6 months. One study was based solely in physical education classes consisting of girls only, which met four times per week (Neumark-Sztainer et al., 2003).

Healthy Lifestyle Education

All 16 studies applied healthy lifestyle education. This element appears to be an essential component of any school-based obesity intervention program. Fifteen of sixteen studies focused on formal classroom sessions. Some studies developed unique methods of incorporation of healthy lifestyle education into the curriculum. For example, Frenn, Malin, Bansal, Delgado, and associates (2003) used video sessions to aid in healthy lifestyle education. Haerens and associates (2006) used a computer-tailored model of intervention. Neumark-Sztainer and colleagues (2003) incorporated videos pertaining to body image and poster collages within the physical education class setting. Warren and colleagues (2003) used quizzes, flash cards, and craftwork. One study used informal education techniques. Pangrazi, Beighle, Vehige, and Vack (2003), as part of the Promoting Lifestyle Activity for Youth intervention, encouraged teachers to discuss the importance of physical activity frequently.

Parental Involvement

Nine of 16 studies integrated family involvement into the obesity intervention. For example, Caballero and associates (2003) incorporated family fun nights and workshops to help keep parents informed and involved. Cason and Logan (2006) sent newsletters home to family members to reinforce concepts taught in class. Haerens and associates (2006) used newsletters and interactive meetings to keep parents involved. Hawley and colleagues (2006) provided parents with a family field guide and provided a community family fun night. In the study by Muller and colleagues (2001), home visits were provided by a dietician. Warren and associates (2003) asked parents to fill out a social and medical history and provide a dietary and physical activity assessment and had their nutrition knowledge assessed in the form of a questionnaire.

Body Mass Index

Nine of 16 studies (56%) evaluated the effect of their intervention on BMI. Of the nine studies, only one study resulted in any significant difference in BMI characteristics between intervention and control populations (James et al., 2004). In overweight and obese children who reduced their intake of carbonated beverages, there was a small (0.2%) reduction in BMI compared with an increase in BMI of 7.5% in the control group (James et al.).

Research Level

Using the model by Stetler and colleagues (1998), which describes six different levels of research, each study was evaluated for research significance. All of the studies reviewed used an experimental research design. Five of sixteen articles were quasi-experimental studies, while nine of the 16 articles represented individual experimental studies. The studies by Muller and associates (2001) and Wheling-Weepie and McCarthy (2002) used biphasic approaches, employing both individual experimental study design and quasi-experimental design.

DISCUSSION

From the data extracted from the 16 articles meeting the criteria for inclusion, it is apparent that the current modalities being used in school-based obesity prevention programs lack a congruous approach. It is clear that obesity prevention is a multifactorial problem requiring intervention in the areas of dietary habits, physical activity, and healthy lifestyle education, while enlisting dedicated parental involvement. Most of the studies included multiple areas of intervention, with a number of them addressing all four aspects analyzed in this study. This integrative review of available current literature points to no specific intervention or combination of interventions as the most beneficial.

While a number of the studies reviewed proved to be beneficial in one or more areas, all of them had limitations. The most striking limitations were those of duration and impact on BMI. The average length of the interventions with specifically stated durations was 10.4 months (excluding a study of 8 years, the results of which have not yet been reported), with two studies having a duration of 6 weeks or less (Hawley et al., 2006; Wheling-Weepie & McCarthy, 2002). Of the nine studies using BMI as an outcome measure, the average duration was 13 months, with a range of 3 to 36 months. None of these studies achieved an outcome of significantly lowering BMI, and only one achieved a statistically significant difference between intervention group and control group (James et al., 2004). Because of the multifactorial nature of the problem, it is impossible to make a direct correlation between duration of study and effect on BMI. However, Caballero and associates (2003) represents the longest study duration (36 months) of those using BMI as an outcome measure and looked at a specific cohort of American Indian schoolchildren. They stated that "the lack of effect of the intervention on [percent body fat] suggests that more intense or longer interventions may be needed to modify the continuing trend toward higher adiposity in this population." (p. 1037).

While some of the interventions were long term, many had a duration of 6 months or less, which appears to be an inadequate duration to achieve significant changes in BMI. This observation is supported by Kain and associates (2004), whose study duration was 6 months. They concluded that the finding of decreased adiposity in the male participants in the intervention group was most likely a result of better adherence to the physical activity portion of the intervention and greater intensity of activity, but this observation needs to be evaluated over a longer duration to obtain a more definitive answer. Similar conclusions also were stated by Sahota and colleagues (2001), whose study duration encompassed one school year. They believed that BMI "could not be expected to change significantly over such a short time" (p. 4) and in fact should not change significantly for fear that the children are taking part in an intervention that is too intense. Thus it cannot be denied that longer studies with an adequate amount and intensity of physical activity can have an impact on BMI. This belief is supported by Caballero and colleagues (2003), who note that increases in daily activity coupled with decreases in time spent sedentary have been positively associated with weight maintenance in children. Current evidence suggests that the prevention of transition to overweight or obesity requires about 45 to 60 minutes of moderate intensity activity daily (Saris et al., 2003). In addition, the CDC (2003) recommends at least 60 minutes daily of moderate to vigorous activity for children and adolescents in activities that are enjoyable and involve a variety of activities. In a similar review by Saris and associates (2003) that examined 13 prospective studies on physical activity and weight gain, 11 of those studies demonstrated that a lower level of physical activity was associated with an increase in BMI, body fat, weight, or percent overweight/obese. In addition, they concluded that an acceptable level of physical activity was essential to prevent weight gain.

Parental involvement is an essential component to any school-based intervention (Dietz & Gortmaker, 2001). Without parental involvement and support, results are usually fleeting. The AAP policy statement on prevention of pediatric overweight indicates "Families should be educated and empowered through anticipatory guidance to recognize the impact they have on their child's development of lifelong habits of physical activity and nutritious eating" (AAP, 2003, p. 427). In this review; however, only

9 of 16 articles reviewed had any parental component. One study made a point of involving parents to the extent of including three to five home visits by a nutritionist into the curriculum (Muller et al., 2001).

A majority of the studies, however, while including a parental component, seemed to fall short of the needed depth of involvement, and six studies had no parental involvement at all. The study by Neumark-Sztainer and associates (2003), for example, involved parents through a series of 14 postcards dealing with health-related topics that were mailed home every 2 to 3 weeks. These mailings consisted of topics such as "Strawberry season is coming, so get your taste buds ready," which had no correlation to the actual intervention (p. 46). This approach never directly involves the parent in the actual intervention and thus falls short of the desired outcome.

According to Pyle and colleagues (2006), the inclusion of a parental involvement component to obesity interventions is "crucial." The parental role should be "central to the collective efforts to combat the nation's childhood obesity epidemic" (Lindsay et al., 2006, p. 170). A wealth of literature supports the importance of parental involvement in childhood obesity prevention. It would appear that the studies that omit this component from school-based obesity prevention programs may not be establishing an intervention with the potential for long-term success.

Healthy lifestyle education was used as an intervention component in all 16 studies reviewed. This modality appeared to be a successful intervention in many of the studies. Significant increases were seen in knowledge about and positive attitudes toward nutrition and food-related behaviors (Agron, Takada, & Purcell, 2002; Caballero et al., 2003; Cason & Logan, 2006). Increases in knowledge as determined by post-intervention questionnaires would be anticipated because of the relatively short duration of the interventions. A more significant measurement could involve the retention of knowledge and its implementation into daily dietary habits or physical activity. Because the majority of the reviewed studies failed to report long-term post-intervention follow-up regarding maintenance of knowledge or physical activity patterns, the retention of these parameters is unknown.

Dietary habit modification also showed effectiveness in a number of interventions. In two studies that had both dietary habit intervention and strong parental involvement, promising behavioral modifications took place. Caballero and colleagues (2003) produced significant changes in fat intake and in food-related and health-related knowledge and behaviors. Coleman and associates (2005), in the Child and Adolescent Trial for Cardiovascular Health (CATCH) intervention, focused on school food service. In the CATCH program, intervention cohorts were able to meet recommended fat content goals, whereas control cohorts were not able to do so. In this study, the rate of increase in risk of overweight was significantly lower in boys and girls in the intervention group compared with control subjects. Surprisingly, in the study by James and associates (2004), which had no parental involvement, a modification of the intake of carbonated beverages resulted in a significant difference in percentage of overweight and obese children in the control group versus the intervention group. This finding may point to a larger than anticipated impact of highly sweetened carbonated beverages on the obesity epidemic. The World Health Organization has recommended that this type of simple sugar be limited to no more than 10% of daily energy intake (James et al.).

Physical activity as an intervention component was evaluated in 14 of the 16 studies. It seems intuitive that any obesity prevention program should include some form of physical activity advocacy and education. What is not intuitive is the proper intensity and duration of the activity or where and when to employ it, which is made apparent by the diversity of approaches utilized in the studies reviewed. Despite the multiple approaches, there was very little change in physical activity patterns among any of the studies. If fact, one study resulted in a decrease in activity among study participants (Frenn and associates, et al., 2003). This decrease, however, was significantly less than that of control subjects (−8.58 minutes vs. −37.61 minutes.). Interestingly, when this cohort is broken down further into peer-led activity intervention versus Internet and video-only intervention, the peer-led activity group actually increased their total physical activity. This finding suggests that while healthy lifestyle education and dietary habit modification alone may slow or decrease activity level, a more hands-on approach to physical activity modification is required to increase activity.

The ultimate goal of the present study is to use the information gathered to draw attention to the need for a more cohesive method of developing and implementing school-based overweight and obesity prevention programs. It is evident from the studies examined in this review that school-based obesity prevention programs can and do have a positive impact on knowledge, attitudes, and behaviors in children and adolescents regarding nutrition and physical activity. Schools are an important part of the social environment that shapes children's dietary and physical activity patterns and therefore play an integral role in promoting positive changes in knowledge, attitudes, and behavioral modifications. In addition to the school environment, parental involvement is critical in reinforcing the patterns of healthful dietary practices at

home and encouraging daily physical activity while discouraging television and video game overuse (Barlow & Dietz, 1998).

Our task in the near future is to develop a cohesive, long-lasting, and reproducible approach to dealing with this far-reaching and growing epidemic while utilizing theoretical frameworks to guide the development, implementation, and evaluation of interventions, as well as evidence-based strategies. It is evident from this review that childhood obesity is a global epidemic. This study includes articles from United Kingdom, Chile, and Germany, as well as the United States. Therefore, the task is not easy because the diversity, both culturally and economically in the United States, and especially abroad, requires that programs be modified to meet the individual community's needs. Eventually a nationwide program of healthy lifestyle education and physical fitness should be implemented in all schools. This program should be initiated at the earliest levels and carried out through high school graduation. This endeavor may pose several challenges, such as cost, buy in from key stakeholders, and resistance from school administrators. It is our belief that for a program to be successful and sustainable the intervention components must include dietary, physical activity, healthy lifestyle education, and parental involvement. These components should be developmentally appropriate and culturally relevant, as well as of a sufficient duration to achieve desired outcomes.

Study Limitations

A potential limitation of this review is that the literature search was limited to articles and journals retrieved from only three search engines, CINAHL, Medline and PsycINFO, which may increase the probability of inadequate sampling. Undoubtedly, other articles exist but were excluded from review if they were not found on the aforementioned search engines at the time of review. The significance of utilizing multiple channels for obtaining research articles is essential for increasing validity of the integrative review (Cooper, 1984).

Involvement of school food service programs appears to be an effective method of influencing dietary habits at school. A program that includes healthy lifestyle education supported by a strong parental influence at home also is key.

RECOMMENDATIONS

At the conclusion of this integrative review, we find that the most effective school-based obesity intervention programs should be guided by behavioral theoretical frameworks. The study should include an experimental research design that includes the intervention components of dietary habit modification, physical activity modification, healthy lifestyle education, and parental involvement. BMI should be one of the outcome measures. This belief is supported by Baranowski and associates (2000), who found that measures of height and weight are "critical for both surveillance and epidemiologic research" (p. S6). The program should be of a duration long enough to give the participants ample time to exhibit the desired outcome. Involvement of school food service programs appears to be an effective method of influencing dietary habits at school. A program that includes healthy lifestyle education supported by a strong parental influence at home also is key. This review provides no definitive recommendations regarding physical activity. It is clear that because of cultural and financial diversity among U.S. children, each program will need to have aspects specifically tailored to each community. However, a strong infrastructure with reproducible components can and should form the basis for all of these programs.

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