

Research Article

Childhood Obesity: A Qualitative Review of School-Based Interventions

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Childhood obesity rates have more than doubled in the past thirty years. Obesity increases the risk of cardiovascular disease, diabetes mellitus, osteoarthritis, and multiple types of cancers. Schools are a logical setting for childhood obesity prevention interventions. The purpose of this review was to determine how effective school-based interventions are in reducing childhood obesity. A literature search was conducted using the databases: CINAHL, Academic Search Premier, ERIC, MEDLINE, and Psychology and Behavioral Sciences Collection between 2005 and 2015. There were a total of 13 interventions that met the inclusion criteria. The majority of interventions (85%) targeted both physical activity and nutrition behaviors. The majority of the studies took place in the elementary and middle schools. More than half of the interventions used a behavioral theory with social cognitive theory being the most common theory. There is a need to design more robust and theory-driven school-based interventions.

Keywords: Childhood obesity; CINAHL; Health

Introduction

Childhood obesity rates have continued to grow. It has more than doubled in the past thirty years [1]. The percentage of children 6 to 11 that were obese increased from 7% in 1980 to 18% in 2012. During the same time period, adolescents 12 to 19 had an increase in obese children from 5% to 21%. It is clear that over time the obesity epidemic among U.S. children and adolescents has continued to steadily grow. Obesity is known to be a contributing risk factor in multiple different chronic illnesses [2]. The prevalence of obesity is 31.3% of children 10 to 17 years old in the United States [3]. This continued growth and trend over the years have been attributed to many different factors. Environment factors are the most popular and common factor attributed to the risk of increased obesity. These factors are things such as access to healthy foods, access to high energy foods, and access to areas to participate in physical activity, and other factors all play a major role in increasing the risk of obesity [4].

Obesity increases the risk of cardiovascular disease, diabetes mellitus, osteoarthritis, and multiple types of cancers [4]. This increase of risks has led to increased morbidity and mortality related to these chronic illnesses. The adverse health outcomes related to obesity have shown earlier onset of some chronic illnesses such as diabetes as well as premature deaths. Childhood obesity can have a negative effect on social and psychological factors, and inherently lead to long term morbidity and eventually mortality [4]. Early progression of these risk factors proves truly important in targeting the obesity epidemic at an earlier stage in human life to improve overall health and quality of life of individuals.

It has become a public health priority across the nation, and is becoming a global interest. For this reason, it is imperative to develop evidence-based strategies to help slow down and reverse this growing trend. Schools are a promising setting to implement these

strategies for children. Schools are the setting where most children spend the bulk of their time, and consume the majority of their daily meals during the week. It provides a large number of available participants in a convenient sample. Legislation has been helpful in utilizing guidelines to implement interventions in schools. To date it is unclear how many school-based obesity interventions have been truly effective.

There have been multiple school based intervention reviews completed. This article will review interventions published after 2004 due to a previous review that was published in 2006. Sharma [5] reviewed articles from 1999 to 2004, and found that targeting physical activity and nutrition is important. The articles also found that curricular programs should be supplemented with health promotion interventions. It has been expressed that interventions should include home components and pay attention to environmental and cultural practices [2].

There are multiple areas of focus that can be conducted within school-based interventions to affect change in obesity. There are some interventions that have focused on nutrition and diet. Other intervention studies have looked at physical activity. Researchers have studied programs that focused on the effectiveness of slowing down excessive weight gain. Interventions have been created to increase knowledge and eliminate environmental factors with obese children to create a healthy behavior change. There are also interventions that have multiple focuses in trying to create sustained behavior change. It is in this context that the purpose of this review is to determine how effective school-based interventions are in reducing childhood obesity. Our *a priori* hypothesis in this regard seems to be that there would be few school-based interventions and will have modest effects. The PRISMA statement will be used to describe the methods used to evaluate interventions.

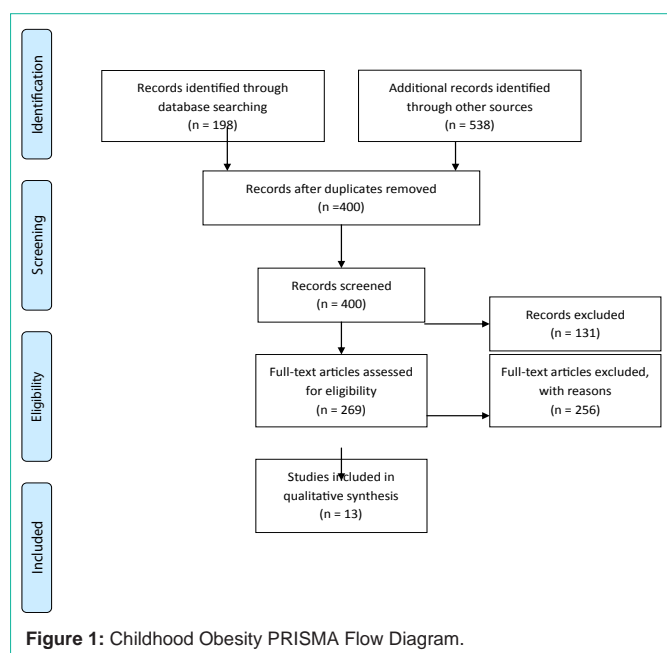


Figure 1: Childhood Obesity PRISMA Flow Diagram.

Methods

A literature search was conducted using the databases: CINAHL, Academic Search Premier, ERIC, MEDLINE, and Psychology and Behavioral Sciences Collection. There were two searches conducted. The first search used the key terms: child obesity intervention. The second search used the key terms: school based obesity interventions. The inclusion criteria included: occurred between 2005 and 2015, written in English, school is the major setting of the study, and an intervention is being conducted. The exclusion criteria included: non-English articles, older than 2005, review articles, reports, family-based intervention, primary-care based, cost effectiveness study, community-based, non-intervention study, and intervention protocol studies. Figure one shows the PRISMA diagram used to select articles. PRISMA is used to ensure transparent and complete reporting of systematic reviews [6]. Figure 1 displays the system utilized for the interventions reviewed for this study.

Results

There were a total of 13 interventions reviewed that are discussed in this article and summarized in [Table 1,2]. These have been arranged chronologically. Eighty-five percent of the interventions focused on both diet and physical activity as the behavior change. Eight percent of interventions focused on diet only, and 8% of interventions focused on physical activity only. The top three most used theories were Social Cognitive Theory, Social ecological model, and the Health Belief Model. Thirty eight percent of the studies did not utilize a behavioral theory. The quasi experimental design was the most used design. Randomized controlled trials were also used as the experimental design. The most popular components for interventions were nutrition curriculums and increased physical activities Table 1&2.

Ninety-two percent of the studies used BMI as an outcome measure. Waist circumference, skinfold thickness, and body fat percentage were also popular outcome measure used. Eight-five

percent of the studies used both physical activity and diet as the behavior change as the mechanism for change of the intervention outcome. Knowledge, awareness, and environment were the most use mediating variables in the studies. Only 38% of the studies used process evaluation to verify the fidelity of their intervention.

The first intervention is the study of the *Planet Health* program by Chavarro et al [7]. This study examined the effect of obesity reduction on the onset of menarche. The researchers assessed physical activity, video and movie time, and BMI. They found that the intervention help to delay menarche in intervention girls ($p < 0.0001$), and found that it increased in physical activity, reduced physical inactivity, and changed BMI/fat distribution ($p < 0.0001$).

A second intervention is the study of the *HEALTH-KIDS* program by Wang et al [8], which examined the effect of improved social and school nutrition and physical activity environments on BMI, dietary intake, and physical activity. The study was conducted in urban African American adolescents in the 5th to 7th grades. They assessed BMI, knowledge, dietary intake, and physical activity as it relates to school, family, and community environments. The researchers found baseline data to show that high energy foods were consumed regularly, high volumes of TV time, and minimal physical activity.

The next intervention is the study of the *Kiel Obesity Prevention Study (KOPS)* by Danielzik et al [9]. The study examined the effect of dietary and physical activity education on obesity. They assessed the nutritional status of student's effect on BMI, WC, and skinfold thickness. It was found the intervention reduced the increase in overweight children, and increased knowledge in children.

The next invention is the study of the *Switch what you Do, View, and Chew* by Gentile et al [10], which examined the effect of multilevel programming on screen time, fruits and vegetable consumption, and physical activity. They assessed food and beverages sold at school, physical activity programs and equipment, dietary and physical activity attitudes and behaviors of children, and community member involvement. The researchers found improvement in healthy behaviors and changed food and physical activity environment of children.

The next invention is the study of the *Health Eating Active Communities Program (HEAC)* by Samuels et al [11], which examined the effect improving children's environments in low income neighborhoods on obesity. They assessed BMI, physical activity, dietary consumption, and screen time at home. The researchers found the program to only offer a small amount of effectiveness in increasing fruits and vegetable consumption, but a significant effect on adult consumption ($p < 0.05$). Adults also saw a lower amount of screen time ($p < 0.05$).

The next intervention review is the study of the *Living 4 Life* program by Utter et al [12], which examined the effects of improved nutrition and increased physical activity on obesity. The study assessed BMI, nutrition, and physical activity. The researchers found that there were no significant differences between the intervention and nonintervention groups.

Another intervention is the study of the *Healthy School Start* program by Nyberg et al [13]. This study examined the effect of parental

Table 1: Summary of school-based childhood obesity prevention interventions (n=13).

#	Intervention/ Study	Theory	Intervention Duration & Description	Design & sample	Salient findings
1.	Planet Health [7]	Behavioral-choice Theory, Social Cognitive theory	- 16 classroom lessons over 2 school years - Components: 1) reducing television viewing to less than 2 hours per day 2) increase moderate and vigorous physical activity 3) consume less high fat foods 4) consume fruits and vegetables at 5 times a day	Quasi experimental	- Delayed menarche in intervention girls (p<0.0001) - Increased physical activity, reduced physical inactivity, and changed BMI/fat distribution (p<0.001)
2.	HEALTH-KIDS [8]	Social Cognitive Theory, Theory of Triadic Influence, Cultural Sensitivity, Social Marketing Theory	- Over 1.5 years deliver nutrition messages, increase physical activity at school, reduce sedentary lifestyle at home, monthly health class, and - Components: 1) Social environment enrichment 2) Community support and environment modification 3) Family Support	Randomized controlled intervention trial	- An increase in community awareness - Increased support of school staff and parents - School recess is a promising area for increased interventions
3.	KOPS [9]		- 6 h course of nutrition followed by 20 min 'active break' - Components: 1) eat fruits and vegetables 2) reduce high fat food intake 3) 1hr/day physical activity 4) watch tv<1hr/day	Longitudinal	- School-based health promotion had long term effects on overweight (p< 0.001) - Effect of intervention influenced by the parameters used to define overweight
4.	Switch what you Do, View, and Chew [10]	Social ecological framework	- Components: 1) Community: awareness 2) School: curriculum incorporation 3) Family: education packets	Clustered randomized control trial	- Offers small-to-modest effects on minimizing screen time and promoting fruits and vegetables consumption
5.	HEAC [11]		- Components: 1) Community: policy and environmental change 2) Technical assistance, advocacy, and policy	Quasi Experimental	- Improved healthy behaviors and changed food and physical activity environment of children to create a healthier lifestyle
6.	Living for Life [12]		- Components: 1) improve dietary behaviors 2) increase physical activity during and after school 3) decrease television use	Quasi experimental	- No significant differences - Potential effectiveness using peer leadership, but only with the support of school leadership and staff
7.	Healthy School Start [13]	Social Cognitive Theory	10 30-minute sessions over 6 months. Components: 1) brochures 2) motivational interviewing 3) teacher-led classroom activities	Clustered randomized control trial	- Can promote healthy lifestyles and normal weight development among low-income children with parental involvement
8.	TEAM Mississippi [14]	Social Learning Theory	- Monthly nutritional and physical activity events for 9 months - Components: 1) dietary habits 2) physical activity 3) fitness	Quasi experimental	- Improved physical activity and dietary habits (p=0.04 and p=0.0005) - A population-based approach is helpful
9.	Elizondo-Montemayor [15]		- Structured daily meals and physical activity plan every 3 weeks for 3 months - Components: 1) anthropometric assessment 2) dietetic assessment 3) physical activity recall 4) dietary planning 5) structured meals 6) 60-mins physical activity 7) parent education	Quasi experimental	- Decrease in overweight/obese students (p<0.01) - Decrease in prevalence of the metabolic syndrome in Mexican children (p<0.01)
10.	JOIN [16]		- 16 weekly 1-hour group sessions for 1 year - Components: 1) consumption of unhealthy foods and drinks 2) increase physical activity 3) manage screen time	Quasi experimental	- Programs need flexibility - Programs need to focus on one particular change agent at a time.
11.	Safdie [17]	Ecological Framework, Theory of Planned Behavior, Social Cognitive Theory, and Health Belief Model	- 18 months - Components: 1) basic: improve nutrition and physical activity norms 2) plus: same as basic with added financial and human resources	Quasi experimental	- Improved the food environment at school during school hours. (p<0.05) - Improvement in individual food intake behavior (p<0.05) - No effect on physical activity, overweight, or obesity - Human resources and financial support helpful

12.	DOiT [18]	Health Behavior Change	<ul style="list-style-type: none"> - 12 theory lessons, 4 physical activity lessons, and 3 optional lessons over 2 school years - Components: 1) reduce SCB intake 2) reduce sweets intake 3) reduce screen time 4) increase physical activity 5) consume daily breakfast 	Cluster-randomized controlled trial	<ul style="list-style-type: none"> - No significant intervention effect on measures - Intervention effective in reducing SCB consumption in girls (B = -188.2 ml/day; 95%CI = -344.0; -32.3). - Increase in breakfast consumption in boys (B = 0.29 days/week; 95%CI = 0.01; 0.58).
13.	Li [19]	Social ecological model	<ul style="list-style-type: none"> - 3 health education lectures, PE 3 times a week, extracurricular PA 3 times a week for 12 weeks - Components: 1) Improve PE 2) Extracurricular PA for overweight/ obese students 3) PA at home 4) health education 	Quasi experimental	<ul style="list-style-type: none"> - Program effective in increasing physical activity (p<0.001) - Multi-component physical activity program was effective in reducing BMI, skinfold thickness, fasting glucose, and increasing the duration of MVPA (p<0.05)

support on dietary and physical activity behaviors for children that are just starting school. The program focused on preschool children and focused on: health information for parents, brief motivational interviewing, and classroom lessons for the children. The researchers assessed physical activity, food intake, parental self-efficacy, waist circumference, and BMI. They found that the intervention help to promote healthy lifestyles and normal weight development among low-income children.

The next intervention review is the study of the *Team Mississippi Project* by Greening et al [14], which examined the effects of nutrition activities and increased physical activity on obesity. The study assessed BMI, knowledge, fitness level, percent body fat, WC, nutrition, and physical activity. The researchers found that there were improvements in physical activity and dietary habits (p=0.04 and p=0.0005).

Another intervention is the study of lifestyle intervention in Mexican children by Elizondo-Montemayor et al [15]. This study examined the effect of structured daily meals and physical activity plans on obesity and metabolic syndrome. They found that the prevalence of metabolic syndrome fell significantly from 44% to 16% (P < 0.01). There was a significant decrease in body mass index percentile (P < 0.01) and in body-fat percentage (P < 0.01).

Another intervention is the study of the study of collaborative school based interventions by Jain et al [16], which examined the effect using multifaceted programs conducted by school nurses and wellness coordinators on childhood obesity. They assessed the ability of the school nurses and wellness coordinators' ability to implement the programs at their respective schools. The researchers found the programs needed flexibility and that focusing on overall wellness was easier than focusing on just obesity.

Another invention reviewed is the study of a program's effect on obesity risk factors in Mexican children by Safdie et al. [17], which examined the effect of improved physical activity and dietary norms on the risk factors related to obesity. The researchers assessed eating behaviors, physical activity behaviors, and BMI. They found that the intervention improved the food environment at school during school hours (p<0.05) and Improvement in individual food intake behavior (p<0.05). The researchers suggested improvement in resources would be a major factor in changing health behavior.

The next invention is the *Dutch Obesity Intervention in Teenagers*

(*DOiT*) by van Nassau et al [18], which examined the effect of increased knowledge and awareness of proper dietary and physical activity behavior on energy-balance related behavior and adiposity. They assessed adolescent dietary and physical activity behavior and their BMI, skin fold thickness, and waist circumference. It was found that there were some beneficial effects in subgroups. There were no significant effects on BMI, WC, or adiposity.

The final invention reviewed is the study of a physical activity program in China by Li et al [19,20] which examined the effect of improved physical activity school programs on obesity in Chinese children. They assessed BMI, physical education, extracurricular physical activity, knowledge and physical activity at home. The researchers found the program to be effective in increasing physical activity (p<0.001).

Discussion

The purpose of this study was to review school-based interventions for preventing childhood and adolescent obesity carried out between 2005 and 2015. Sharma [5] reviewed school-based interventions which focused on preventing and treating childhood obesity. He reviewed interventions published between 1999 and 2004. He found that there were, overall, only modest changes in behavior. He found that screen time was the most modifiable behavior, and recommended that more enhancements should be done to increase the effectiveness of interventions. Since this review article's publication, there have been publications of other school-based interventions designed for preventing childhood obesity. This review focuses on 13 of those interventions. Based on the review completed, there were only 13 studies found, and it is evident that more intervention studies should be conducted seeing that childhood obesity has still continued to grow. The grade range of the interventions was primary, elementary, middle, and high school. The majority of the studies took place in the middle and elementary school range.

The majority of interventions (85%) targeted both physical activity and nutrition behaviors; however, there were two that focused on only one factor either physical activity or nutrition as the behavior change agent. These are two common factor attributed to the risk of increased obesity [4]. Multi-level and multi-component designs have shown to be more helpful in creating behavior change. Parental involvement and school buy-in was found to be very important in creating behavior and environmental change. Knowledge of nutrition and physical activity along with access to healthy environments

Table 2: Outcome measures, sample size details, process evaluation details and number of measurements in different school-based childhood obesity prevention interventions.

#	Study	Outcome Measures			Sample Size Justification	Process Evaluation	Number of Measurements
		Mediating and Moderating variables	Behaviors	Body Composition or Other Functional Outcome			
1.	Planet Health [7]	Decrease television time, increase physical activity	PA and diet	BMI, skinfold thickness, onset of menses	No	No	Two (pre, post)
2.	HEALTH-KIDS [8]	School social and physical environment	PA and Diet	BMI, WC, BP, skinfold thickness	No	Yes	Two (pre, post)
3.	KOPS [9]	Nutritional status	Diet	BMI, WC, and skinfold thickness	No	Yes	Three (pre, post, follow-up)
4.	Switch what you Do, View, and Chew [10]	Awareness, gender, and family involvement	PA and Diet	BMI	Yes	No	Three (baseline, follow-up, follow-up)
5.	HEAC [11]	Improve physical and food environment	PA and diet	Policy development	Yes	No	Two (baseline, follow-up)
6.	Healthy School Start [12]	Knowledge, attitude, and preference	Diet and PA	BMI and WC	Yes	Yes	Three (baseline, follow-up, follow-up)
7.	Living for Life [13]	Improve food quality and consumption and decrease sedentary lifestyle	PA and diet	BMI, weight, and body fat percentage	No	No	Two (pre, post)
8.	TEAM Mississippi [14]	Improve dietary habits and fitness	PA and diet	BMI, WC, and body fat percentage	No	No	Two (pre, post)
9.	Elizondo-Montemayor [15]	Metabolic Syndrome	Diet and PA	BMI, WC, BP, Glucose, Triglycerides, and HDL-C	No	No	Two (pre, post)
10.	JOIN [16]	Lifestyle change	PA and diet	BMI	No	No	Two (pre, post)
11.	Safdie [17]	Improve physical activity and food environments	PA and diet	BMI	Yes	Yes	Four (baseline, 3 follow-ups)
12.	DOIT [18]	Awareness/knowledge and access/efficacy	PA and Diet	BMI, WC, and skinfold thickness	Yes	No	Three (pre, post, post)
13.	Li [19]	PE improvement, increase knowledge about physical activity	PA	BMI, WC, skinfold thickness, serum lipids, duration of MVPA, and fasting glucose	No	Yes	Two (baseline, follow-up)

Note: PA: Physical activity; BMI: Body Mass Index; WC: Waist circumference; BP: blood pressure.

provides support to garner change in healthy behavior of children. Programs can be selected for creating change in children utilizing multilevel and multi-component studies [2]. There still needs to be development and enhancements of the interventions to create more effective programs to prevent childhood obesity in schools [5]. More than half of the interventions used a behavioral theory with social cognitive theory being the most common theory. More studies should be conducted on how policy changes that are coupled with health education and promotion affect behavior change.

Limitations

There are multiple limitations to this study. There is possible publication bias, where there were studies that were not published because they did not have significant findings. This may lead to possible studies being excluded if they do not have positive or significant results. There may also be reporting bias due to only studies written in English being reviewed. Another limitation was the lack of information on training, qualifications of intervention providers, and full results of the process evaluation. This does not allow for a full picture of how effective or ineffective the interventions were without that information. Finally, the variations in the lengths of the interventions would make it difficult to complete a full comparison between the various programs.

Implications for practice

Multi-level interventions directed towards reducing childhood obesity, as well as, adolescent obesity should target both physical activity and nutrition behaviors. Reduction of a sedentary lifestyle within the school settings and outside of school settings is a factor that should continue to be monitored. Increasing water intake, increasing fruits and vegetables intake, and decreasing fat intake are all important aspects in changing nutrition behavior. There is also importance in reducing access to fatty foods, increasing access to health foods during school hours, and increasing physical activity during and after school as well.

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