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# SCHOOL-BASED INTERVENTIONS FOR PROMOTING NUTRITION AND PHYSICAL ACTIVITY & PREVENTING OBESITY: OVERVIEW OF STUDIES AND FINDINGS

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## **EXECUTIVE SUMMARY**

School-based interventions for children should be a focal point for community obesity prevention efforts. Considerable evidence has been accumulating over the past two decades, indicating that high quality comprehensive interventions conducted at school sites can reduce the prevalence of overweight and obesity, prevent weight gain and improve child and adolescent food and Physical Activity (PA) behaviors. This review provides an updated assessment of school-based interventions which were designed to impact student nutrition, PA and clinical outcomes. Evidence reviews commencing in 2008 and primary studies ending in 2018 were evaluated. The findings from this review support the use of comprehensive interventions that address physical activity (PA) and nutrition, including school physical education (PE), school food improvements, and nutrition and PA promotion for students and staff with curricula/classroom activities that match existing requirements, motivate student participation, and are easy and convenient for school staff to deliver. The findings from this review provide information that can be useful to update and enhance SNAP-Ed efforts in schools to promote nutrition, PA and healthy weight in childhood.

# 1. Introduction

With one-third of children now classified as overweight or obese, the need is urgent for obesity prevention interventions targeting children.<sup>1</sup> The Institute of Medicine's Committee on Accelerating Progress in Obesity Prevention provided strong evidence supporting schools as the focal point for preventing child obesity.<sup>2</sup> Schools provide an opportune setting to reach large numbers of children where they spend a significant proportion of their day and where many receive the bulk of their daily food intake. Schools also provide opportunities for students to participate in increased physical activity (PA.).

Public health professionals and policymakers have sought methods to promote healthy lifestyles in the school setting by improving children's nutrition and PA. In 2016, the USDA strengthened regulations governing foods and beverages offered to children at school through the Healthy Hunger-Free Kids Act.<sup>3</sup>

Research has informed and motivated many positive changes and continues to guide interventions in school settings. Many strategies have been empirically evaluated and a growing body of literature offers insights regarding promising approaches for addressing childhood obesity.

With the intent of informing evidence-based practices for implementation through the California SNAP-Ed program, the Nutrition Policy Institute, University of California, Division of Agriculture and Natural Resources, conducted a review of the peer reviewed published literature on school-based strategies for nutrition and PA promotion and obesity prevention. This report presents the findings, which will be combined with those from future reviews to inform comprehensive SNAP-Ed programming across multiple settings. It first outlines the methods used to conduct the review, then presents descriptive and analytic findings, and concludes with a discussion and recommendations for California SNAP-Ed.

## 2. Methods

The literature review involved the following steps, which are described in detail in this section:

1. Developed research questions and inclusion/exclusion criteria
2. Developed key word search strategies and search for literature
3. Screened references for inclusion/exclusion
4. Abstracted key pieces of information from the included studies
5. Organized, analyzed and summarized the evidence

### 2.1 Inclusion and exclusion criteria

The purpose of this review was to determine the effectiveness of K-12 school-based interventions that aimed to improve dietary intake, increase PA, and/or prevent obesity, and to the extent possible, describe distinguishing features of effective interventions to inform the Supplemental Nutrition Assistance Program Education (SNAP-Ed) work of the California Department of Public Health.

Inclusion/exclusion criteria guided development of search strategies and selection of relevant references for inclusion in the review. All retrieved references were screened for relevance by applying the following inclusion/exclusion criteria.

- **Types of Articles and Time Frame**
  - Review articles published between 01/01/2005 and 6/30/2015.
  - Original articles from the review articles that met the inclusion criteria below, published between 1988-2014.
  - Original articles identified from an updated supplemental review 2014-2018.
- **Setting**
  - Interventions conducted at an elementary, middle, or high school, or before- or after-school settings.
- **Study Design**
  - Studies that had a control group (exposure assigned by investigator or naturally occurring) and measured at least one of the outcome(s) of interest before and after an intervention occurred.
- **Intervention**
  - Studies that evaluated an intervention directed at a change in a nutrition- or PA-related exposure or another exposure with a potential impact on children's weight status- see more in section 2.2 on interventions.
  - Interventions for the review were not excluded based on expectations regarding feasibility of implementation through SNAP-Ed.
- **Outcome Measures:** studies must have measured and reported at least one of the following outcome variables both before and after the intervention occurred (see section 2.2 for more on outcomes).
  - Nutrition behaviors
  - PA behaviors
  - Weight status
  - Clinical measures related to obesity

- **Population:**
  - Children in grades K-12 (ages 5-18 years).
  - All student populations were included regardless of characteristics such as weight status, socioeconomic status, race, ethnicity or geographic region.
  - After identifying articles, those pertaining to interventions conducted outside the US were excluded.

## 2.2 Evidence search

Guided by the inclusion/exclusion criteria, we created Boolean operator search strategies to run in PubMed (Appendix 3). To maximize efficiency without sacrificing comprehensiveness, we searched for and identified relevant review papers published between January 1, 2005 to June 30, 2015. We then supplemented this with a search for primary studies published since January 1, 2014 to June 30, 2018.

The first search for reviews yielded a total of 1894 articles. Articles were then further filtered to exclusively identify review articles, in order to identify studies that had already been submitted to an initial screening for quality. The literature review team analyzed abstracts for to exclude reviews of topics other than PA and nutrition interventions in school settings and other reviews that did not meet the inclusion criteria. After abstract review, 82 review articles remained that met all of the inclusion criteria. The literature review team then abstracted individual studies from these 82 review articles. Details about the study design, sample size and demographics, number and type of intervention strategies, outcome measures and results were abstracted from 583 individual articles.

Additional screening criteria were then applied to these 583 articles, to focus on the most relevant studies of the highest methodological standards. Due to the significant impact of federal regulations and policy in school meal setting, the decision was made to only present results from studies conducted within the United States. Studies were excluded from final review for the following reasons: studies were conducted in settings outside of the United States, the study design did not include a case and control group and/or groups were not randomized, studies were not published in peer reviewed articles, or duplicate citations were identified from multiple reviews with the same interventions and outcomes. After applying these criteria, 84 studies of PA and nutrition interventions in school settings remained. The details of the 84 studies are summarized in the tables in Appendix 1.

A supplemental search and review was conducted for relevant individual articles published between January 1, 2014 and June 30, 2018 in the PubMed and Education Source databases. The PubMed search included the filter “evaluation studies” in order to obtain more targeted results. The search yielded a total of 857 articles. Details about the study design, sample size and demographics, number and type of intervention strategies, outcome measures and results were abstracted. After abstract review, 20 articles evaluating PA and nutrition interventions in school settings that met all of the above

inclusion criteria remained. The details of the 20 studies are also summarized in Appendix 1.

## 2.3 Evidence synthesis and analysis

To organize and interpret the literature, we identified five common activities that were included in the interventions as follows:

1. **Physical Education (PE)** = changes to PE quantity and/or quality during the school day or as part of an after-school program, including changes in policies and practices.
2. **PA offered** = a change in the quantity or quality of PA offered other than PE classes, including PA opportunities before or after school, recess, etc. through policy and practice changes.
3. **PA promotion** = any combination of PA education and promotion including classroom curricula/activities and social marketing messages in the school community to promote PA and participation.
4. **School foods** = any combination of changes to school meals, snacks, competitive foods and beverages, or foods in the classroom through changes in policies and practices.
5. **Nutrition promotion** = Any combination of nutrition education, healthy food and beverage promotion/local produce promotion, or limits on marketing of unhealthy food and beverages including classroom curricula/activities.

We categorized interventions into three groups, according to whether they addressed PA only, nutrition only or both nutrition and PA. We combined interventions into groups that had similar activities in each of these groups for a total of 12 different possible combinations. The breakdown on number of studies by category is found in Table 1.

We evaluated intervention effectiveness according to the published impact on weight, clinical, and nutrition and PA behavioral outcomes (all effect sizes were considered provided findings were statistically significantly different for intervention and controls).

Measures included:

- **Weight status:** change in BMI, BMI z-score, skinfold thickness, percent body fat, waist circumference, and/or prevalence of overweight/obesity.
- **Clinical outcomes:** change in blood pressure, heart rate, fasting insulin, blood cholesterol, etc.
- **Nutrition:** change in consumption or offering of fruits and vegetables (FV), healthy meals and snacks, foods/beverages characterized by added sugar, and/or calories.
- **PA:** change in total PA, vigorous PA, moderate-to-vigorous PA, moderate PA, and light PA.

## 3. Results

### 3.1 Numbers of studies and outcomes measured

One hundred four primary studies of interventions identified in the review articles and supplemental search met the criteria for inclusion in this review (Appendix 1). Publication dates ranged between 1988 and 2018.

All interventions were implemented in schools, before, during or after school. Many of the interventions were tested among samples that included low-income children.

Of the interventions identified, 22 were nutrition only interventions,<sup>4-28</sup> 33 were PA only interventions,<sup>29-64</sup> and 49 were multi-component,<sup>65-114</sup> that is they had at least one nutrition component plus at least one PA component. The most frequently tested intervention components were PE/PA offered + school food + nutrition promotion + PA promotion,<sup>72,74,76-78,83,87,92,96,97,99,101,103,105,107,110,111,113</sup> PE/PA offered + nutrition promo +/- PA promo,<sup>65,66,73,81,84-86,89-91,93,95,98,100,102,106,112</sup> and PE only.<sup>31,35,38,39,42,44,46,47,49,50,56,62</sup> (Table 1). The updated supplemental search yielded studies primarily of nutrition only or PA and nutrition multicomponent studies. This may reflect a real increase in the proportion of nutrition and multicomponent interventions being evaluated, as recommended by the Centers for Disease Control and Prevention (CDC) and the Health and Medicine Division (HMD) of the National Academies of Sciences, Engineering, and Medicine (NASEM) for more comprehensive interventions to achieve impacts on weight outcomes.

Sixty-five of the studies were of interventions in elementary schools, 37 were conducted in middle or high schools, one was conducted in a K-8 school, and one was conducted in a mix of elementary, middle and high schools (Appendix 1).



**TABLE 1. NUMBER OF INTERVENTIONS CLASSIFIED BY COMPONENT (NUMBER IN BRACKETS ARE THE ADDITIONAL STUDIES IDENTIFIED IN THE UPDATED SUPPLEMENTAL SEARCH)**

<b>Group Number</b>	<b>Component Groups</b>	<b>Number of studies</b>
<b>1</b>	<b>PA Only components</b>	<b>33</b>
1.1	PE only	12
1.2	PE + other PA <sup>1</sup>	8
1.3	PA offered only ± other PA <sup>1</sup>	6
1.4	PA promotion only	7
<b>2</b>	<b>Nutrition Only components</b>	<b>22</b>
2.1	School foods only	4
2.2	School foods + nutrition promotion	7
2.3	Nutrition promotion only	9
2.4	Water access only	2
<b>3</b>	<b>PA + Nutrition Multicomponent</b>	<b>49</b>
3.1	PE and/or PA offered + nutrition promotion ± PA promotion	17
3.2	After school PE + school foods	2
3.3	PE and/or PA offered+ school foods+ nutrition and/or PA promotion	18
3.4	PA promotion + nutrition promotion only	12
	<b>TOTAL</b>	<b>104</b>

<sup>1</sup>“Other PA” refers to any other-than-PE/PA interventions, mainly PA promotion/health education.

Over half of the studies measured weight outcomes, nearly half measured PA outcomes, and almost half measured nutrition outcomes, but fewer measured clinical outcomes. (Table 2).

**TABLE 2. NUMBER OF INTERVENTIONS THAT MEASURED EACH OUTCOME**

<b>Outcome<sup>1</sup></b>	<b># Interventions that measured these outcomes</b>
Weight outcomes	62 (60%)
Clinical outcomes	21 (20%)
Fruits and vegetables	23 (22%)
Other nutrition outcomes <sup>1</sup>	26 (25%)
PA outcomes	51 (49%)

<sup>1</sup>“Other nutrition outcomes” refer to foods/beverages offered/served or consumed in addition to FV.

## **3.2 Effects of interventions**

### **3.2.1 Effects of intervention types: Singly and in combination**

This section presents the results of various interventions tested singly or in various combinations. We summarized study findings in the three broad intervention categories described above: 1) PA only 2) nutrition only and, 3) PA+ nutrition multicomponent interventions. (Table 3). Findings are reported separately for studies identified by the review article search, followed by those, if any, from the updated supplemental search.

**Table 3. PROPORTION OF EFFECTIVE INTERVENTIONS BY COMPONENT COMBINATIONS**

Category	Total number of interventions	Effective for any outcome	Effective for weight outcome	Effective for clinical outcome	Effective for FV outcome	Effective for other nutrition outcome	Effective for PA outcome
<b>n, effective interventions/n, interventions that measured a given outcome (percent)</b>							
<b>PA Only components</b>	<b>33</b>	<b>28/33 (85%)</b>	<b>8/18 (44%)</b>	<b>5/8 (63%)</b>	<b>N/A*</b>	<b>N/A</b>	<b>17/24 (71%)</b>
PE only	12	10/12 (83%)	4/7 (57%)	4/6 (67%)	N/A	N/A	3/4 (75%)
PE + other	8	7/8 (88%)	2/6 (33%)	1/2 (50%)	N/A	N/A	4/7 (57%)
PA offered only+other	6	5/6 (83%)	0/1 (0%)	N/A	N/A	N/A	5/6 (83%)
PA promotion/ education only	7	6/7 (86%)	2/4 (50%)	N/A	N/A	N/A	5/7 (71%)
<b>Nutrition Only components</b>	<b>22</b>	<b>20/22 (91%)</b>	<b>3/3 (100%)</b>	<b>2/5 (40%)</b>	<b>12/13 (92%)</b>	<b>8/10 (80%)</b>	<b>N/A</b>
School foods only	4	3/4 (75%)	N/A	N/A	2/2 (100%)	1/2 (50%)	N/A
School foods + nutrition promotion	7	6/7 (86%)	2/2 (100%)	1/3 (33%)	3/3 (100%)	2/3 (67%)	N/A
Nutrition promotion only	9	9/9 (100%)	1/1 (100%)	1/2 (50%)	7/8 (100%)	3/3 (100%)	N/A
Water access only	2	2/2 (100%)	N/A	N/A	N/A	2/2 (100%)	N/A
<b>PA + Nutrition-multicomponent</b>	<b>49</b>	<b>40/49 (82%)</b>	<b>22/41 (54%)</b>	<b>3/8 (38%)</b>	<b>5/10 (50%)</b>	<b>9/18 (50%)</b>	<b>20/27 (74%)</b>
PE and/or PA offered + nutrition promotion ± PA promotion	17	16/17(94%)	10/16 (63%)	2/4 (50%)	1/3 (33%)	2/3 (67%)	6/8 (75%)
After school PE + school foods	2	2/2 (100%)	2/2 (100%)	1/1 (100%)	N/A	N/A	1/1 (100%)
PE and/or PA offered+ school foods+ nutrition and/or PA promotion	18	14/18 (78%)	4/12 (33%)	0/2 (0%)	1/4 (25%)	4/10 (40%)	7/11 (64%)
PA promotion + nutrition promotion only	12	8/12 (67%)	6/11 (55%)	0/1 (0%)	3/3 (100%)	3/5 (60%)	6/7 (86%)
<b>TOTAL</b>	<b>104</b>	<b>88/104 (85%)</b>	<b>33/62 (53%)</b>	<b>10/21 (48%)</b>	<b>17/23 (74%)</b>	<b>17/28 (61%)</b>	<b>37/51 (73%)</b>

\* N/A= did not measure/report on this outcome

## Group 1: PA only interventions

**PA INTERVENTIONS IN SCHOOL SETTINGS ARE CONSISTENTLY EFFECTIVE AT IMPROVING PA AND CLINICAL OUTCOMES AND ARE EFFECTIVE AT IMPROVING BMI/WEIGHT OUTCOMES ABOUT HALF OF THE TIME.**

Eighteen of 33 studies of PA only interventions measured weight outcomes,<sup>29,31,34,35,40-42,44-46,54-58,61-64</sup> including changes in the quantity or quality of PA during PE classes, or supplementary PE during, before, or after school hours, or PA and PE promotion through activity-based curriculum.

Fourteen studies were of interventions in elementary schools,<sup>29,30,34,37,42-45,49-51,55,57,58,60,62</sup> while 19 took place in middle<sup>31,36,41,47-50,54,61,63</sup> and high<sup>32,33,35,38-40,46,52,53,56,59,64</sup> school settings with adolescents, an age group that is at higher risk of obesity than younger children, and among whom achieving high rates of participation in PA is challenging.

### Findings

- Eight of the 18 studies measuring weight outcomes found a positive impact.<sup>31,40,41,45,46,55,56,62</sup>
- Twenty-four studies measured PA outcomes<sup>29-34,36,37,40,43-45,47-55,57-61,63,64</sup> and nearly three-fourths (17) of them were effective at increasing PA. <sup>30-34,36,43,45,47-53,57-61,63</sup>
- Several of the PA only interventions were efficacy studies; the objective being to demonstrate that improvements could be made in highly controlled conditions on clinical measures such as heart rate, lung capacity (VO2 max) etc. Of the 8 studies that measured clinical outcomes in children,<sup>29,31,38,39,42,46,62,64</sup> two thirds (5) showed a positive impact.<sup>29,31,38,39,42</sup>
- PA interventions were carried out in-school (during PE, recess, and classrooms), before school, and/or after school.

## Group 1.1: PE only interventions

**INTERVENTIONS TO INCREASE THE FREQUENCY, DURATION, INTENSITY AND/OR PARTICIPATION IN SCHOOL PE ARE CONSISTENTLY EFFECTIVE AT INCREASING PA AND ARE EFFECTIVE AT IMPROVING WEIGHT-RELATED OUTCOMES ABOUT HALF OF THE TIME AMONG SCHOOL CHILDREN AT ELEMENTARY, MIDDLE AND HIGH SCHOOL LEVELS.**

Twelve studies evaluated interventions that increased the type and intensity of PA during PE or supplemented PE during school hours and after school. Examples of strategies used in these interventions include reducing PE class size to minimize inactive/waiting time and increase teacher attention to individual participation, dispensing with the requirement to change clothes before and after PE class to maximize activity time during the class period, introducing methods for encouragement of full participation, providing structured rigorous activity for longer or more frequent class periods, and overseeing and using coaching

methods to increase student full participation. Four of these studies were conducted in elementary school settings,<sup>42,44,50,62</sup> while eight were conducted in middle<sup>31,47,49</sup> and high<sup>35,38,39,46,56</sup> school settings.

### **Findings:**

- Four<sup>31,46,56,62</sup> of the seven<sup>31,35,42,44,46,56,62</sup> studies that measured weight outcomes for PE only interventions found positive impacts.
- Modifying PE in ways that encourage participation by all students, including those that may be hard to motivate appears to improve weight outcomes.
- In studies where there is a gender effect, PE tends to have a greater effect on girl's BMI than boys BMI. The reasons for this are unclear, but investigators speculate that it could be due to the lower baseline levels of PA among girls.
- In the studies effective for weight outcomes, PE interventions were conducted by health professionals or well-trained teachers; thus, training in PE methods seems to be key to effective implementation.
- After school PE programs can have a positive impact on weight outcomes, including a way to reach and target higher risk groups e.g. those overweight or with diabetes, adolescents, etc. without singling out, or stigmatization. However, reach is lower than with school mandated PE or PA opportunities that are well promoted at school.
- As a single component intervention, modifying school PE is among the most effective school strategies documented to date in changing weight outcomes.

### **Group 1.2: PE plus other PA interventions (mainly PA promotion)**

**COMBINING PE CHANGES WITH OTHER PA INTERVENTIONS (MAINLY PA PROMOTION/HEALTH EDUCATION) IS NOT CONSISTENTLY EFFECTIVE AT IMPROVING WEIGHT-RELATED OUTCOMES AND HAS A POSITIVE IMPACT ON PA JUST OVER HALF THE TIME. THUS, COMBINING PE WITH PA PROMOTION/HEALTH EDUCATION DOES NOT APPEAR TO BE MORE EFFECTIVE THAN PE ONLY.**

Eight studies evaluated PE interventions combined with PA promotion/education in the classroom.<sup>29,32,40,41,52,58,63,64</sup> Most studies were of adolescents in lower income or high minority populations. PE Interventions included substituting more engaging activities with age- and cultural- appeal such as dance and circuit training, in place of regular PE activities, increasing time for MVPA during PE classes, and using incentives to increase participation. PE changes were combined with PA promotion or health education/life skills curriculum activities in the classroom including aiming to increase self-efficacy and enjoyment of PA. Two studies were conducted in elementary school settings,<sup>29,57,58</sup> while six were conducted in middle<sup>41,63</sup> and high<sup>32,33,40,52,53,64</sup> school settings.

### **Findings**

- Seven of the 8 studies in this group measured PA outcomes.<sup>29,32,33,40,52,53,57,58,63,64</sup> Of those, four interventions found positive impacts.<sup>32,33,52,53,57,58,63</sup>
- Of the 8 studies, 6 assessed weight outcomes<sup>29,40,41,58,63,64</sup> and two<sup>40,41</sup> identified a positive impact on weight.
- Two studies assessed clinical outcomes,<sup>29,64</sup> with one<sup>29</sup> reporting a positive impact.
- Adding a PA promotion component to PE interventions may not confer an additional benefit for weight or PA outcomes.

### **Group 1.3: PA offered plus PA promotion**

**CHANGES TO PA (NOT PE) OFFERED AT SCHOOL DURING THE SCHOOL DAY, OR BEFORE OR AFTER SCHOOL CONSISTENTLY INCREASES PA BUT TOO FEW STUDIES HAVE EVALUATED IMPACTS ON WEIGHT-RELATED OUTCOMES.**

Six studies evaluated interventions that offered PA opportunities during, before and after the school day.<sup>30,34,37,43,51,60</sup> Types of PA offered included changes in the quantity and/or quality of PA opportunities provided to children during the school day, including structured recess physical activities, playground markings, walking clubs, structured indoor/outdoor activities led by teachers in classrooms, and a walking school bus. Several of these interventions also promoted the use of these PA opportunities with messaging to students. All studies in this group were conducted in elementary school settings.

#### **Findings from the studies identified in reviews:**

- Five of the six studies showed increases in PA outcomes (MVPA, etc.),<sup>30,34,43,51,60</sup> Only one study examined a weight outcome<sup>34</sup> and had no impact in that regard.
- Too few studies (1) in this group examined a weight outcome, therefore no conclusion can be drawn in that regard. However, given that PA interventions increase PA time during the school week, they have the potential to contribute to weight outcomes in multicomponent interventions.
- Increasing both time and quality of PA offered might be more effective than just changing one of these aspects.
- PA promotion to increase participation in these activities is likely to contribute to the success in increasing PA outcomes.
- A program offering organized activity during recess found significant benefit for girls, but not boys on energy expenditure by accelerometer, and on time spent in vigorous activity. Weight outcomes were not assessed.<sup>30</sup>

## **Group 1.4: PA promotion only**

**SCHOOL-BASED PA PROMOTION WAS CONSISTENTLY EFFECTIVE AT IMPROVING PA OUTCOMES AND WAS EFFECTIVE AT IMPROVING WEIGHT OUTCOMES HALF OF THE TIME.**

Seven studies evaluated PA promotion only interventions,<sup>36,45,48,54,55,59,61</sup> which included new curricula, classroom based activities, and interactive media based lessons and homework assignments, messaging across the curriculum and whole school promotion. One study focused lessons entirely on reducing sedentary screen time.<sup>55</sup> By definition none included students participating in physical activities. Two studies were conducted in elementary schools,<sup>45,55</sup> while five were conducted in middle<sup>36,48,54,59</sup> and high<sup>61</sup> school settings.

- All seven studies evaluated PA outcomes and showed a significant improvement in PA measures in 5 of the studies.<sup>36,45,48,59,61</sup>
- Of the 7 studies, 4 evaluated weight outcomes,<sup>45,54,55,61</sup> and of those, 2 showed significant improvement in weight outcomes;<sup>45,55</sup> in one of these studies, the positive effect was only for girls.<sup>45</sup>
- One study showed benefit for elementary school girl's on weight outcomes using messages and instruction on reducing sedentary screen time presented in 18 multimedia interactive lessons over 6 months.<sup>45</sup> The authors speculate the mechanism of action may be the observed increase in time spent in light PA. See Appendix 2 for a case example of this promising practice example by Robinson et al.

## **Group 2: Nutrition only interventions**

**NUTRITION-ONLY INTERVENTIONS ARE OFTEN EFFECTIVE AT IMPROVING DIETARY INTAKE BUT ARE LESS FREQUENTLY EFFECTIVE AT IMPROVING WEIGHT OUTCOMES (AND ARE LESS OFTEN EVALUATED FOR THEIR EFFECTS ON WEIGHT).**

**INTERVENTIONS AIMED AT COMPREHENSIVE SCHOOL FOOD CHANGES (IN ALL SCHOOL VENUES) MAY BE MORE EFFECTIVE THAN LIMITED INTERVENTIONS ADDRESSING ONLY ONE FOOD ENVIRONMENT IN THE SCHOOL (E.G. SCHOOL MEALS OR VENDING MACHINES).**

**ENGAGING ALL KEY STAKEHOLDERS IN PLANNING, IMPLEMENTATION AND OVERSIGHT OF SCHOOL FOOD AND NUTRITION INTERVENTIONS IS LIKELY TO IMPROVE THEIR EFFECTIVENESS, PARTICULARLY FOR IMPLEMENTING SCHOOL NUTRITION POLICIES.**

**EFFECTIVE TRAINING OF FOOD SERVICE STAFF IS FUNDAMENTAL FOR SCHOOL FOOD CHANGES.**

**IMPROVING ACCESS TO WATER HAS NOT BEEN ADEQUATELY TESTED FOR ITS IMPACT ON DIETARY INTAKES, OR BMI, BUT SHOULD BE TESTED IN MULTICOMPONENT INTERVENTIONS SEEKING TO IMPROVE WEIGHT OUTCOMES.**

Twenty-two studies evaluated the impact of changing school foods, improving water access, conducting nutrition promotion or combining these elements.<sup>4-28</sup>

The types of interventions in this category included school nutrition policies (limited or comprehensive), serving fruit in more convenient and appealing ways in the school lunch offerings, providing student incentives for consuming more FV, providing more choice of FV, school garden-enhanced education, increased regionally procured produce, improving the nutrition quality of school meals, offering healthy beverages, including increased water access, and eliminating unhealthy beverages. Several of these interventions were combined with nutrition messaging, and promotion of the healthier foods and beverages offered.

Eighteen studies were of interventions in elementary schools,<sup>4-8,10,12-18,20-24,26,28</sup> while three took place in middle<sup>25,27</sup> and high<sup>11</sup> schools and one took place in a mix of elementary, middle and high schools.<sup>19</sup> About half of these studies were conducted in schools with a high proportion of lower income and/or minority students, and two of them were conducted in schools in rural areas.<sup>7,27</sup>

Only three studies measured weight outcomes, while all but 2 measured impacts on FV and/or other dietary behavior change. The methods for measuring nutrition outcomes varied considerably between studies, which limits their comparability.

## Findings

- All three studies evaluating the impact of school-based nutrition only interventions on weight outcomes<sup>23,24,28</sup> found positive impacts.
- Twelve<sup>4,5,7,13-15,17,18,21,22,24,25,27</sup> of the 13 interventions measuring FV outcomes,<sup>4,5,7,13-15,17,18,21,22,24,25,27,28</sup> observed positive impacts on children's FV consumption.
- Of the 10 interventions measuring other nutrition outcomes,<sup>6,7,11,12,14,19,20,23,26,28</sup> 8 found positive impacts,<sup>6,12,14,19,20,23,26,28</sup> including consumption of lower fat foods and healthier beverage choices.
- Based on a limited number of studies, nutrition promotion only interventions show promise as a means of improving weight outcomes.
- Simple interventions for changing school foods, using principles of behavioral economics demonstrated effectiveness for dietary behavior change.
- Strategies, as described in this section 2, that have proven to be effective with regard to nutrition outcomes are worthy of consideration for inclusion in multi-component interventions given that several of the multicomponent studies evaluated in section 3 showed no effects on dietary behavior change. Incorporating strategies that are effective at improving dietary intake into these multicomponent interventions could strengthen their overall effectiveness by increasing impact on diet.
- Removal of unhealthy beverages and foods may be as effective as providing healthier options in improving nutrition outcomes.



- Effective engagement of all stakeholders made a difference in implementation of a comprehensive nutrition policy intervention.
- Training and involvement of food service workers fosters cooperation, support, and motivation to implement school food changes being advocated.

## **Group 2.1: School food changes only**

**INTERVENTIONS THAT MAKE CHANGES TO SCHOOL FOODS AS A SINGLE INTERVENTION HAVE NOT BEEN EVALUATED FOR WEIGHT OUTCOMES, BUT ARE CONSISTENTLY EFFECTIVE AT IMPROVING DIETARY INTAKE.**

The four interventions in this category<sup>6,11,16,25</sup> included those targeting changes to the calorie/fat levels of lunch items, offering pre-sliced fruit vs. whole fruits, and/or providing more choice of FV from which students could select. Two studies were conducted in elementary schools<sup>6,15,16</sup>, while two were conducted in middle<sup>25</sup> and high<sup>11</sup> school settings.

### **Findings**

- None of these interventions were evaluated for weight outcomes
- Two were effective at achieving changes in reported FV consumption among both overweight and non-overweight kids,<sup>16,25</sup> and one was effective in increasing selections of lower fat lunch entrees.<sup>11</sup>
- Simple interventions focusing on FV appeal, and/or choice appear to be as effective at increasing FV intake as more complex changes in school foods; authors refer to offering fruit slices as a “scalable low cost environmental change that promotes healthy eating and reduces waste.”<sup>25</sup> The cost of the fruit slicing equipment they calculated to be just over a dollar a day over the school year.

## **Group 2.2: School food changes plus nutrition promotion**

**INTERVENTIONS THAT COMBINE SCHOOL FOOD CHANGES WITH NUTRITION PROMOTION FOUND THAT THIS COMBINATION IS CONSISTENTLY EFFECTIVE AT IMPROVING DIETARY INTAKE AND A LIMITED NUMBER OF STUDIES INDICATE THIS COMBINATION IS ALSO CONSISTENTLY EFFECTIVE AT IMPROVING BODY WEIGHT. THESE EFFECTS WERE SEEN IN ETHNICALLY/RACIALLY AND GEOGRAPHICALLY DIVERSE CHILDREN.**

Seven studies identified in reviews evaluated this combination of intervention components.<sup>7,8,10,22-24,26</sup> Examples of Interventions included providing a low fat milk option with social marketing; improving the nutrition quality of school meals by ensuring compliance with nutrition standards, combined with encouraging healthier a la carte items, and providing nutrition messaging and curricula during and after school; increasing the availability, attractiveness and encouragement for FV, tokens for increasing consumption, and special events (kick offs, taste tests, challenges, theater, etc.). Training of food service workers was included in all of these interventions.

One intervention was a two year comprehensive nutrition policy project (the School Nutrition Policy Initiative)<sup>10</sup> that comprised school self-assessment compared with a set of goals/standards, nutrition education, nutrition policies (several of the policies were related to foods to be offered, discouraged at various venues around the school) social marketing, and parent outreach.

All interventions in this group were conducted in elementary school settings.

### **Findings**

- Both of the studies that examined impact of School Food + Nutrition Promotion interventions on weight outcomes found a positive impact. One of the three studies that examined impact of these interventions on clinical outcomes found a significant favorable impact.
- All three of the studies that examined the impact of these interventions on FV intake found a favorable impact as did two of the three studies that examined impacts on other nutrition outcomes.
- Interventions that had a strong staff training component were more frequently effective, at least for dietary change, than those that did not have a strong staff training component.
- Effective interventions with nutrition-related policies appear to work better with the establishment of structures to engage stakeholders in developing the policies and implementing and monitoring the adoption of the policy components.

See case examples of promising practices in this category by Foster et al.<sup>10</sup> and Scherr et al.<sup>24</sup> in Appendix 2.

## **Group 2.3: Nutrition promotion only**

**NUTRITION PROMOTION-ONLY INTERVENTIONS ARE CONSISTENTLY EFFECTIVE AT IMPROVING DIETARY INTAKE BUT ONLY ONE STUDY EVALUATED IMPACT ON WEIGHT OUTCOMES.**

Nutrition promotion only interventions were evaluated in nine studies reviewed here.<sup>4,5,9,13,14,17,18,20,21,27,28</sup> Interventions involved novel curricula/selected lessons implemented by teachers or trained professionals and/or using social marketing approaches to motivate student behavior change for healthful food and beverage selection.

All interventions occurred in elementary school settings,<sup>4,5,9,13,14,17,18,20,21,28</sup> with the exception of one middle school<sup>27</sup> and one study that was conducted in elementary, middle and high school settings.<sup>19</sup>

### **Findings from studies identified in reviews:**

- Dietary behaviors were evaluated using different methods in each of these studies.

- Seven<sup>4,5,9,13,14,17,18,20,21,27</sup> of the eight studies that examined impact on FV intake reported a favorable impact on intake as did all of the three studies that reported other nutrition outcomes.<sup>14,20,28</sup>
- The only study that reported weight-related outcomes<sup>28</sup> reported a favorable impact, as did one<sup>28</sup> of the two studies<sup>17,28</sup> that reported impact on clinical outcomes.
- A garden-based education program with cooking demonstrations reported positive outcomes for weight, metabolic risk, FV intake and other nutrition outcomes.<sup>28</sup>
- A marketing intervention found that the number of students taking vegetables from a salad bar doubled when exposed to a vinyl banner and tripled when exposed to a banner plus television segments promoting FV consumption.<sup>14</sup>
- An intervention using incentives to promote f/v consumption found positive impacts for prizes, but not for receiving praise.<sup>21</sup>
- A classroom-based program found that students receiving the curriculum with a taste testing component consumed more FV than students who received the curriculum without taste testing as well as a control group.<sup>13</sup>

### Group 3: Nutrition + PA interventions

**MULTICOMPONENT SCHOOL-BASED INTERVENTIONS THAT INCLUDE BOTH NUTRITION AND PA COMPONENTS ARE CONSISTENTLY EFFECTIVE AT INCREASING PA BUT WERE ONLY EFFECTIVE AT IMPROVING WEIGHT AND NUTRITION OUTCOMES ABOUT HALF THE TIME.**

Forty-nine studies evaluated multicomponent interventions that included at least one nutrition component and at least one PA component.<sup>65-114</sup>

- Seventeen of these combined PE and/or PA offered with nutrition promotion (with or without PA promotion).<sup>65,66,73,81,84-86,89-91,93,95,98,100,102,106,112</sup>
- Two combined after school PE with School Food changes.<sup>68,114</sup>
- Eighteen studies combined PE and/or PA offered with School Food changes and Nutrition promotion and/or PA promotion.<sup>72,74,76-78,83,87,92,96,97,99,101,103,105,107,110,111,113</sup>
- Twelve studies combined PA promotion with Nutrition promotion.<sup>67,69-71,75,79,80,82,88,94,104,108,109</sup>

Thirty-three studies were of interventions in elementary school settings,<sup>65,66,68,71-77,80-88,92,93,96,97,101,105-114</sup> of which four were after-school programs.<sup>65,66,75,77</sup> Fifteen studies were of interventions in middle<sup>67,70,78,79,89,90,102-104</sup> and high<sup>91,94,95,98-100</sup> school settings. One study was of an intervention in a K-8 school setting.<sup>69</sup>

A large variety of interventions were tested, and these and their findings are described in the sections below.

### **Group 3.1: PE and/or PA offered plus nutrition promotion and/or PA promotion**

**EXERCISE THROUGH PE OR PA OFFERED PLUS CLASSROOM CURRICULA ENCOURAGING HEALTHY EATING (AND PA) APPEAR TO BE CONSISTENTLY EFFECTIVE IN ACHIEVING POSITIVE WEIGHT AND PA OUTCOMES; FEWER OF THESE STUDIES LOOKED AT IMPACT ON DIETARY INTAKE; MORE RECENT INTERVENTIONS IN THIS CATEGORY SHOW HIGHER SUCCESS RATES WITH WEIGHT OUTCOMES.**

Seventeen studies evaluated interventions combining PE and/or PA offered with nutrition promotion (with or without PA promotion). Ten of the sixteen studies in this category that measured weight outcomes showed positive results.<sup>65,66,73,89,91,93,95,102,106,112</sup>

Interventions tested in these studies usually included an exercise component either during PE or outside PE class, together with nutrition promotion and PA promotion using specially designed curriculum to stimulate and reinforce behavior changes. Elementary, middle and high schools were all represented in this group of studies. Many were conducted in schools with a high proportion of children receiving FRPM or had high proportion of minority groups.

Two were small studies (n~60-70) conducted with overweight or high risk (for diabetes) Hispanic children recruited in elementary and middle schools.<sup>89,102</sup> Interventions included an exercise component and a specialized curriculum over 12-14 weeks to address risk factors, and behaviors to reduce risk. No information was reported about the risk of stigmatization from providing these interventions for selected children.

One study was an evaluation of a component of the Stanford Heart Disease Prevention Project conducted in the early to mid-1980s, which tested a high school curriculum intervention of 20 classroom sessions, including PE class, to promote PA and improved nutrition.<sup>91</sup> The intervention was delivered by specially trained teachers and Stanford project coordinators and showed improvements in BMI, body fat, and resting heart rate.

A large multicenter study across four states evaluated an elementary school wellness curriculum in 7 classroom modules designed to stimulate changes in health behaviors.<sup>106</sup> No changes were required of the school in PE or PA offered, or School Foods, but suggestions for change were made to teachers as part of the curriculum (e.g. how to include 10 minutes of PA during class time) in addition to student knowledge and attitudes. The curriculum was designed with expert input from a nutrition foundation.

Most of the interventions tested in these studies included an exercise component and nutrition education. Additional components included classroom wellness policies, PA coaching, progress tracking, cognitive behavioral counseling, staff professional development and parent outreach and education.

Ten studies were conducted in elementary schools,<sup>65,66,73,81,84-86,93,106,112</sup> while seven were conducted in middle<sup>89,90,102</sup> and high<sup>91,95,98,100</sup> school settings.

## Findings

- Exercise through PE or PA offered plus classroom curricula encouraging healthy eating (and some included PA) appear to be effective in achieving weight outcomes about half the time. They were effective at improving PA outcomes 75% off the time, FV intake in one of three studies, and other nutrition outcomes in 75% of studies where a given outcome was measured.
- Some of the effective interventions were not universally applied to all students at the schools but recruited children at high risk of obesity/diabetes. While no information is reported about acceptability of the intervention, or stigmatization, these studies provide examples of effective interventions that can be conducted in the school (vs. a clinical setting) for children at risk of obesity and diabetes.
- Most of the curriculum-based interventions we reviewed did not measure changes made by schools as a result of introducing the curriculum, although some stated school changes as an objective of the curriculum, such as PA offered, or PE, or school foods. However, selected curricula showed positive results among students in lower increases in BMI, decreases in the prevalence of overweight and obesity, improved intakes of FV and increased MVPA.
- Curricula selected for adaptation for testing in SNAP-Ed should come from studies showing positive effects on weight outcomes and should evaluate changes in school policies and practices as a result of the curriculum, to better understand the effective components of the curriculum that had most impact.
- The effectiveness of interventions tested as components of the early heart disease demonstration projects and other similar large demonstration projects, such as the Stanford Heart Disease project (conducted over 20 years ago), are impressive. However, the replicability/feasibility of these interventions for use in SNAP-Ed is not high, particularly due to the changes in school procedures in recent decades, reduction in PE in favor of academic subjects, and the cost of specialized staff required to conduct/oversee the interventions.

See case example of a promising practice in this category by Melnyk et al.<sup>95</sup> in Appendix 2.

### **Group 3.2: After school PE plus school food changes**

**THE COMBINATION OF AFTER SCHOOL PE PLUS SCHOOL FOOD CHANGES MAY BE AN EFFECTIVE COMBINATION, BUT THIS COMBINATION HAS NOT BEEN ADEQUATELY EVALUATED.**

Two studies identified in the reviews combined after school PA offered with school food changes.<sup>68,114</sup> Both showed positive impact on weight outcomes and one also showed

positive impact on clinical outcomes.<sup>114</sup> Both studies combined after school PE with provision of a healthy snack.<sup>68,114</sup> Both were conducted in elementary school settings.

### **Findings from studies identified in the reviews**

- The after-school interventions were conducted in Georgia over the school year and included a high percentage of African American elementary school children. The programs were similar and comprised two-hour structured sessions that included at least 40 minutes of MVPA, provision of a healthy snack, assistance with homework, and, in one study, transportation home after the program (which comprised 25% of program costs).
- These programs resulted in reductions in body fat and heart rate and increase in bone mineral density of children enrolled in the intervention compared to children enrolled in the control group. The intervention children had significantly smaller increases in BMI than those in the control group, and higher MVPA.
- The school food changes in these after school studies were relatively simple in comparison with more comprehensive school food interventions (provision of healthy snacks).

See case example of a promising practice in this category by Yin et al.<sup>109</sup> in Appendix 2.

### **Group 3.3: PE and/or PA offered plus school food changes plus nutrition promotion and/or PA promotion**

**THIS COMBINATION OF INTERVENTION COMPONENTS IS NOT CONSISTENTLY EFFECTIVE AT IMPROVING WEIGHT OUTCOMES.**

**INTERVENTIONS TESTED ARE CONSISTENTLY EFFECTIVE FOR PRODUCING POSITIVE PA OUTCOMES, BUT LESS CONSISTENTLY EFFECTIVE THAN NUTRITION ONLY INTERVENTIONS FOR PRODUCING NUTRITION OUTCOMES/DIETARY CHANGE.**

**INCORPORATING STRUCTURES FOR IMPLEMENTING AND MONITORING MULTICOMPONENT INTERVENTIONS IS LIKELY TO CONTRIBUTE TO THEIR FULL IMPLEMENTATION AND EFFECTIVENESS.**

Eighteen studies were identified in the reviews that combined PE and/or PA offered with School Food Changes and Nutrition Promotion and/or PA Promotion.<sup>72,74,76-78,83,87,92,96,97,99,101,103,105,107,110,111,113</sup> A wide range of interventions were tested. Most included several components; e.g. an exercise component during or outside of PE, provision of healthy snacks and/or improvements to school meals, plus a nutrition education curricula/classroom educational activities. Some included school-wide promotion of healthy eating and PA. Twelve of the 18 studies evaluated weight outcomes,<sup>72,74,76,78,83,92,96,99,103,110,111,113</sup> and four showed positive results.<sup>78,103,110,113</sup>

All except one<sup>113</sup> of the effective interventions for weight were large studies (large numbers of schools and students) of extensive multi-pronged interventions with explicit goals to change the food environment, the PA environment and encourage healthy nutrition and PA behaviors through classroom promotion/education. Goals for PA included increases in MVPA through changes in the quantity, frequency and types of activities in PE and during the school day. There were several dietary behavior change objectives in each intervention including reduction in fat, high energy snacks, increase in FV and some included wholegrains, and lower fat milk. Multiple school food venues were targeted. Interventions were conducted for 1-3 years. All three of these studies described the details of their interventions in separate publications from those reporting results. Studies were conducted either in elementary or middle schools and with large samples of racial and ethnic minorities. One study included rural only schools.

Substantial training components for school staff were included in each study, and the study staff had a significant role in supporting and overseeing the intervention in study schools. Two of the investigators had prior successful experience in studies to change school foods.

One study testing this combination of interventions was conducted in an elementary after-school program.<sup>77</sup> The intervention consisted of the provision of FV with all snacks and a weekly social-cognitive-theory based curriculum promoting skills building for behavior change.

Fifteen studies were conducted in elementary schools,<sup>72,74,76,77,83,87,92,96,97,101,105,107,110,111,113</sup> while three were conducted in middle<sup>78,103</sup> and high<sup>99</sup> school settings.

## **Findings**

- These multicomponent interventions were more frequently effective at improving weight outcomes than Nutrition Only interventions and about as effective as PA only interventions. Weight outcomes were generally greater for those overweight or obese at baseline, and in one study, were greater for boys than girls.
- Multicomponent Interventions were similarly effective at improving PA outcomes as PA only interventions but less effective for improving nutrition outcomes than nutrition only interventions. It is possible that an exclusive focus on nutrition results in a more intensive and focused intervention that is therefore more likely to get dietary behavior change.
- One study found that the study arm with school food and PA environment changes yielded significant positive benefits but adding a classroom internet-based program produced no additional benefit for weight outcomes, although did support nutrition outcome improvements.

- One study found that school food changes to be the most challenging, and found these changes were not fully implemented due to food service concern with loss of revenue from school food sales.
- Two studies emphasized tailoring curricula and other interventions to be simple for teachers/staff to implement, and to align with school and district mandates to facilitate adoption.
- The after-school intervention did not find any positive weight outcomes but did report increased MVPA.

### **Group 3.4: PA promotion plus nutrition promotion**

**WHILE PA PROMOTION COMBINED WITH NUTRITION PROMOTION WAS NOT OFTEN EFFECTIVE FOR IMPROVING WEIGHT OUTCOMES IN EARLIER STUDIES, MORE RECENT STUDIES HAVE SHOWN SIGNIFICANT IMPACTS ON WEIGHT OUTCOMES. THIS COMBINATION IS CONSISTENTLY EFFECTIVE AT IMPROVING DIETARY AND PA OUTCOMES.**

Twelve studies identified in reviews combined PA promotion with nutrition promotion.<sup>67,69-71,75,79,80,82,88,94,104,108,109</sup> Interventions tested curricula to motivate children to do more PA, eat healthier, and/or reduce unhealthy food choices and sedentary behavior. Studies were conducted in elementary and middle schools and included samples with high proportion of minority children.

Intervention components included health education, PA, peer-led education, incentives and social marketing to encourage consumption of healthy food, social-emotional and character development (SECD), and the use of high school students to mentor middle school students.

Five studies were conducted in elementary schools<sup>71,75,80,82,88,108,109</sup>, five were conducted in middle<sup>67,70,79,104</sup> and high<sup>94</sup> school settings and one was conducted in a K-8 setting.<sup>69</sup>

#### **Findings**

- Eleven studies evaluated weight outcomes<sup>67,69-71,75,79,80,82,88,94,108,109</sup> and six found significant reductions<sup>67,69,75,80,82,88</sup>
- All three studies that evaluated FV change<sup>79,82,94</sup> showed positive impacts.
- Of the five studies that measured other nutritional outcomes,<sup>71,79,80,82,104</sup> three found positive impacts.<sup>79,80,82</sup>
- Of seven studies that measured PA outcomes,<sup>67,69,75,79,80,82,94,104</sup> six found positive effects.<sup>69,75,79,80,82,94,104</sup>

## **4. Conclusions and implications for future interventions**

Over the past two decades, the evaluation literature of school-based- interventions to prevent obesity and promote nutrition and PA among children and adolescents suggests



components and methods that show promise for achieving these goals. The evidence base is incomplete and is evolving. We now know enough about some of the successful intervention components to adapt and build on evaluated models, while continuing to evaluate innovations, new combinations of effective elements, and implementation mechanisms. The following conclusions and recommendations drawn from the current literature should be updated as the body of published evaluations increases, particularly evaluation of interventions directed at improving weight outcomes for which the evidence is sparse.

- Interventions that target only PA are the most consistently effective at increasing PA;
- Interventions that target only nutrition are the most consistently effective at improving dietary intake, and
- Interventions that address both nutrition and PA are more consistently effective at improving body weight than nutrition only interventions and are about as consistently effective as PA only interventions in this regard.
- PA only interventions are more effective than nutrition only interventions on weight outcomes, but nutrition only interventions have less often evaluated weight outcomes. Deliberate targeting of an outcome appears to increase the probability of achieving that outcome. For example, interventions that targeted healthy weight were much more likely to improve body weight than those that did not.

#### Implications:

- If improvement in body weight is a primary objective, interventions should be consciously designed to address body weight and should include both PA and nutrition components.
- If increases in PA are the main outcome, focusing exclusively on PA is likely to be the most effective.
- If improvements in dietary intake are the main desired outcome, focusing exclusively on nutrition is likely to be the most effective.
- To increase PA, interventions show more promise when they include:
  - A PE component that increases class time, frequency, and participation in vigorous activity during or after school.
  - Combining PE with PA promotion in curricula/class learning activities.
  - Tailoring activities for enjoyment and encouraging full participation among particular sub-groups of students, in particular adolescents, girls, overweight students, African Americans, and Hispanics; after school special programs enable more targeting than universal interventions during school.
- To improve dietary intake, interventions show more promise in achieving effects when they include:

- A focus on changing school foods complemented by nutrition promotion of the new changes.
- Reducing availability of unhealthful foods and beverages, for example re-formulating high fat items to lower fat ones, as opposed to just adding healthy options to improve with weight and dietary outcomes.
- The use of principles of behavioral economics to make simple changes (slicing fruit, offering choice of FV, providing incentives).
- Targeting of policies and practices that cover all sources of food in the school - school meals, competitive foods, classroom foods, etc. Evidence in this regard is promising but requires further testing.
- Nutrition education alone has not been shown to be effective in improving weight outcomes; it should be regarded as fundamental, but should be incorporated as a component of comprehensive interventions.
- To improve body weight outcomes, interventions show more promise for achieving effects when they include:
  - Both nutrition and PA components, with an explicit goal of improving student weight outcomes.
  - School-wide interventions, as opposed to interventions that target overweight or obese children.
  - An increase in time, quality, intensity and frequency of participation in PE.
  - Changes to school foods (based on effective models that have demonstrated effects in changing dietary behaviors) that focus on a variety of school food and beverage sources/venues. Interventions combining school food changes with PA to date have not been as effective in changing dietary behavior as school food changes alone. Consider strengthening multi-component interventions with successful models of school food change.
- Recent evaluations of interventions have identified explicit mechanisms and systems for successful implementation including:
  - Ensure interventions fit with mandates, culture and priorities of schools, students and parents. Simpler changes tend to be more widely adopted.
  - Engaging stakeholders (school administrators, food service, school staff, teachers, students, parents) in planning from the outset, and in implementation and monitoring.
  - Comprehensive school policy interventions may work best with a team approach. That is where health professionals work with school staff on policy goals, assessment and definition of success; schools develop small task forces for policy implementation, and health professionals and academics work with school staff to monitor implementation of the policy.

- Possible inclusion of a community component. Some studies included a community component to reinforce messages being promoted by school interventions, but this combination has not been systematically evaluated for its contribution as an enhancement to school interventions. Community interventions harmonized with the school intervention messages in the school community catchment area may well increase effectiveness of school-based activities. However, if resources are limited, a focus on the school is likely preferable to a weak intervention in both school and community.
- Well planned and sufficient training and support for those implementing the interventions. Health professionals employed by the investigator teams actually conducted the interventions in several studies; but this approach may not be feasible for wide-spread dissemination across many schools. Instead, high quality training of school staff supported by local health personnel might be a cost-effective option.

**Conclusions:** School-based interventions for children should be a focal point for community obesity prevention efforts. Considerable evidence has been accumulating over the past two decades that well planned and well implemented comprehensive interventions conducted at school can reduce the prevalence of overweight and obesity, prevent weight gain, reduce risk factors for diabetes and heart disease and improve child and adolescent food and activity behaviors. The weight of evidence supports the use of comprehensive interventions that address PA and nutrition: including school PE, school food improvements, and nutrition and PA promotion with students and staff using curricula/classroom activities that fit with existing requirements, motivate student participation, and are easy and convenient for school staff to deliver. Evidence from the later studies included in the review suggest the importance of paying attention to HOW the interventions are implemented as well as WHAT components the interventions include in the plan - including stakeholder engagement in planning, implementing and evaluating the interventions. Information from this review provides a useful basis for reviewing and enhancing SNAP-Ed efforts in schools to promote nutrition, PA, and healthy weight in childhood.

## **Appendices**

Appendix 1: Study descriptions

Appendix 2: Case examples of promising practices

Appendix 3: PubMed Boolean operator search strategy

Appendix 4: Definitions and acronyms

## Appendix 1: Study descriptions

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<b>Group 1: Physical Activity Only Interventions</b>			
<b>Group 1.1: PE only</b>			
Carrel L, Clark RR, Peterson SE et al. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: a randomized, controlled study. Arch Pediatr Adolesc Med 2005;159:963-8. Ref. #31	<b>A School-based exercise program</b> -9 month school year -Smaller fitness oriented PE class of 12-14 children 5 times every 2 weeks for 45 minutes each (vs traditional PE class for controls of 35-40 children)	Middle	<b><u>Positive weight outcome</u></b> No change on BMI, however significant decrease in bodyfat for intx vs control children at p<0.04 (36.5% to 32.6% in intx vs 36.4% to 34.5% in controls). Small statistically significant improvements also observed in V02 max, fasting insulin levels for intx vs control
Dorgo S, King GA, Candelaria NG, Bader JO, Brickey GD, Adams CE. Effects of manual resistance training on fitness in adolescents. Journal of Strength & Conditioning Research 2009;23(8):2287-94. Ref. #35	<b>Jumping exercises</b> -18 weeks -PE Manual Resistance Training (MRT) program. 80- min classes 3 times per week plus 10 to 15 min warm-up and 20 to 30 min of MRT- (specific activities conducted by trained research assistants)	High	No intx effect on BMI

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Eliakim A, Barstow TJ, Brasel JA, Ajie H, Lee WN, Renslo R, et al. Effect of exercise training on energy expenditure, muscle volume, and maximal oxygen uptake in female adolescents. <i>Journal of Pediatrics</i> 1996;129(4):537- 43. Ref. #38</p>	<p><b>Endurance exercise program</b> -5 weeks -2.5 hours of endurance PA training during summer 4 hour a day anatomy class</p>	<p>High</p>	<p>Significant positive effects on VO2 max ( P &lt;0.05 )</p>
<p>Ewart CK, Young DR, Hagberg JM. Effects of school-based aerobic exercise on blood pressure in adolescent girls at risk for hypertension. <i>American Journal of Public Health</i> 1998;88(6):949-51. Ref. #39</p>	<p><b>Project Heart</b> -1 semester -50-min 'Project Heart' aerobic exercise classes including didactic instruction. Control group received 50-min standard PE classes</p>	<p>High</p>	<p>A significantly greater drop in average resting systolic pressure was observed in the aerobics intervention group than in physical education only (control) participants p= &lt;.03.</p>
<p>Fuchs RK, Bauer JJ, Snow CM. Jumping improves hip and lumbar spine bone mass in prepubescent children: a randomized controlled trial. <i>J Bone Miner Res.</i> 2001;16(1):148-56. Ref. #42</p>	<p><b>Jumping exercises</b> -3x per week for 7 mo -50-100 jumps off 61-cm boxes additional to PE</p>	<p>Elementary</p>	<p>No change to % body fat or weight, significant increase in lumbar spine bone mineral content (p&lt;0.05) and density (p&lt;0.01) and femoral neck BMC (p&lt;0.001) and bone mineral area (p&lt;0.001)</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Going S, Thompson J, Cano S, Stewart D, Stone E, Harnack L, et al. The effects of the Pathways Obesity Prevention Program on physical activity in American Indian children. <i>Prev Med</i> 2003;37:S62-9. Ref. #44</p>	<p><b>Pathways Obesity Prevention Program</b> -3 years -Increased frequency and quality of physical education</p>	<p>Elementary</p>	<p>No significant difference in PA level or % body fat between groups.</p>
<p>Hergenroeder AC, Kozinetz C, Schoene RB. Skinfold measurements, oxygen uptake, and exercise in adolescents. <i>Clin J Sport Med</i> 1993; 3: 153–160. Ref. #46</p>	<p><b>Aerobic exercise in PE</b> -18 weeks -2x 40-min and 1x 60-min aerobic exercise lessons: jogging or aerobic dance</p>	<p>High</p>	<p><b><u>Positive weight outcome</u></b> Sum of three skin-fold thickness (mm): -8.83 (-12.8, -4.83) (intx - control) p &lt;0.05 Triceps skin-fold thickness (mm): -2.48 (- 4.10, -0.84) p&lt;0.05 Subscapular skin-fold thickness (mm): -1.50 (-3.09, 0.09) p&lt;0.05 Anterior mid-thigh skin-fold thickness (mm): - 4.85 (-6.61, -3.09) p&lt;0.05 Aerobic fitness – VO2max (mL min<sup>-1</sup> kg<sup>-1</sup>): 7.1 (-3.65, 17.85) p=0.18*</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Jago R, McMurray R, Bassin S, et al. Modifying middle school physical education: piloting strategies to increase physical activity. <i>Pediatr Exerc Sci</i> 2009;21(2):171–85. Ref. #47</p>	<p><b>More MVPA in PE</b>  -9 weeks  -PE activity taught by PE specialists and used specific activities compiled on “instruction cards” to increase MVPA during physical education class.  -Examples of activities included chase games, circuit training, basketball knockout, and steeplechase.</p>	<p>Middle</p>	<p>PE activity based: 1.2 MET hours gained per day  Curriculum based: 1.72 MET hours gained per day</p>
<p>McKenzie T, Nader P, Strikmiller P, et al. School physical education: effect of the child and adolescent trial for cardiovascular health. <i>Prev Med</i> 1996;25:423–31. Ref. #49</p>	<p><b>CATCH PE</b>  -2.5 years  -Participating schools agreed to provide at least 90 minutes of CATCH PE per week, with focus on increasing MVPA in PE</p>	<p>Middle</p>	<p>Significant increase in % of MVPA in PE (34% in control and 37% in intx, <math>p &lt; 0.0016</math>) and estimated lesson energy expenditure (2.18 in control vs 2.21 in intx, <math>p &lt; 0.002</math>). Small non-significant increase in PE minutes per week and length of PE lessons</p>
<p>McKenzie TL, Stone EJ, et al. Effects of the CATCH physical education intervention: teacher type and lesson location. <i>Am J Prev Med.</i> 2001;21(2):101–9. Ref. #50</p>	<p><b>CATCH PE by teacher type and lesson location</b>  -2.5 years  -Physical education modifications (curricular materials, professional development sessions for teachers, feedback and technical support)</p>	<p>Elementary</p>	<p>Significant effect on MVPA minutes with a change from 10 to 11 minutes in control school and a change from 10.5 to 14 minutes in intx schools (<math>p &lt; 0.003</math>). Small significant increase in minutes spent in fitness activity</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Sadowsky HS, Sawdon JM, Melissa ES, Sticklin AM. Eight-week moderate intensity exercise intervention elicits body composition change in adolescents. <i>Cardiopulm Phys Ther J</i> 1999; 10: 38–44. Ref. #56	<b>Exercise at a specified ventilatory response index (VRI) level</b> -8 weeks -4x moderate-intensity exercise: 5-min walking, 30- min aerobic activity (aerobic dance, walk/joy), cool-down	High	<b><u>Positive weight outcome</u></b> BMI: -0.24 (-0.48, -0.002) (intx - control) (p =0.048). Percent body fat: -0.77 (-1.74, 0.20) p=0.12
Stephens MB, Wentz SW. Supplemental fitness activities and fitness in urban elementary school classrooms. <i>Fam Med</i> 1998;30:220–3. Ref. #62	<b>Supplemental fitness activities</b> -15 weeks -three additional 35-minute sessions per week for 15 weeks (usual PE 45 min once per week).	Elementary	<b><u>Positive weight outcome</u></b> Weight increased from baseline to post intervention in both groups but to a lesser extent in the intx school (intx change: 0.4 kg; control group change 0.9 kg; p < 0.001) Significant decrease in skinfold thickness in the intx group compared with the control (intx group change: -2 ml, control group change: 2.5 ml; p < 0.01). Maximal and recovery heart rate values reduced significantly in the intx group compared with the control group (p < 0.05). Systolic and diastolic blood pressure increased in both groups with no significant differences between the groups.
<b>Group 1.2: Physical education with additional strategies</b>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Bayne-Smith M, Fardy PS, Azzollini A et al. Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban teenaged girls through a school based intervention: the PATH program. Am J Public Health. Sept. 2004; 94(9):1538-43. Ref. #29</p>	<p><b>PATH Program</b> -12 weeks -Daily PE classes (5 days/week) that consisted of 5–10-min lecture on a topic of CV health and fitness and 20–25 min of VPA)</p>	<p>Elementary</p>	<p>No significant intx effect on PA. No significant intx effect on BMI. Significant positive effects on mean systolic and diastolic blood pressure. No significant effect on mean blood cholesterol level or VO2max</p>
<p>Dishman, R.K., R.W. Motl, R. Saunders, et al. Enjoyment mediates effects of a school-based physical-activity intervention Med. Sci. Sports Exerc., 37(3) (2005), pp. 478–487. Ref #33</p>	<p><b>LEAP</b> -1 year -Choice-based, gender-sensitive PE with emphasis on self-efficacy, self- management, fun and enjoyment</p>	<p>High</p>	<p>Girls in high implementing schools had greater PA levels; changes in PA were partially mediated by self-efficacy and enjoyment. Organizational factors - high implementing schools had 2 different organizational characteristics: a physical activity team and having a faculty-staff health promotion. No relationship with implementation reported</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Fardy PS, White RE, Haltiwanger-Schmitz K, Magel JR, McDermott KJ, Clark LT, et al. Coronary disease risk factor reduction and behavior modification in minority adolescents: the PATH program. <i>Journal of Adolescent Health</i> 1996;18(4):217. Ref. #40</p>	<p><b>PATH</b> -11 weeks -PA sessions</p>	<p>High</p>	<p><b><u>Positive weight outcome</u></b> No effect on leisure time PA rates. Statistically significant improvement in VO2 max among adolescent males and females , P &lt; 0.001</p>
<p>Flores R. Dance for health: improving fitness in African-American and Hispanic adolescents. <i>Public Health Rep</i> 1995; 110: 189-193. Ref. #41</p>	<p><b>Dance for Health</b> -12 weeks - 50 minute dance-orientated aerobic PE class three times a week</p>	<p>Middle</p>	<p><b><u>Positive weight outcome</u></b> Statistically significant reductions in BMI between intx and control girls at 12 weeks: intx girls: 22.1 (SD 6.0); control girls 22.5 (SD 4.4) This represents a change of -0.8 kg m<sup>-2</sup> in the intervention group and +0.3 kg m<sup>-2</sup> in the control group (P &lt; 0.05). No statistically significant change between intx and control boys for BMI (BMI -0.2 kg m<sup>-2</sup> intx boys, vs. -0.6 kg m<sup>-2</sup> control boys).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Pate RR, Saunders R, Dishman RK et al. Long-term effects of a physical activity intervention in high school girls. <i>Am J Prev Med</i> 2007; 33: 276–80. Ref. #52</p>	<p><b>LEAP 2</b> -1 year -Girl-friendly PA of moderate to vigorous PA for 50% or more of PE class time (aerobics, dance, walking, self-defense, martial arts, weight training plus competitive sport and traditional PE).)</p>	<p>High</p>	<p>After the 1-year intervention, the prevalence of VPA was 9% significantly higher in the intx schools than in the control schools, with a greater percentage of girls in high-implementing schools reported engaging in VPA.</p>
<p>Pate RR, Ward DS, Saunders RP et al. Promotion of physical activity among high-school girls: a randomized controlled trial. <i>Am J Public Health</i> 2005; 95: 1582–7. Ref #53</p>	<p><b>LEAP 2</b> -1 year -Girl-friendly PA of moderate to vigorous PA for 50% or more of PE class time (aerobics, dance, walking, self-defense, martial arts, weight training plus competitive sport and traditional PE).)</p>	<p>High</p>	<p>After the 1-year intervention, the prevalence of VPA was 9% significantly higher in the intx schools than in the control schools, with a greater percentage of girls in high-implementing schools reported engaging in VPA. Girls in high implementing schools had greater PA levels; changes in PA were partially mediated by self-efficacy and enjoyment.</p>
<p>Dishman, R.K., R.W. Motl, R. Saunders, et al. Self-efficacy partially mediates the effect of a school-based physical-activity intervention among adolescent girls <i>Prev. Med.</i>, 38 (5) (2004), pp. 628–636. Ref #32</p>	<p><b>LEAP</b> -1 year -Choice-based, gender-sensitive PE with emphasis on self-efficacy, self-management, fun and enjoyment</p>		<p>Organizational factors - high implementing schools had 2 different organizational characteristics: a physical activity team and having a faculty–staff health promotion. No relationship with implementation reported</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Sallis JF, McKenzie TL, Alcaraz JE, et al. Project SPARK. Effects of physical education on adiposity in children. Ann New York Acad Sci. 1993; 699:127-36. PMID: 8267303. Ref. #58</p>	<p><b>SPARK</b> -Baseline (fall, fourth grade) and final (spring, fifth grade) (3 × 30-min classes per week including warm-up, fitness activities such as walk/run/jog/aerobic dance and sports skills such as soccer/basketball/softball)</p>	<p>Elementary</p>	<p><b>1993 study:</b> Non-significant BMI change in favor of the intx in boys and girls. All boys in all three groups increased their BMI over 2 years. Control girls had significantly lower BMI than girls in either teacher-led or specialist-led intervention group (P &lt; 0.01). Changes in skin-fold thickness not significant between groups in girls or boys.</p>
<p>Sallis J, McKenzie T, Alcaraz J, Kolody B, Faucette N, Hovell M. The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. Am J Public Health 1997;87:1328-4. Ref. #57</p>	<p><b>SPARK</b> -Baseline (fall, fourth grade) and final (spring, fifth grade) (3 × 30-min classes per week including warm-up, fitness activities such as walk/run/jog/aerobic dance and sports skills such as soccer/basketball/softball)</p>	<p>Elementary</p>	<p><b>1997 study:</b> Intx had 2 Arms. Arm1-SPARK led by teacher &amp; Arm2-SPARK led by specialist. 1.11 MET hours gained per day (teacher) and 1.68 MET hours gained per day (specialist). Students spent more minutes per week being physically active in specialist-led (40 min) and teacher-led (33 min) physical education classes than in control classes (18 min; P &lt; .001). After 2 years, girls in the specialist-led condition were superior to girls in the control condition on abdominal strength and endurance (P &lt; .001) and cardiorespiratory endurance (P &lt; .001).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Webber LS, Catellier DJ, Lytle LA, Murray DM, Pratt CA, Young DR, Elder JP, Lohman TG, Stevens J, Jobe JB, Pate RR. Promoting physical activity in middle school girls: Trial of Activity for Adolescent Girls. American journal of preventive medicine. 2008 Mar 31;34(3):173-84. Ref. #63</p>	<p><b>Activity for Adolescent Girls</b>  -3 years total (2 yrs staff directed and 1 additional year)  -Program Champions promoted MVPA for at least 50% of class time and encouraged teachers to promote PA.</p>	<p>Middle</p>	<p>After the staff-directed intervention (pre-stated primary outcome), there were no differences (mean 0.4, 95% CI 8.2 to 7.4) in adjusted MET-weighted MVPA in 8th-grade girls in intervention and control schools. Following the Program Champion-directed intervention, girls in intervention schools were more physically active than girls in control schools (mean difference 10.9 MET-weighted minutes of MVPA, 95%CI 0.52-21.2). This difference is about 1.6 minutes of daily MVPA or 80 kcal per week. There were no differences in fitness or percent body fat at either 8th-grade time-point. Positive but non-significant improvements for body weight (p-value not reported). Change in minutes of moderate to vigorous physical activity, and change in minutes of total physical activity were positive but non-significant.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Young DR, Phillips JA, Yu T et al. Effects of a life skills intervention for increasing physical activity in adolescent girls. Arch Pediatr Adolesc Med 2006; 160: 1255-61. Ref. #64</p>	<p><b>life skills-oriented physical education curriculum</b>  -8 months  -MVPA during PE was promoted by teaching topics that were active in nature (e.g., soccer vs. softball), breaking skills training into small-group activities, and playing games in small groups. Skills training was limited to that needed for competency, rather than proficiency. One semester of team sport and one semester of individual sport taught 5 days per week</p>	<p>High</p>	<p>0.553 MET hours gained per day. No intx effect on PA. No intx effect on biometrics.</p>
<p><b>Group 1.3: Physical activity offered with or without additional strategies other than PE</b></p>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Bleeker M, Beyler N, James-Burdumy S, Fortson J. The impact of playworks on boys' and girls' physical activity during recess. J Sch Health. 2015 Mar;85(3):171-8. Ref #30</p>	<p>Playworks -1 school year -Organized activities during recess, improvements to the recess play yard</p>	<p>Elementary</p>	<p>Significant impact on the mean number of accelerometer intensity counts recorded per minute during recess for girls, with girls in treatment schools registering, on average, 315 more accelerometer intensity counts per minute during recess than their counterparts in control schools; this amounted to about a 34% increase in intensity counts per minute. No significant differences in mean number of accelerometer intensity counts or steps taken were found for boys.</p>
<p>Donnelly JE, Greene J, Gibson C, Smith B, Washburn R, Sullivan DK, DuBose K, Mayo M, Schmelzle KH, Ryan J, Jacobsen D, Williams SL. Physical Activity Across the Curriculum (PAAC): a randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. Prev Med 2009; 49(4):336-341. Ref #34</p>	<p><b>PAAC (Physical Activity Across the Curriculum)</b> -3 years - 90 min/wk of moderate to vigorous physically active academic lessons.</p>	<p>Elementary</p>	<p>No significant differences for change in BMI or BMI percentile for intervention vs control. BMI Hedges' g 0.01 (-0.09,0.11) Children in intx had 12% more PE school day (p&lt;0.01) and 17% more PA on weekends compared to control children (p&lt;0.001). Children in intx also had 36% more MVPA minutes than control children (p&lt;0.001).</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Elder JP, McKenzie TL, Arredondo EM, et al. Effects of a multipronged intervention on children's activity levels at recess: the Aventuras para Niños Study. <i>Adv Nutr.</i> 2011;2:171S-6S. Ref #37	<b>Aventuras para niños</b> -5 semesters -Playground markings and recess walking clubs (year 1), organized recess activities (year 2) 2 9 per month	Elementary	Significant decrease in boys' MVPA after 1 year for intervention (p\0.05)
Gao Z, Podlog L. Urban Latino children's physical activity levels and performance in interactive video dance games: effects of goal difficulty and goal specificity. <i>Arch Pediatr Adolesc Med</i> 2012; 166: 933-937. Ref #43	<b>Dance video game</b> -8 weeks -Exergaming (Dance Dance Revolution), 45 min per session × 4 days/week	Elementary	Children who set specific (easy or difficult) goals had significantly greater increased PA levels and Dance Dance Revolution (DDR) performance than those in the control group. Children's increased PA levels in the difficult goal group were significantly higher than those in the easy- goal group.
Mendoza JA, Watson K, Baranowski T, Nicklas TA, Uscanga DK, Hanfling MJ. The walking school bus and children's physical activit a pilot cluster randomized controlled trial. <i>Pediatrics.</i> 2011;128(3):537-544. Ref #51	<b>Walking school bus</b> -5 weeks -walking school bus - students walked to and from school by a trained staff 5 days/week -Weekly rate or active commuting and mins/day of MVPA	Elementary	Significant effect on minutes/day of MVPA in intx group (p<0.01).

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Sirard JR, Alhassan S, Spencer TR, Robinson TN. Changes in physical activity from walking to school. J Nutr Educ Behav. 2008;40(5):324-326. PubMed doi:10.1016/j.jneb.2007.12.002 Ref #60</p>	<p><b>Walking school bus</b> -1 week -Intervention group: walking school bus, walked at normal pace; control: morning commute was not altered -Counts/min, % of time spent in MVPA using an accelerometer</p>	<p>Elementary</p>	<p>Intx children increased their MVPA during the commute time (45 minutes before school) 14 minutes/day more than control children. No significant differences were detected for other weekday periods and no significant differences were detected between groups (all p ≥ 0.40) for PA</p>
<p><b>Group 1.4: Physical activity education and/or physical activity promotion only</b></p>			
<p>Dzewaltowski DA, Estabrooks PA, Welk G et al. Healthy youth places: a randomized controlled trial to determine the effectiveness of facilitating adult and youth leaders to promote physical activity and fruit and vegetable consumption in middle schools. Health Educ Behav 2009; 36: 583-600. Ref #36</p>	<p><b>Healthy Youth Places</b> -1 year -Social and policy environment - development of personal and proxy agency of adult leaders and youth to build school environments to promote PA; facilitate student leadership</p>	<p>Middle</p>	<p>After intervention, intervention schools significantly changed in PA compared to control schools. Proxy efficacy to influence school PA environments mediated the program effects</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Goran MI, Reynolds K. Interactive multimedia for promoting physical activity (IMPACT) in children. <i>Obes Res</i> 2005; 13: 762–771. Ref #45</p>	<p><b>IMPACT (Interactive Multimedia for Promoting Physical Activity in Children)</b>  -8-weeks  -45 minutes x 16 lessons  -interactive, educational learning game - multimedia, animated CD-ROM promoting physical activity, plus four classroom and four homework family- based assignments</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b>  There was a significant treatment effect for obesity reduction in girls but not in boys (BMI z-score, <math>p=.01</math>). These obesity improvements were likely caused by increases in light activity resulting from the intervention translating to 20 minutes more time spent in light activities per day.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Marks J, Campbell M, Ward D, Ribisl K, Wildemuth B, Symons M. A comparison of web and print media for physical activity promotion among adolescent girls. J Adolesc Health. 2006;39(1):96-104. Ref #48</p>	<p><b>LifeBytes</b>  -1 module, reviewed 4 times over 2 weeks = 89 min total usage  -LifeBytes website included interactive games, a quiz, downloadable charts to plan daily activities, and interactive demonstrations of different types of activities, including addressing barriers and benefits of physical activity, goal setting, and social support.  -Comparison of web-based versus print delivery of LifeBytes PA education and promotion; survey administered to students - self-reported physical activity, PA intentions and self-efficacy</p>	<p>Middle</p>	<p>Self-reported physical activity increased significantly in the print group only (p =.002). Both groups increased physical activity intentions (Web: t[157] = 2.27, p =.02; print: t[159] = 6.32, p ≤ .001) and self- efficacy (Web: t[155] = 2.58, p = .01; print: t[156] = 3.11, p = .002) over the two-week time period.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Robbins L, Gretebeck K, Kazanis A, Pender, N. Girls on the move program to increase physical activity participation. Nurs Res.2006;55(3):206-16. Ref #54	<b>Girls on the move-</b> -12 weeks -3 computerized, individually tailored feedback sessions for increasing PA. -Individual counseling from the school's pediatric NP focus on goal setting and contract indicating mutual agreement regarding the goals. -Telephone calls focusing on agreed goals.	Middle	No intx effect on PA. No significant differences between intx vs. control and pre vs. post BMI.

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Robinson TN. Reducing children's television viewing to prevent obesity: a randomized controlled trial. JAMA. 1999;282(16):1561-7. Ref #55</p>	<p><b>Children TV viewing time</b></p> <ul style="list-style-type: none"> <li>-6 months</li> <li>-18 lessons of 30-50 min each</li> <li>-3<sup>rd</sup> &amp; 4<sup>th</sup> grade</li> <li>-teachers trained to give lessons</li> <li>-Lessons included”</li> <li>-Self monitoring and reporting</li> <li>-Challenged with TV turnoff, no screens for 10 days.</li> <li>-Then 7hr per week budget</li> <li>-Lessons on intelligent and selective viewing</li> <li>-Each household was given electronic time manager, locks power for TV, video, etc and monitors and budgets time for each person with personal id code.</li> </ul>	<p>Elementary</p>	<p><b>Positive weight outcome</b></p> <p>Compared with controls, significant decrease in BMI, -0.45 kgs.m<sup>2</sup>, p=.002, triceps skinfolds-1.47mm p=.002, waist circumference, -2.30cms, p&lt;.001, and waist to hip ratio, -0.02, p&lt;0.001. Intx had also significant decreases in TV viewing, meals eaten in front of TV.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Shimon JM, Petlichkoff LM. Impact of pedometer use and self-regulation strategies on junior high school physical education students daily step counts. J Phys Act Health. 2009;6(2):178–84. Ref #59</p>	<p><b>Pedometer use in PA</b>  -4 weeks  -Self regulation strategies classes, and information on goal setting strategies for Intx group 1.  -Unsealed pedometers for self-monitoring and recorded daily steps  -Daily step count (pedometer).</p>	<p>High</p>	<p>No significant differences on daily steps between Intx2 (no self-regulation strategies) and control group. Significant effect on daily steps between Intx1 (with self-regulation strategies) and control group. 14888 average daily steps for self-regulation vs 11571 for control at p&lt;0.05</p>
<p>Spruijt-Metz D, Nguyen-Michel ST, Goran MI, Chou C-P, Huang TTK. Reducing sedentary behavior in minority girls via a theory based, tailored classroom media intervention. Int J Pediatr Obes. 2008;3(4):240-248. Ref #61</p>	<p><b>Get Moving!</b>  -36 months  -Theory-based tailored classroom media intervention. Children received weekly lessons designed to increase positive meanings of PA and increase intrinsic motivation for PA. Teams</p>	<p>Middle</p>	<p>Significantly reduced time spent on self-reported sedentary behavior (p=0.05)</p>
<p><b>Group 2: Nutrition only interventions</b></p>			
<p><b>Group 2.1: School foods only</b></p>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Bartholomew JB, Jowers EM. Increasing frequency of lower-fat entrees offered at school lunch: an environmental change strategy to increase healthful selections. <i>Journal of the American Dietetic Association</i>. 2006 Feb 28;106(2):248-52. Ref #6</p>	<p><b>Lower-fat school lunch entrees</b>            -2 semesters            -Phase 1: 1 out of 3 school entrees offered were low-moderate fat.            -Phase 2: # of competing high-fat entrees was reduced from 2 to 1.</p>	<p>Elementary</p>	<p>-Phase 1: in intx school, number of days that a low-fat entree was offered increased by 70%, with no increase in the rate of selection of the low- or moderate-fat entrees.            -Phase 2: low- and moderate-fat entrees selected at higher rate in the intx school (32.1% and 26.4%, respectively) than the control school (13.8% and 7.5%, respectively), P&lt;0.01.</p>
<p>French SA, Story M, Fulkerson JA, Hannan P. An environmental intervention to promote lower-fat food choices in secondary schools: outcomes of the TACOS Study. <i>American journal of public health</i>. 2004 Sep;94(9):1507-12. Ref #11</p>	<p><b>TACOS (Trying Alternative Cafeteria Options in Schools)</b>            -2 years            -Increased availability of lower-fat a la carte foods</p>	<p>High</p>	<p>33.6% intervention vs 22.1% control sales of lower-fat food sales p=.04; no sig changes in student food choices</p>
<p>Hendy, H. M., Williams, K. E., &amp; Camise, T. S. (2005). "Kids Choice" school lunch program increases children's fruit and vegetable acceptance. <i>Appetite</i>, 45(3), 250-263. Ref #15</p>	<p><b>Kids choice programme</b>            -Duration not reported            -Changes in school lunch procedures, token reinforcement for vegetables and fruits</p>	<p>Elementary</p>	<p>Significant intervention effect on FV intake at both follow-ups in both reinforcement conditions</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Hendy HM, Williams KE, Camise TS, Alderman S, Ivy J, Reed J. Overweight and average weight children equally responsive to 'Kids Choice Program' to increase fruit and vegetable consumption. <i>Appetite</i> . 2007;49(3):683-6. Ref #16	<b>Kids choice programme</b> -Duration not reported -Changes in school lunch procedures, token reinforcement for vegetables and fruits	Elementary	Significant intervention effect on FV intake at both follow-ups in both reinforcement conditions
Wansink B, Just DR, Hanks AS, Smith LE. Pre-sliced fruit in school cafeterias: children's selection and intake. <i>American journal of preventive medicine</i> . 2013 May 31;44(5):477-80. Ref #25	<b>Pre-sliced fruit</b> - -Duration not reported -Offer cut fruit instead of whole fruit	Middle	% of students who selected apples and ate more than half increased by 73% (p 0.02) at schools that served pre-sliced fruit, the percentage that wasted half or more decreased by 48% (p 0.03).
<b>Group 2.2 School food changes and nutrition promotion</b>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Cohen JF, Kraak VI, Choumenkovitch SF, Hyatt RR, Economos CD. The CHANGE study a healthy-lifestyles intervention to improve rural children’s diet quality. J Acad Nutr Diet. 2014;114:48–53. Ref #7</p>	<p><b>CHANGE (Creating Healthy Active Nurturing Growing-up Environments)</b>  -6 months to 1 year  -Offer whole grains daily, provide 5 different fruit and vegetable options weekly (with a fresh fruit or vegetable option daily, and a dark green or orange vegetable or fruit at least 3 times per week), providing beans or peas weekly, supplying 1% and nonfat milk daily, limiting ice cream sells, and encouraging a healthier a la carte portfolio.  -Expose students to the Shape Up: During and After-School curriculum, the Eat Well Keep Moving curriculum, and the 5-2-1 messages</p>	<p>Elementary</p>	<p>Children in the intervention groups consumed significantly more vegetables and combined fruits and vegetables than the control group. There were no significant differences between the intervention and control schools in fruit, legume, whole grain, or dairy consumption.</p>

<p>Coleman KJ, Shordon M, Caparosa SL, et al. Changing nutrition policies and environments in low-income schools using implementation models: The healthy options for nutrition environments in schools (ONES) intervention. Obesity. 2011; 19:S124 Ref #8</p>	<p><b>Healthy ONES (Healthy Options for Nutrition Environments in Schools)</b></p> <ul style="list-style-type: none"> <li>-104 weeks</li> <li>-Snacks: bringing and consuming unhealthy snacks from home was discouraged by teachers.</li> <li>-Daily fruit at recess program.</li> <li>-Lunch: unhealthy items were removed from the menu. Added healthier in-house prepared entrees to menus.</li> <li>-Cater healthy food for events and celebrations.</li> <li>-Changed fundraising to include nonfood events. Removed unhealthy foods from PTA sponsored events menus.</li> <li>-Exclusive use of nonfood rewards by custodian and cafeteria staff for student helpers.</li> <li>-Advertising of approved healthy snack and beverages only.</li> <li>-"Healthy and Unhealthy" snack poster displayed</li> <li>-Promotion of healthy eating during class. Student chef clubs and cooking classes</li> <li>-Encouraged parents to try meals to demonstrate they were healthful and flavorful</li> <li>encouraged parents to try meals to demonstrate they were</li> </ul>	<p>Elementary</p>	<p>Non-significant difference in prevalence of overweight and obesity in favor of the control.</p>
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<b>Full Citation</b>	<b>Intervention details (name, duration, key elements)</b>	<b>School Grade Level(s)</b> (Elementary, Middle, High)	<b>Results</b> (effect size, if available) <sup>1</sup>
	<p>healthful and flavorful -free meal for staff who eat school lunches with students. Staff proactively discouraged students from consuming unhealthy snacks during recess. Cafeteria monitors proactively discouraging unhealthy food from home. Staff not consuming unhealthy food and beverages in front of students. Staff participated in parent nutrition meetings, student cooking classes and the fruit at recess program.</p>		

<p>Foster GD, Sherman S, Borradaile KE et al. A policy-based school intervention to prevent overweight and obesity. Pediatrics April 2008;121(4):e794-e802. Ref #10</p>	<p><b>School Nutrition Policy Initiative</b>  -2 years  -All foods sold and served were changed to meet nutritional standards based on the Dietary Guidelines; breakfast was served in classrooms to increase the number of students eating a healthy breakfast  -Sodas, chips and other high-calorie snacks were no longer sold in vending machines  -Social marketing promotional competitions to promote healthy eating, healthy food branding logos and promotional slogans  -50 hours of food and nutrition education per student per school year  -Nutrition educators reached family members through home and school association meetings, report card nights, parent education meetings, and weekly  -Nutrition workshops.  -staff were offered 10 hours per year of training in nutrition education</p>	<p>Elementary</p>	<p><b>Positive weight outcome</b>  Significantly fewer children in the intervention schools (7.5%) than in the control schools (14.9%) became overweight after 2 years. After controlling for gender, race/ethnicity, and age, the predicted odds of incidence of overweight were 33% lower for the intx group ([OR]: 0.67; 95% confidence interval [CI]: 0.47– 0.96; P &lt; .05). No differences between intx and control in the incidence of obesity. Adjusted OR obesity 1.09(0.85,1.40). Significant decrease in the prevalence of overw. Adjusted OR=0.65 (0.54,0.79).  Intx effect on the prevalence of overweight was particularly effective for black students (OR: 0.59; 95% CI: 0.38 to 0.92; P &lt;.05).  No differences between intx and control in the prevalence of obesity. (adj OR:1.09(0.85-1.40).  No differences between intx and control in self-reported consumption of energy, fat, F&amp;V and PA.  Physical inactivity was 4% lower in the intx than in the control group after 2 years (adjusted OR: 0.96; 95% CI: 0.94 to 0.99; p&lt;.01).</p>
<p>Perry , C.L.; Bishop, D.B.; Taylor, G.L.; Davis, M.; Story, M.; Gray, C.; Bishop, S.C.; May, R.A.W.;</p>	<p><b>5-a-day Cafeteria Power Plus)</b>  -2 school years  -School food service change</p>	<p>Elementary</p>	<p>Significant intervention effect on total FV intake</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Lytle, L.A.; Harnack, L. A randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. Health Educ. Health Education &amp; Behavior. 2004;31(1):65-76. Ref #22</p>	<p>-Kick-off campaigns, samplings, theater production, challenge weeks</p>		
<p>Resnicow K, Cohn L, Reinhardt J, et al. A three-year evaluation of the know your body program in inner-city schoolchildren. Health Educ Q. Winter 1992;19(4):463-480. Ref #23</p>	<p><b>Know Your Body (KYB)</b>  -2.5 years  -Addition of a salad bar, increasing the visibility and availability of low-fat milk, and offering heart healthy entree options  -Food tasting parties, drug and nutrition poster and essay contests, and special health lectures  -30-45 minutes weekly health education curriculum included grade-specific  -Teacher manuals and student activity books; peer leader training; student health committees</p>	<p>Elementary</p>	<p>Students in the longitudinal cohort (n = 1,209) who were exposed to high implementation teachers had significantly (p &lt; .05) lower total plasma cholesterol and systolic blood pressure at 3-year posttest than comparison students. Students in the posttest only cohort (n = 3,066) who had high implementation teachers showed significantly (p &lt; .05) lower total plasma cholesterol, systolic blood pressure, self-reported intake of meat and desserts, as well as higher health knowledge and self-reported intake of "heart healthy" foods and vegetables than comparison students. No significant effect on BMI</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Scherr RE, Linnell JD, Dharmar M, Beccarelli LM, Bergman JJ, Briggs M, Brian KM, Feenstra G, Hillhouse JC, Keen CL, Ontai LL, Schaefer SE, Smith MH, Spezzano T, Steinberg FM, Sutter C, Young HM, Zidenberg-Cherr S. A Multicomponent, School-Based Intervention, the Shaping Healthy Choices Program, Improves Nutrition-Related Outcomes. J Nutr Educ Behav. 2017 May;49(5):368-379. e1. Ref #24	Shaping Healthy Choices Program (SHCP). -1 school year -Garden-enhanced education, family, and community partnerships; increased regionally procured produce in the lunchroom; and school-site wellness committees.	Elementary	<b>Positive weight outcome</b> There was a greater improvement in BMI percentile (-6.08; P < 0.01), BMI Z-score (-0.28; P < .001), and waist-to-height ratio (-0.02; P < .001) in the intervention compared with the control schools.
Wechsler H, Basch CE, Zybert P, Shea S. Promoting the selection of low-fat milk in elementary school cafeterias in an inner-city Latino community: evaluation of an intervention. American Journal of Public Health. 1998 Mar;88(3):427-33. Ref #26	<b>Lowfat Lucy: Low-fat milk social marketing campaign</b> -7-10 days - -Offer 1% low-fat white milk -Taught about harmful effects of a high-fat diet -Low-fat milk positioned as good-tasting, "cool", motivation to taste with "Lowfat Lucy" cow	Elementary	Intervention was associated with a significant increase in the proportion of cartons served that contained low-fat milk (p=.006). Cartons of low-fat milk more than doubled in intervention schools, from 25% to 57% while the control schools remained constant at 28%.
<b>Group 2.3: Nutrition promotion only</b>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Baranowski, T., Baranowski, J., Cullen, K.W., et al., 2003. Squire's quest! Dietary outcome evaluation of a multimedia game. Am. J. Prev. Med. 24, 52-61. Ref #4</p>	<p><b>Squire's Quest</b> -5 weeks -10-session psychoeducational multimedia game</p>	<p>Elementary</p>	<p>Significant difference of 0.91 in combined fruit, juice and vegetable servings(p&lt;0.02) difference of 0.52 (p&lt;0.002) in fruit servings; difference of 0.24 (p&lt;0.001) in vegetable servings</p>
<p>Cullen KW, Watson K, Baranowski T, Baranowski JH, Zakeri I. Squire's quest: intervention changes occurred at lunch and snack meals. Appetite. 2005;45(2):148-51. Ref #9</p>	<p><b>Squire's Quest</b> -5 weeks -10-session psychoeducational multimedia game <b>LIFT+ Program (Living Free of Tobacco Plus)</b> -1 school year - LIFT+ program: workshops on the benefits of eating F&amp;V, goal setting. Students complete the training and then teach it to younger students. -Activities for the students to complete with their families.</p>	<p>Elementary Middle</p>	<p>Significant difference of 0.91 in combined fruit, juice and vegetable servings(p&lt;0.02) difference of 0.52 (p&lt;0.002) in fruit servings; difference of 0.24 (p&lt;0.001) in vegetable servings F&amp;V consumption was significantly higher for the intervention group. At one year follow up, fruit consumption was only marginally higher and vegetable consumption was only significantly higher for white children in the intervention group compared to the CG.</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Wilson DB, Jones RM, McClish D, Westerberg AL, Danish S. Fruit and vegetable intake among rural youth following a school-based randomized controlled trial. <i>Prev Med.</i> 2012;54:150–6. Ref #27</p>			
<p>Gatto, N. M., Martinez, L. C., Spruijt-Metz, D., &amp; Davis, J. N. (2017). LA sprouts randomized controlled nutrition, cooking and gardening programme reduces obesity and metabolic risk in Hispanic/Latino youth. <i>Pediatric obesity</i>, 12(1), 28-37. Ref #28</p>	<p><b>LA Sprouts</b> -12 week; - 90 mins/wk -Gardening, nutrition and cooking intervention</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> LA Sprouts participants compared to controls had significantly greater reductions in BMI z-scores (-0.1 vs. -0.04, respectively; p=0.01) and WC (-1.2 vs. 0.1cm; p&lt;0.001). LA Sprouts participants compared to controls increased dietary fiber intake (+3.4% vs. -16.5%; p=0.04). All participants decreased vegetable intake, but decreases were less in LA Sprouts than controls (-3.7% vs. -26.1%; p=0.04). Change in fruit intake did not differ between LA Sprouts and controls.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Gold A, Larson M, Tucker J, Strang M. Classroom Nutrition Education Combined With Fruit and Vegetable Taste Testing Improves Children's Dietary Intake. J Sch Health. 2017 Feb;87(2):106-113. Ref #13</p>	<p><b>Go Wild With Fruits and Veggies! (GWWFV)</b></p> <ul style="list-style-type: none"> <li>-Seven, 45-60 minute lessons</li> <li>-Lessons mix classroom instruction and activities, including games, exercise, reading, and tasting demonstrations.</li> <li>-Access to the federal Fresh Fruit and Vegetable Snack Program (FFVSP), and taste testing within GWWFV were also measured.</li> </ul>	<p>Elementary</p>	<p>Students with access to the FFVSP consumed more fruits (<math>p &lt; .01</math>) and vegetables (<math>p &lt; .0001</math>). Students who participated in the FFVSP and GWWFV with taste testing consumed more fruits and vegetables (<math>p &lt; .05</math>) compared with students who participated in the FFVSP and GWWFV without taste testing, along with the control group.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Hanks AS, Just DR, Brumberg A. Marketing Vegetables in Elementary School Cafeterias to Increase Uptake. Pediatrics. 2016 Aug;138(2). Ref #14</p>	<p>-6 weeks -Students randomly assigned to a control condition or 1 of 3 treatment conditions: (1) a vinyl banner displaying vegetable characters that was fastened around the base of the salad bar; (2) short television segments with health education delivered by vegetable characters; or (3) a combination of the vinyl banner and television segments.</p>	<p>Elementary</p>	<p>Results show that 90.5% (from 12.6% to 24.0%; P = .04) more students took vegetables from the salad bar when exposed to the vinyl banner only, and 239.2% (from 10.2% to 34.6%; P &lt; .001) more students visited the salad bar when exposed to both the television segments and vinyl banners.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Hoffman JA, Franko DL, Thompson DR, Power TJ, Stallings VA. Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. <i>J Pediatr Psychol.</i> 2010;35(1):61–71. Ref #17</p>	<p><b>School Based Fruit and Vegetable Promotion Program</b>  -1.5 years -  -Cafeteria posters reflecting the fruit and vegetable of the day, daily loudspeaker announcements, lunch aides giving verbal praise and a sticker to students eating the fruit and vegetable of the day  <b>5-A-Day Adventures</b>  -CD- ROM used during computer class, interactive children's book  -5-A-Day Kids Cookbook, and a school cookbook developed by children, parents, and teachers.</p>	<p>Elementary</p>	<p>2010: Children in the experimental group ate more fruits and vegetables than the control group in both years of the program. These results were statistically significant.  2011: BMI z-scores did not differ between intervention and control at any of the follow-up time points. Intx children consumed more fruit at lunchtime than control children in years 1 and 2 of the intervention (year 1 diff 22 g, 95% CI 14 g to 30 g, <math>p &lt; 0.0001</math>; year 2 diff 15 g, 95% CI 6 g to 23 g, <math>p &lt; 0.005</math>). No differences in fruit consumption in year 3 or at follow-up (3.5 years).  Lunchtime vegetable consumption was higher in the intx than in the control in years 1, 2 and 3 (year 1 diff 7 g, 95% CI 3 g to 10 g, <math>p &lt; 0.005</math>; year 2 diff 3 g, 95% CI -0.5 g to 6.5 g, <math>p &lt; 0.05</math>; Year 3 diff 3 g, 95% CI -0.2 g to 6.7 g, <math>p &lt; 0.05</math>) but there were no differences between the groups at follow-up.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Hoffman JA, Thompson DR, Franko DL, Power TJ, Leff SS, Stallings VA. Decaying behavioral effects in a randomized, multi-year fruit and vegetable intake intervention. <i>Prev Med</i> 2011;52:370–5. Ref #18</p>	<p><b>School Based Fruit and Vegetable Promotion Program</b> -1.5 years - -Cafeteria posters reflecting the fruit and vegetable of the day, daily loudspeaker announcements, lunch aides giving verbal praise and a sticker to students eating the fruit and vegetable of the day</p>	<p>Elementary</p>	<p>2010: Children in the experimental group ate more fruits and vegetables than the control group in both years of the program. These results were statistically significant. 2011: BMI z-scores did not differ between intervention and control at any of the follow-up time points. Intx children consumed more fruit at lunchtime than control children in years 1 and 2 of the intervention (year 1 diff 22 g, 95% CI 14 g to 30 g, <math>p &lt; 0.0001</math>;</p>
<p>Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, et al. Gimme 5 fruit, juice, and vegetables for fun and health: outcome evaluation. <i>Health Educ Behav.</i> 2000;27(1):96–111. Ref #5</p>	<p><b>5-A-Day Adventures</b> -CD- ROM used during computer class, interactive children's book -5-A-Day Kids Cookbook, and a school cookbook developed by children, parents, and teachers. <b>Gimme 5</b> -9 months -Food marketing -Communications, food marketing -Curriculum, goal setting and problem solving</p>		<p>year 2 diff 15 g, 95% CI 6 g to 23 g, <math>p &lt; 0.0005</math>). No differences in fruit consumption in year 3 or at follow-up (3.5 years). Lunchtime vegetable consumption was higher in the intx than in the control in years 1, 2 and 3 (year 1 diff 7 g, 95% CI 3 g to 10 g, <math>p &lt; 0.005</math>; year 2 diff 3 g, 95% CI -0.5 g to 6.5 g, <math>p &lt; 0.05</math>; Year 3 diff 3 g, 95% CI -0.2 g to 6.7 g, <math>p &lt; 0.05</math>) but there were no differences between the groups at follow-up. Significant difference of 0.2 in fruit and vegetable servings (<math>p &lt; 0.038</math>). The intx appeared to prevent a reduction in F&amp;V intake. Intx F&amp;V portions were 2.3 at baseline and stayed at 2.3 at Year 2, Control F&amp;V portions started at 2.4 and declined to 2.1 at Year 2. Most of the changes were due to vegetable servings, not fruit servings.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Morrill BA, Madden GJ, Wengreen HJ, Fargo JD, Aguilar SS. A Randomized Controlled Trial of the Food Dudes Program: Tangible Rewards are More Effective Than Social Rewards for Increasing Short- and Long-Term Fruit and Vegetable Consumption. <i>J Acad Nutr Diet.</i> 2016 Apr;116(4):618-29. Ref #21</p>	<p><b>Food Dudes</b> -4.5 months -Randomized controlled trial with three groups (ie, prize, praise, and control).</p>	<p>Elementary</p>	<p>Students attending the Food Dudes schools consumed more F/V than control schools after phase I, with larger differences in prize schools (92% difference) than praise schools (50% difference). After phase II, Food Dudes schools consumed 46% more F/V than control schools, with no difference between prize and praise schools. At 6-month follow-up, only prize schools consumed more F/V than control schools (0.12 cups more per child, 42.9% difference).</p>
<b>Group 2.4: Water access only</b>			
<p>Giles CM, Kenney EL, Gortmaker SL, Lee RM, Thayer JC, Mont-Ferguson H, Cradock AL. Increasing water availability during afterschool snack: evidence, strategies, and partnerships from a group randomized trial. <i>American journal of preventive medicine.</i> 2012 Sep 30;43(3):S136-42. Ref #12</p>	<p><b>Provide water after school</b> -1 school year -Water-delivery systems to serve water during snack time</p>	<p>Elementary</p>	<p>The intervention was associated with an increased average volume of water served (3.6 ounces/day; p 0.01) during snack. On average, the intervention led to a daily decrease of 60.9 kcals from beverages served during snack (p 0.03).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Kenney EL, Gortmaker SL, Carter JE, Howe MC, Reiner JF, Cradock AL. Grab a Cup, Fill It Up! An Intervention to Promote the Convenience of Drinking Water and Increase Student Water Consumption During School Lunch. Am J Public Health. 2015 Sep;105(9):1777-83. Ref #19</p>	<p><b>Promoting water</b> -3 months -Signage promoting water and disposable cups were installed near water sources in cafeteria.</p>	<p>Elementary, Middle, High</p>	<p>The percentage of students in intervention schools observed drinking water during lunch nearly doubled from baseline to follow-up compared with controls (+ 9.4%; P &lt; .001). The intervention was associated with a 0.58-ounce increase in water intake across all students (P &lt; .001). Without cups, children were observed drinking 2.4 (SE = 0.08) ounces of water from fountains; with cups, 5.2 (SE = 0.2) ounces. The percentage of intervention students observed with sugar-sweetened beverages declined (-3.3%; P &lt; .005).</p>
<p><b>Group 3: Physical activity and nutrition interventions-combined</b></p>			
<p><b>Group 3.1: PE and/or PA offered with nutrition promotion with or without PA promotion</b></p>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Annesi JJ, Smith AE, Walsh SM, Mareno N, Smith KR. Effects of an after-school care-administered physical activity and nutrition protocol on body mass index, fitness levels, and targeted psychological factors in 5- to 8-year-olds. <i>Transl Behav Med.</i> 2016 Sep;6(3):347-57. Ref #65</p>	<p><b>Revised Youth Fit For Life</b> -12-weeks -45 minute sessions, 4 days/week</p>	<p>Elementary, after-school</p>	<p><b>Positive weight outcome</b> Improvements in physiological measures and ESE were significantly greater in the experimental group. BMI increase was significantly less from time 1 to time 3 for the treatment group, <math>t(112) = 2.60, p = 0.011, ES = 0.15</math>. For the overall sample, mean BMI percentile in the control group increased from 71.29 to 72.67 % over the length of the study. For the treatment group, BMI percentile reduced from 68.79 to 65.14 %.</p>
<p>Annesi JJ, Walsh SM, Greenwood BL, Mareno N, Unruh-Rewkowski JL. Effects of the Youth Fit 4 Life physical activity/nutrition protocol on body mass index, fitness and targeted social cognitive theory variables in 9- to 12-year-olds during after-school care. <i>J Paediatr Child Health.</i> 2017 Apr;53(4):365-373. Ref #66</p>	<p><b>Youth Fit 4 Life (YF4L)</b> -1school year (9 months) -Four sessions per week for 45 minutes. Each session includes high energy physical activities and a short educational component where children learn about healthy eating and setting goals.</p>	<p>Elementary, after-school</p>	<p><b>Positive weight outcome</b> Of the overall sample, 28% were overweight or obese at baseline. YF4L was associated with significantly greater improvements in BMI, and measures of self-regulation, mood, self-efficacy, cardiovascular endurance and strength over both 3 and 9 months. Changes in self-regulation, mood and self-efficacy significantly mediated the treatment type-BMI relationship over both 3 months (<math>R^2 = 0.12, P = 0.002</math>) and 9 months (<math>R^2 = 0.13, P = 0.001</math>), with change in self-regulation being a significant independent mediator.</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Centeio EE, McCaughtry N, Moore EWG, Kulik N, Garn A, Martin J, Shen B, Somers CL, Fahlman M. Building healthy communities: A comprehensive school health program to prevent obesity in elementary schools. <i>Prev Med.</i> 2018 Jun;111:210-215. Ref #73</p>	<p><b>Building Healthy Communities: Elementary School Program (BHC)</b> -8 months -Six components: 1) principal engagement, 2) classroom nutrition lessons and PA breaks, 3) active recess, 4) quality physical education, 5) student leadership, and 6) after-school Healthy Kids Clubs</p>	<p>Elementary</p>	<p>ANCOVA revealed a significant difference in WHtR among treatment and control groups at time two (T2) <math>F(1,6148.14) = 4.43, p = .035, R^2 = 0.64, R^2_{Treatment} = 0.01</math>, with no significant differences based on age, sex, and race. Additionally, the ANCOVA for BMI revealed a marginally significant lower BMI among the treatment than comparison group students <math>F(1, 614) = 3.575, p = .059, R^2 = 0.01</math> (Mdiff = -0.23, 95%CI upper boundary: -0.03).</p>
<p>Harrell JS, McMurray RG, Bangdiwala SI, Frauman AC, Gansky SA, Bradley CB. Effects of a school-based intervention to reduce cardiovascular disease risk factors in elementary school children: the Cardiovascular Health in Children Study (CHIC). <i>J Pediatr.</i> 1996;128: 797- 805. Ref #81</p>	<p><b>Cardiovascular Health in Children (CHIC) Study</b> -8 weeks -Twice weekly classroom curriculum on nutrition, exercise, smoking avoidance, and peer pressure</p>	<p>Elementary</p>	<p>Children in the intervention group had significantly greater knowledge (7.9% more correct) and a significant increase in self-reported physical activity than children in the control group.</p>

<p>Hopper CA, Gruber MB, Munoz KD et al. Effect of including parents in a school-based exercise and nutrition program for children. Res Q Exerc Sport 1992; 63(3):315-321. Ref #84</p>	<p><b>School nutrition and PA program with parental involvement 1</b> -6 weeks -In-class instruction and activities relating to developing healthy nutritional habits: two 30 min in-school sessions per week for 6 weeks (same content and instructions for both groups), taught by regular classroom teacher and assisted by a nutrition education specialist. Main focus of curriculum was reducing saturated fat, but also the following topics were included: preparing snacks using fruits and vegetables, preparing heart-healthy meals (reducing sugar, salt, saturated fat, and cholesterol), reading food labels, and eating high fiber foods, meat alternatives, and high energy foods. Methods used were hands-on preparation, films, games, group discussion, and role-playing designed to encourage the use of heart healthy foods. Food choices were designated as everyday foods or sometimes foods. Students were taught specific concepts relating to nutrition and its influence on</p>	<p>Elementary</p>	<p>Intervention groups increased knowledge of exercise and nutrition concepts, sit-and-reach flexibility, and no increase in skinfold and percent of calories in fat. Posttest %calories from fat showed that the school-and-home group and school only group each showed significantly lower percent of calories from fat than the control group (p&lt;0.05). Posttest sit-and-reach flexibility showed that the school-and-home group, but not the school-only group, achieved significantly greater flexibility than the control group (p&lt;0.05).</p>
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Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
	cardiovascular disease, as well as how to discuss nutritional topics at home with their parents and how eating habits could be improved within the family.		
Hopper CA, Munoz KD, Gruber MB, MacConnie SE, Schonfeldt B, Shunk T. A school-based cardiovascular exercise and nutrition program with parent participation: An evaluation study. Child Health Care 1996;25:221-35. Ref #85	<b>Exercise and nutrition program with a parent component</b> -10 weeks -In-school heart-healthy nutrition curriculum in 2, 30 min sessions/week for 10 weeks, based on the approach from the Minnesota Heart Project	Elementary	Children in the treatment group scored higher than the children in the control group on posttest vegetable and fruit servings (4.5, $p < .05$ ). children in the treatment group scored higher than the children in the control group on posttest fitness (mile run in sec) and nutrition knowledge ( $p < .001$ ). No significant group differences were found for change scores on any of the other measures.

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Hopper CA, Munoz KD, Gruber MB, Nguyen KP. The effects of a family fitness program on the physical activity and nutrition behaviors of third- grade children. Res Q Exerc Sport 2005; 76(2):130-9. Ref #86</p>	<p><b>School nutrition and PA program with parental involvement 2</b> 20 weeks (10 weeks fall semester and 10 weeks spring) -Two 30-min lessons per week - classroom nutrition education emphasizing impact of nutrition on health, reading food labels, hands on activities, games, group discussion and role. Children were also taught how to discuss nutritional topics at home and how to improve eating habits within the family.</p>	<p>Elementary</p>	<p>At posttest, the treatment group scored significantly higher than the control group on exercise and nutrition knowledge and significantly lower than the control group on total fat intake. There was no improvement in physiological measures, including blood cholesterol.</p>
<p>Johnston CA, Tyler C, McFarlin BK, et al. Weight loss in overweight Mexican American children: a randomized, controlled trial. Pediatrics. 2007;120(6):e1450-e1457. Ref #89</p>	<p><b>Intensive program for overweight children</b> -3 months (5x/week) -Student received points for trying new fruits and vegetables, keeping moving during PA, and for meeting program and individual glass. Points exchanged weekly for prizes - Participants attended a healthy lifestyle class during last period of class time. A nutrition component was done in a classroom 1 day/week</p>	<p>Middle</p>	<p><b><u>Positive weight outcome</u></b> Significant BMI reduction at 6 months in intx "completers" of - 0.37 BMI points on average vs control group gain of 1.13 BMI points (p&lt;0.001). Non-significant reduction in body fat in both groups, higher in intx group. Small significant reduction in total cholesterol and LDL cholesterol in intx group. No significant changes to HDL, triglycerides, glucose or insulin.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Jones D, Hoelscher DM, Kelder SH et al. Increasing physical activity and decreasing sedentary activity in adolescent girls—The Incorporating More Physical Activity and Calcium in Teens (IMPACT) study. <i>Int J Behav Nutr Phys Act</i> 2008; 5: 42. Ref #90</p>	<p><b>IMPACT study</b> -1.5 years -Based on Social Learning theory and Transtheoretical model -Promote active classroom learning Health curriculum, PE program, promotion of high calcium choices in school</p>	<p>Middle school</p>	<p>12 schools, 6 intx and 6 control, RCT, matched pair design, n=606 girls at follow up.  Signif differences in comparison with control group for daily mins vpa (6 mins P=.05), Daily after school activity mins (8.95 mins, p=.04), daily weekend activity minutes (19 mins, p=.05), reduced duration of screen time (12 mins, p=.05) and total daily sedentary activity mins (17, p=.04).</p>
<p>Killen JD, Telch MJ, Robinson TN, Maccoby N, Taylor CB, Farquhar JW. Cardiovascular disease risk reduction for tenth graders. A multiple-factor school-based approach. <i>JAMA</i>. 1988;260(12):1728-1733. Ref #91</p>	<p><b>Health education and behavioral skills training</b> -7 weeks 20 regular classroom sessions, 50 minutes each focusing on: physical activity, nutrition, smoking, stress, and problem solving</p>	<p>High</p>	<p><b><u>Positive weight outcome</u></b> Significant BMI changes (0.1 for boys in the intervention compared to 0.4 for control, and -0.3 for girls in the intervention compared to 0.0 in the control group) (p =.05).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Madsen K, Linchey J, Gerstein D, Ross M, Myers E, Brown K, Crawford P. Energy Balance 4 Kids with Play: Results from a Two-Year Cluster-Randomized Trial. Child Obes. 2015 Aug;11(4):375-83. Ref #93</p>	<p><b>Energy Balance for Kids with Play (EB4K with Play)</b>  -2 years  -Nine components targeting direct-to-student nutrition and physical activity interventions: nutrition education; individualized nutrition and physical activity goal setting/coaching; community visibility and engagement; energy balance team; teacher engagement/coaching; organized play during in-school and before-school recess; class game time; other opportunities for physical activity during and after school; and junior coach program.</p>	<p>Elementary</p>	<p>At endpoint, there were no group differences in change in PA or dietary behaviors, although BMI z-score decreased overall by -0.07 (p=0.05). Students' dietary knowledge significantly increased, as did the amount of vegetables schools served. Post-hoc analyses stratified by grade revealed that, relative to control students, fourth-grade intervention students reduced school-day sedentary time by 15 minutes (p=0.023) and third-grade intervention students reduced BMI z-score by -0.2 (0.05; p&lt;0.05). There were no significant differences for older students.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Melnyk BM, Jacobson D, Kelly SA, Belyea MJ, Shaibi GQ, Small L, O'Haver JA, Marsiglia FF. Twelve-Month Effects of the COPE Healthy Lifestyles TEEN Program on Overweight and Depressive Symptoms in High School Adolescents. J Sch Health. 2015 Dec;85(12):861-70. Ref #95</p>	<p><b>COPE (Creating Opportunities for Personal Empowerment) Healthy Lifestyles TEEN (Thinking, Emotions, Exercise, Nutrition) program</b></p> <ul style="list-style-type: none"> <li>-Cognitive-behavioral skills-building intervention</li> <li>-Once a week for 15 weeks</li> <li>-20 min of physical activity integrated into a health course taught by teachers</li> </ul>	<p>High School</p>	<p><b>Positive weight outcome</b> COPE teens had a significantly lower BMI at 12 months (<math>F(1,698) = 11.22, p = .001</math>) than Healthy Teens (24.95 versus 25.48). There was a significant decrease in the proportion of overweight and obese COPE teens from baseline to 12 months (<math>\chi(2) = 5.40, p = .02</math>) as compared with Healthy Teens. For youth who began the study with extremely elevated depressive symptoms, COPE teens had significantly lower depression at 12 months compared with Healthy Teens (COPE <math>M = 42.39</math>; Healthy Teens <math>M = 57.90</math>); (<math>F(1,12) = 5.78, p = .03</math>).</p>
<p>Neumark-Sztainer D, Story M, Hannan PJ, Rex J. New Moves: A school-based obesity prevention program for adolescent girls. Prev Med 2003;37:41-51. Ref #98</p>	<p><b>New Moves</b></p> <ul style="list-style-type: none"> <li>-16 weeks</li> <li>-1 educational session per week</li> <li>-Focus on discussion social support or nutrition. Maintenance component: weekly meetings with healthy food for lunch at school during 8 weeks following the intx.</li> </ul>	<p>High</p>	<p>No intx effect on BMI or F&amp;V. Significant positive change in "physical activity stage" scale indicating less regression (<math>p &lt; 0.04</math>). 20% of control girls progressed in PA and 24% regressed vs 31% of intx girls progressed and 19% regressed.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Pbert L, Druker S, Barton B, Schneider KL, Olendzki B, Gapinski MA, Kurtz S, Osganian S. A School-Based Program for Overweight and Obese Adolescents: A Randomized Controlled Trial. J Sch Health. 2016 Oct;86(10):699-708. Ref #100</p>	<p><b>Counseling and afterschool exercise program</b> -12-session school nurse-delivered cognitive-behavioral counseling intervention plus school-based after school exercise program (intervention), or 12-session nurse contact with weight management information (control).</p>	<p>High School</p>	<p>At follow-up, students in intervention compared with control schools were not different in BMI, percent body fat, and waist circumference. Students reported eating breakfast (adjusted mean difference 0.81 days; 95% confidence interval [CI] 0.11-1.52) on more days/week; there were no differences in other behaviors targeted by the intervention.</p>
<p>Rosenbaum M, Nonas C, Weil R, Horlick M, Fennoy I, Vargas I, Kringas P, El Camino Diabetes Prevention Group. School-based intervention acutely improves insulin sensitivity and decreases inflammatory markers and body fatness in junior high school students [see comment. J Clin Endocrinol Metab 2007; 92: 504-508. Ref #102</p>	<p><b>El Camino Diabetes Prevention</b> -3-4 months -14 45-min classroom session once per week integrated into regular science program and taught by the study investigators. Session 3-8 focused on nutrition education and dietary modification to lower dietary fat, reduce consumption of sweetened drinks and fast or supersized foods. Session 10- 11 focused on exercise. The other 6 sessions focused on research study design, diabetes epidemiology, responsibilities of scientists and data analyses.</p>	<p>Middle</p>	<p><b><u>Positive weight outcome</u></b> BMI (and % body fat) significantly lower in intervention group compared with control and compared with baseline. BMI declined 0.7 in intx group 24.7 to 24.0 vs 0.5 increase in control group from 24.3 to 24.8 (p&lt;0.05). % Body fat decline 1.3% in intx from 24.4% to 23.1% vs 1.6% increase in control group from 25.8 to 27.5 (p&lt;0.05)  No significant effect on lipid profiles, glucose or insulin</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Spiegel SA, Foulk D. Reducing overweight through a multidisciplinary school-based intervention. <i>Obesity</i> (Silver Spring, Md.). 2006; 14(1):88-96. Ref #106</p>	<p><b>Wellness, Academics, and You</b>  -1 Spring semester  -WAY program curriculum. The nutritional program (Module 4) addresses nutrition and the way you eat (diet). Consistent messages and information with the 5 A Day media campaign.  -Students learn about nutrients, eating balanced meals, balancing energy input with energy output, the food pyramid, nutrient density, and serving sizes.</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b>  Significant difference between the intervention and control in BMI. (Pearson correlation coefficient = -0.186, p=0.01).  Notable decrease in the intervention group in the prevalence of obesity, and the decrease was most significant for overweight participants (significance not reported).  Physical activity levels and changes in reported nutritional uptake were notable but not significant.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Wright K, Giger JN, Norris K, Suro Z. Impact of a nurse-directed, coordinated school health program to enhance physical activity behaviors and reduce body mass index among minority children: a parallel-group, randomized control trial. Int J Nurs Stud. 2013 Jun;50(6):727-37. Ref #112</p>	<p><b>Kids N Fitness(©)</b></p> <ul style="list-style-type: none"> <li>-Nurse directed 6-week program which met weekly to provide 45min of structured physical activity and a 45min nutrition education class for parents and children.</li> <li>-Intervention sites also participated in school-wide wellness activities, including health and counseling services, staff professional development in health promotion, parental education newsletters, and wellness policies for the provision of healthy foods at the school.</li> </ul>	Elementary	Significant results for students in the intervention, included for boys decreases in TV viewing; and girls increases in daily physical activity, physical education class attendance, and decreases in body mass index z-scores from baseline to the 12 month follow-up.
<p><b>Group 3.2: PE and/or PA offered + school foods</b></p>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Barbeau P, Johnson MH, Howe CA et al. Ten months of exercise improves general and visceral adiposity, bone, and fitness in black girls. <i>Obesity</i> 2007; 15(8):2077-85. Ref #68</p>	<p><b>After-school exercise program</b> -43 weeks -Subjects were given healthy snacks during homework time</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> Significant intervention effect on BMI (adjusted mean change -0.45, p=0.008). Significant intervention effect on % body fat (adjusted change -2.01 p&lt;0.0001). Non-significant changes on WC. Significant increase in moderate PA favoring the intervention. No significant increase in vigorous PA. Significant increase in MVPA favoring the intervention (0.54 p&lt;0.001)</p>
<p>Yin Z, Gutin B, Johnson MH et al. An environmental approach to obesity prevention in children: medical College of Georgia FitKid Project year 1 results. <i>Obes Res.</i> 2005; 13(12):2153-2161. Ref #114</p>	<p><b>Georgia FitKid Project</b> -8 months -Afterschool -Two hour structured session included at least 40 minutes of MVPA and a healthy snack, assistance with homework, and transportation home after the program.</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> 9 intervention and 9 control schools - high percentage of black children. Significant reductions in body fat (-.76, CI -1.42-.09), heart rate, and increase in bone mineral density of intervention kids vs control kids. Positive but non-significant changes in cholesterol, blood pressure, BMI, waist circumference, etc. relative to control students. Program encouraged PA participation. Cost was ~ 500 dollars per child, with staff, training and transporting children home (25% of the cost).</p>
<p><b>Group 3.3: PE and/or PA offered + school foods+ nutrition and/or PA promotion</b></p>			

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Caballero B, Clay T, Davis S, Ethelbah B, Rock B, Lohman T, Norman J, Story M, Stone EJ, et al. Pathways: a school-based randomized controlled trial for the prevention of obesity in American Indian school children. Am J Clin Nutr. 2003;78:1030-8. Ref #72</p>	<p><b>Pathways</b></p> <ul style="list-style-type: none"> <li>-3 years</li> <li>-Change in school foods</li> <li>-Increased PA</li> <li>-Class curriculum</li> <li>-Family involvement</li> </ul>	<p>Elementary</p>	<p>1704 children, 41 schools, RCT.</p> <p>No signif reduction in percentage body fat. No change in observed cal intake comparing intx and control schools, no change in motion sensor measures of PA.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Crespo NC, Elder JP, Ayala GX et al. Results of a multi-level intervention to prevent and control childhood obesity among Latino children: the Aventuras Para Ninos Study. <i>Ann Behav Med.</i> Feb. 2012; 43(1):84–100. Ref #74</p>	<p><b>Aventuras Para Ninos</b>  -3 years  -Implementation and improvement of cafeteria salad bars (intx 2 and 3)  -Posters for healthy eating, newsletter about healthy eating, frequent produce buyer cards. (intx 2 and 3)  -Water bottles in classrooms (intx 2 and 3).  -Delivered by a community health advisor (promotora) through home visit and booster phone calls focused on increasing fruit, vegetable, and water consumption, increasing active play and decreasing sugar-sweetened beverages and TV viewing (intx 1 and 3)</p>	<p>Elementary</p>	<p>No significant changes in BMI z-scores, percentiles and proportions of children in the overweight and obese categories.  Intx1 (home only), significantly increased parent-reported child PA, increased child’s daily consumption of F&amp;V.  No main effect of intx2 (school only) on parent-reported child PA or consumption of F&amp;V.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Donnelly JE, Jacobsen DJ, Whatley JE, Hill JO, Swift LL, Cherrington A, Polk B, Tran ZV, Reed G. Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. <i>Obesity Research</i>. May 1996; 4(3):229-243. Ref #76</p>	<p><b>Nutrition education, modified meals and increased PA</b> -2 years -Changes to school lunches using Lunchpower! - a reduced energy, fat and sodium lunch and nutrition -grade-specific nutrition education curriculum education in curriculum</p>	<p>Elementary</p>	<p>Significant increase in BMI in both groups from baseline to follow-up but no significant difference between groups.</p>

<p>Dzewaltowski DA, Rosenkranz RR, Geller KS, Coleman KJ, Welk GJ, Hastmann TJ, Milliken GA. HOP'N after-school project: an obesity prevention randomized controlled trial. <i>Int J Behav Nutr Phys Act.</i> 2010 Dec 13;7:90. Ref #77</p>	<p><b>Healthy Opportunities for Physical Activity and Nutrition (HOP'N)</b></p> <ul style="list-style-type: none"> <li>-building the capacity of after-school staff to increase physical activity (PA) and fruit and vegetable (FV) opportunities.</li> <li>-2 years</li> <li>-30 minutes of organized PA following the CATCH Kids Club PA principles daily.</li> <li>-After-school program staff was directed to work with their school's food service to provide FV with every snack.</li> <li>-County Extension Office worked with the school district food service to achieve the same FV goal.</li> <li>-Weekly social-cognitive-theory based curriculum was delivered for 60 minutes once a week: learning objectives, behavior change strategy goals, and implementation procedures and scripts.</li> </ul>	<p>Elementary</p>	<p>The intervention had no impact on changes in BMIz. Overweight/obese children attending HOP'N after-school programs performed 5.92 minutes more moderate-to-vigorous PA per day after intervention, which eliminated a baseline year deficit of 9.65 minutes per day (<math>p &lt; 0.05</math>) compared to control site overweight/obese children. Active recreation program time at HOP'N sites was 23.40 minutes (intervention year 1, <math>p = 0.01</math>) and 14.20 minutes (intervention year 2, <math>p = 0.10</math>) greater than control sites. HOP'N sites and control sites did not differ in the number of FV offered as snacks.</p>
<p>Foster GD, Linder B, Baranowski T et al. A school-based intervention for</p>	<p><b>HEALTHY intervention</b></p> <ul style="list-style-type: none"> <li>-3 years</li> <li>-Quantity and nutritional quality of</li> </ul>	<p>Middle</p>	<p><b><u>Positive weight outcome</u></b> Intx and control had reductions in the prevalence of overweight and obesity with no significant</p>

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diabetes risk reduction. N Engl J Med. 2010 July 29;363(5):443-53. Ref #78	<p>food served in the school was changed</p> <ul style="list-style-type: none"> <li>-Optimization of school food environment</li> <li>-Communication and social marketing</li> <li>-Behavioral knowledge and skills were taught in classrooms using the FLASH program</li> </ul>		<p>difference between groups. Nearly significant (<math>p &lt; 0.05</math>) reduction in the prevalence of obesity in the intx. Mean BMI z-score and percentage of students with WC in the 90th percentile were significantly lower in intx than in control (<math>p &lt; 0.04</math>). Intx schools had a significantly lower percentage of students with waist circumferences at or above the 90th percentile at the end of the study (<math>p &lt; 0.03</math>). NI significant intx effect on insulin or blood pressure</p>
Himes JH, Ring K, et al. Impact of the Pathways intervention on dietary intakes of American Indian school children. Prev Med. 2003;37(6 Pt 2):55-61. Ref #83	<p><b>Pathways</b></p> <ul style="list-style-type: none"> <li>-3 year trial</li> <li>-School food service component</li> <li>-School curriculum</li> </ul>	Elementary	<p>No effect on BMI. Significant intervention effects on percentage of energy from total fat, saturated fat and total carbohydrate by lunch observation and 24-h recall. Significant effects on total energy, protein, total fat, saturated fat and polyunsaturated fat intake by 24-h recall</p>



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<p>Jago R, McMurray RG, Drews KL et al. HEALTHY Intervention: Fitness, Physical Activity and Metabolic Syndrome Results. Med Sci Sports Exerc. Aug. 2011; 43(8):1513–1522. Ref #87</p>	<p><b>HEALTHY intervention</b>  -5 school semesters  -Nutritional quality of food and beverages during breakfast and lunch was improved.  -Social marketing campaign with different themes each semester about consumption of quality food, energy balances, water and life choices.  -No intervention effect on vigorous PA</p>	<p>Elementary</p>	<p>Peer-led, teacher facilitated learning activities (FLASH) were implemented over 5 semesters. Each module delivered on a weekly basis</p>

<p>Luepeker RV, Perry CI, McKinlay SM, et al. Outcomes of a field trial to improve children's dietary patterns and physical activity. JAMA. 1996;275:768-776. Ref #92</p>	<p><b>CATCH</b> -3 school years -School food service - provide lunches with less fat and salt (Eat Smart): goal to provide children with tasty meals that were lower in fat (to 30% of energy), saturated fat (to 10% of energy), and sodium (600-1000mg/serving), while maintaining recommended levels of essential nutrients and child participation in the school meal programs. -Food service personnel participated in a 1-day training session at the beginning of each school year. Monthly follow-up visits to the schools and booster sessions provided further information, help in planning, and support. -Classroom curricula: Adventures of Hearty Heart and Friends, Go for Health-4 and Go for Health-5, for the 3rd through 5th grades, respectively. They consisted of 15, 24 and 16 lessons over 5, 12 and 8 weeks in the 3rd, 4th, and 5th grades, respectively. Each lesson was 30 to 40 minutes in length. The curricula targeted specific psychosocial factors and</p>	<p>Elementary</p>	<p>BMI did not differ significantly between groups at 3 years. PA minutes did not differ significantly. The intx group did report a significant reduction in the total energy intake as well as total fat intake (from 32.7% to 30.3% in intx vs 32.6% to 32.2% in controls, p&lt;0.01) and saturated fat intake (from 12.7% to 11.4% in intx vs 12.5% to 12.1% in controls, p&lt;0.01). No significant effect on blood pressure or serum lipids.</p>
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<b>Full Citation</b>	<b>Intervention details (name, duration, key elements)</b>	<b>School Grade Level(s)</b> (Elementary, Middle, High)	<b>Results</b> (effect size, if available) <sup>1</sup>
	involved skills development focused on eating behaviors and physical activity patterns. Additionally, F.A.C.T.S. for Five was a four- session tobacco use prevention curriculum implemented in the 5th grade. Classroom teachers attended 1 to 1,5 days of training each year to implement the curricula using standardized protocols at all sites to insure comparable implementation.		

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Nader P.R., D.E. Sellers, C.C. Johnson, et al. The effect of adult participation in a school-based family intervention to improve children's diet and physical activity: the child and adolescent trial for cardiovascular health Prev. Med. 1996; 25(4):455-464. Ref #96.</p>	<p><b>CATCH with adult participation</b>-3 years -School food service (see Luepker 1996 (ref #92) for more details) -classroom curricula (see Luepker 1996 (ref #92) for more details)</p>	<p>Elementary</p>	<p>Increased dose of family participation (number of returned take home activity lessons) was not associated with an effect on cholesterol, sodium, total calories from fat, dietary knowledge, dietary intentions, or dietary self- efficacy. Moderate dose of family was participation (4-9 lessons returned) was positively associated with increased minutes of MVPA (p&lt;0.022) compared to lower dose or high dose of family participation. Moderate dose students averaged 57-59 minutes of self-reported PA vs 49 of PA for students with family dose of 0-3 and 44-42 for students with family dose of 10-15. For Hispanic boys and girls, both physical activity self-efficacy and dietary self-efficacy increased with family dose (p&lt;0.009 and p&lt;0.012). For African-American boys and girls, family dose was significantly tied to physical activity self-efficacy (p&lt;0.037). Family dose was not tied to self-efficacy for white girls and boys. For minority boys only, dietary knowledge increased with increased family dose (p value not given).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Nader PR, Stone EJ, Lytle LA, Perry CL, Osganian SK, Kelder S, et al. Three-year maintenance of improved diet and physical activity: the CATCH cohort. Child and Adolescent Trial for Cardiovascular Health. Arch Pediatr Adolesc Med 1999; 153: 695-704. Ref #97</p>	<p><b>CATCH III</b> -3-year follow-up with subgroup of original CATCH participants (see Luepker 1996 (ref #92) for more details)</p>	<p>Elementary</p>	<p>Some evidence of three-year maintenance effects for 8th grade students who participated in CATCH from 3rd to 5th grade. Non-significant BMI change in favor of the intx (p=0.79) Non-significant improvement in triceps skinfold thickness in the intervention group, relative to the control group. (p=0.95) Improvement of 8.8 more minutes of vigorous physical activity in the intervention compared to the control group (p=0.001). Non-significant reduction in caloric intake in the intervention group relative to the control (-235, p=0.13)</p>
<p>Neumark-Sztainer DR, Friend SE, Flattum CF, Hannan PJ, Story MT, Bauer KW, Feldman SB, Petrich CA: New moves – preventing weight-related problems in adolescent girls: a group-randomized study. Am J Prev Med 2010; 39: 421-432. Ref #99</p>	<p><b>New Moves</b> -16 weeks -Lunch (girls were served healthy food) -Nutritional class 1 day/week to increase F&amp;V intake, limit SSB, eat breakfast everyday, pay attention to portion sizes and body hunger/satiety signs</p>	<p>High</p>	<p>No significant intervention effect on BMI. (intx effect: - 0.1, p=0.446) Nonsignificant change in body fat in favor of the intx. (intx effect: 0.46, p=0.216). Significant decrease in total sedentary activity (1.26 30 minute "blocks", p=0.050) No significant intx effect in the amount of moderate PA. (intx effect: 1.20, p=0.068) Nonsignificant change in F&amp;V intake in favor of the intx. (intx effect: 0.24, p=0.365) Nonsignificant change in SSB consumption. (intx effect: 0.05, p=0.751) Nonsignificant change in hours of TV watching (intx effect: 0.05, p=0.883)</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Perry, C, Lytle, L, Feldman, H et al. Effects of the Child and Adolescent Trial for Cardiovascular Health (CATCH) on Fruit and Vegetable Intake. J of Nutrition Educ and Behavior. 1998; 30(6):354-360. Ref #101</p>	<p><b>CATCH</b>  -3 years  -Food service changes including increasing use of fruit and vegetables, and lower fat, saturated fat and sodium in meal  -Total of 55 40min lessons over 3 years ( 47 dedicated to nutrition): 15 lessons in 3rd grade, 24 lessons in 4th grade, 16 lesson in 5th grade</p>	<p>Elementary</p>	<p>NS</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Sallis JF, McKenzie TL, Conway TL, et al. Environmental interventions for eating and physical activity: a randomized controlled trial in middle schools. Am J Prev Med. 2003;24:209-217. Ref #103</p>	<p><b>M-SPAN</b> -2 school years -Project staff worked with food service to provide more low-fat choices and reduce fat content of all school meals and a la carte foods. "1/3 of students brought lunches from home, so intervention strategies were developed to assist students in bringing lower-fat lunches" (strategies include encouraging parents/students to replace high fat items with low fat items, schools offered raffle tickets to students with healthy appearing bagged lunches). Salad bars added 6 of 12 intx schools had school stores with high-fat foods, schools sought out vendors for lower-fat items. Vendor fairs hosted for Nutrition Service directors to sample lower fat products</p>	<p>Middle</p>	<p><b>Positive weight outcome</b> Significant reduction in BMI for intx boys (from 20.12 to 19.48) compared to control boys (from 19.68 to 20.04) at <math>p &lt; 0.044</math>. No significant difference in BMI for intx girls (from 19.76 to 19.88) compared to control girls (19.52 to 19.73) at <math>p &lt; 0.77</math>. Physical activity increase only significant for intx boys. No evidence for change in fat intake. No evidence that outside of school physical activity or nutrition behaviors improved.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Simons-Morton BG, Parcel GS, Baranowski T, Forthofer R, O'Hara NM. Promoting physical activity and a healthful diet among children: results of a school-based intervention study. Am J Public Health. 1991;81(8):986-91. Ref #105</p>	<p><b>Go For Health</b> -35 weeks -Lower fat and sodium lunches -Knowledge and skills targeting nutrition</p>	<p>Elementary</p>	<p>Non-significant reduction in total calories and total fat. Significant difference in % of MVPA in PE from Intx Group: 36.2% (SD = .04) (n = 96); Control group: 7.6% (SD = 9.0) (n = 73)</p>
<p>Stevens J, Story M, Ring K, Murray DM, Cornell CE, Gittelsohn J. The impact of the Pathways intervention on psychosocial variables related to diet and physical activity in American Indian schoolchildren. Prev Med. 2003;37(6 Pt 2):70-9. Ref #107</p>	<p><b>Pathways</b> -3-year trial -Unknown school food service component modified school meals (no additional details) -Unknown school curriculum "focused on knowledge and practice related to healthy eating and lifestyle habits"</p>	<p>Elementary</p>	<p>Significant effect on response to food choice intentions, physical activity behaviors, and curricular knowledge for all children at 2 of 3 time points (p&lt;0.05). Significant effect on attempted weight loss for girls only at first of 1 time points (p&lt;0.05). No reports on anthropometric outcomes in this paper</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Williamson DA, Champagne CM, Harsha D et al. Effect of an environmental school-based obesity prevention program on changes in body fat and body weight: a randomized trial. <i>Obesity</i>. 2012; 20(8):1653–1661. Ref #110</p>	<p><b>The Louisiana Health Study</b> -121 wks -Change food from school cafeterias. Direct children to healthy food choices, increase availability of F&amp;V and whole grains, reduce availability of foods with high dietary fat and sugar. -Advertisement and consumption of soft drinks, candy, and fast foods will be limited and eventually eliminated -Campaign materials in the classroom, hallways, and other locations</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> No differences between groups in BMI z-score. Significant differences in percent body fat for girls (1% difference intx and control, at <math>p &lt; 0.031</math>), and almost significant difference for boys (1.6% difference at <math>p &lt; 0.057</math>). No improvement in physical activity by a self-administered activity checklist. Non-significant reduction on consumption of total fat and saturated fat.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
Williamson DA, Copeland AL, Anton SD et al. Wise Mind project: a school-based environmental approach for preventing weight gain in children. <i>Obesity</i> 2007; 15(4):906–917. Ref #111	<b>Wise Mind Project</b> -2 academic years -Modify cafeteria recipes to increase fruits, vegetables, and grain and reduce high dietary fat, sugar and fried foods. Make fruits, vegetables, and grain more accessible and more appealing. -Menu boards promoting "Wise Mind" food choices in cafeteria Classroom teachers trained to presented info about healthy eating and connection prevention of health problems	Elementary	No effect in weight gain prevention. Small significant effect on food choices. Intx children consumed fewer total calories (about 70 per lunch at $p < 0.05$ ). Trending but not significant increase in PA minutes.
Wright K, Norris K, Newman Giger J, Suro Z. Improving healthy dietary behaviours, nutrition knowledge, and self-efficacy among underserved school children with parent and community involvement. <i>Child Obes.</i> 2012; 8(4):347–356. Ref #113	<b>Coordinated School Health Program (incorporating Kids Nutrition and Fitness (KNF) after-school program)</b> -4 months -School level environmental changes not adequately describe in the paper -After-school weekly 90 minutes lesson on physical and activity and nutrition	Elementary	<b><u>Positive weight outcome</u></b> Significant reduction at 12-month follow-up in BMI for intx children of -2.8 points vs a BMI increase for control children of 2.23 point ( $p < 0.04$ ). Significant increase at 12-month follow-up in daily vegetable servings of 1.51 for intx children vs 0.4 for control children ( $p < 0.03$ ). Significant increase of 2.0 fruit servings for intx children vs a reduction of 0.04 servings for control children ( $p < 0.001$ ). No significant differences in French fry/chip, bean or sweets consumption from baseline to 12 month follow-up.

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<b>Group 3.4: Nutrition promotion and physical activity promotion</b>			

<p>Arlinghaus KR, Moreno JP, Reesor L, Hernandez DC, Johnston CA. <b>Compañeros: High School Students Mentor Middle School Students to Address Obesity Among Hispanic Adolescents.</b> <i>Prev Chronic Dis.</i> 2017 Oct 12;14:E92. Ref #67</p>	<p><b>Compañeros</b></p> <ul style="list-style-type: none"> <li>-6 months</li> <li>-High school health mentors called <i>compañeros</i> were trained to engage Hispanic middle school students in school-based obesity intervention</li> <li>-Participants in both conditions received an obesity intervention for 50 minutes, 5 days a week, for 6 months during students' physical education (PE) class period.</li> <li>-The intervention also included behavioral modification through a token economy system in which the students received points for participation that they could accumulate and redeem for prizes.</li> <li>-<i>Compañeros</i> were instructed to engage in intervention activities with the middle school students. Before each class, the PE teacher informed <i>compañeros</i> of the topic of focus for the day (eg, strategies to eat more vegetables, ways to be more active throughout the day). During class, <i>compañeros</i> were to initiate a discussion of the selected topic with their group of middle</li> </ul>	<p>Middle School</p>	<p><b><u>Positive weight outcome</u></b></p> <p>Significant differences were found between conditions across time (<math>F = 4.58, P = .01</math>). After the 6-month intervention, students in the condition with <i>compañeros</i> had a larger decrease in zBMI (<math>F = 6.94, P = .01</math>) than students in the condition without <i>compañeros</i>. Furthermore, students who received the intervention with <i>compañeros</i> showed greater sustained results at 12 months (<math>F = 7.65, P = .01</math>).</p>
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Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
	school students. For example, between exercise stations compañeros might talk about what they were going to eat for lunch that day or discuss their favorite vegetables.		
Bavarian N, Lewis KM, Acock A, DuBois DL, Yan Z, Vuchinich S, Silverthorn N, Day J, Flay BR. Effects of a School-Based Social-Emotional and Character Development Program on Health Behaviors: A Matched-Pair, Cluster-Randomized Controlled Trial. J Prim Prev. 2016 Feb;37(1):87-105. Ref #69	<b>Positive Action (PA)</b>  -Social-emotional and character development (SECD program without a primary focus on health behavior promotion.	K-8 schools	Longitudinal multilevel modeling analyses revealed evidence of favorable program effects on personal hygiene [effect size (ES) = 0.48], healthy eating and exercise (ES = 0.21), and unhealthy eating (ES = -0.19); in addition, BMI z-scores were lower among students in PA schools at endpoint (ES = -0.21).

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Bogart LM, Elliott MN, Cowgill BO, Klein DJ, Hawes-Dawson J, Uyeda K, Schuster MA. Two-Year BMI Outcomes From a School-Based Intervention for Nutrition and Exercise: A Randomized Trial. <i>Pediatrics</i>. 2016 May;137(5). Ref #70</p>	<p><b>Students for Nutrition and Exercise</b></p> <ul style="list-style-type: none"> <li>-5-weeks</li> <li>-School-wide environmental changes, encouragement to eat healthy school cafeteria foods, and peer-led education and marketing.</li> </ul>	<p>Middle School</p>	<p>Although the Students for Nutrition and Exercise intervention did not exhibit significant effects on BMI percentile overall, intervention students who were classified as obese at baseline (in seventh grade) showed significant reductions in BMI percentile in ninth grade (b = -2.33 percentiles; SE, 0.83; P = .005) compared with control students. This outcome translated into ~9 pounds (~4.1 kg) lower expected body weight after 2 years for an obese student in the intervention school at the mean height and age of the sample at baseline.</p>
<p>de Heer HD, Koehly L, Pederson R, Morera O. Effectiveness and spillover of an after-school health promotion program for Hispanic elementary school children. <i>Am J Public Health</i>. 2011 Oct;101(10):1907-13. Ref #75</p>	<p><b>After-school health education and physical activity program for Hispanic elementary school children.</b></p> <ul style="list-style-type: none"> <li>-Twice a week for 12 weeks, total 24 sessions.</li> <li>-Each session comprised a 20- to 30-minute health education component followed by 45 to 60 minutes of physical activity.</li> </ul>	<p>Elementary, after-school</p>	<p><b><u>Positive weight outcome</u></b></p> <p>Intervention exposure predicted lower body mass index (P = .045), higher aerobic capacity (P = .012), and greater intentions to eat healthy (P = .046) for the classroom at follow-up.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Greening L, Harrell KT, Low AK, et al. Efficacy of a school-based childhood obesity intervention program in a rural southern community: TEAM Mississippi Project. <i>Obesity</i>. 2011;19(6):1213-1219.</p> <p>Ref #80</p>	<p><b>TEAM Mississippi</b></p> <ul style="list-style-type: none"> <li>-9 month school year</li> <li>-Monthly PA and nutrition events</li> <li>-Applied Social Learning Theory</li> </ul> <p>Involved all stakeholders, teachers, state ed, and health depts., academic institutions and caretakers.</p> <ul style="list-style-type: none"> <li>-Used elements from CATCH and Pathways.</li> </ul>	<p>Elementary</p>	<p>No evidence of differences in BMI betw intx and control groups at end of school year, by race ethnicity or gender</p> <p>Small signif diff in % body fat, dietary fat intake, fitness tests.</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Gortmaker SL, Peterson K, Wiecha J, Sobol AM, Dixit S, Fox MK, Laird N: Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. Arch Pediatr Adolesc Med 1999; 153: 409–418. Ref #79</p>	<p><b>Planet Health</b> -2 school years. -Educational sessions promoting decreasing television viewing, decreasing consumption of high-fat foods, increasing fruit and vegetable intake, and increasing MVPA</p>	<p>Middle</p>	<p>Reduce prevalence of obesity among girls in inx schools with controls (odds ratio, 0.47; 95% confidence interval, 0.24-0.93; <math>P = .03</math>), with no differences found among boys.</p> <p>Greater remission of obesity among intervention girls vs control girls (odds ratio, 2.16; 95% confidence interval, 1.07-4.35; <math>P = .04</math>).</p> <p>Reduced television hours among both girls and boys, with increased fruit and vegetable consumption and smaller increment in total energy intake among girls. Reductions in television viewing predicted obesity change and mediated the intervention effect.</p>



Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Hendy HM, Williams KE, Camise TS. Kid's Choice Program improves weight management behaviors and weight status in school children. <i>Appetite</i>. 2011;56(2):484-94. Ref #82</p>	<p><b>Kid's Choice Program</b> -3 months -Kids received a star for eating 1/8 cup FV or choosing low-fat and low sugar healthy drink.</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> Non-significant reduction in average weight participants by 2.40 percent (p=0.32) relative to the control group, but a significant reduction in overweight participants by 2.60 percent (p=0.001). This reduction was not maintained when reexamined 6 months later in overweight children. Intx group increased the number of steps it took by 11,971 steps per month, compared to 758 steps in the control group (p=0.011). Intx group increased their F&amp;V first behavior by 2.31 meals (of six meals), compared to 0.72 in the control group (p=0.000) Intx increased their healthy drinks behavior by 3.46 meals compared to 0.52 meals in the control group, (p=0.000).</p>
<p>Johnston CA, Moreno JP, El-Mubasher A et al. Impact of a school- based pediatric obesity prevention program facilitated by health professionals. <i>J Sch Health</i>. 2013; 83(3):171-181. Ref #88</p>	<p><b>Health Professional facilitated obesity prevention program</b> -2 years - -Health professionals worked with school administration, cafeteria staff, and elective teachers to create a healthier school environment</p>	<p>Elementary</p>	<p><b><u>Positive weight outcome</u></b> Children who were obese/overweight reduced significantly their BMI z scores in intx group (p &lt; .001)</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Mauriello LM, Ciavatta MM, Paiva AL, Sherman KJ, Castle PH, Johnson JL, et al. Results of a multi-media multiple behavior obesity prevention program for adolescents. <i>Prev Med</i> 2010;51:451-6. Ref #94</p>	<p><b>Health in Motion</b> -1 year -Self-directed, 30 minute, interactive technology to provide individually tailored messages for fruit and vegetable consumption (FV; at least 5 servings of fruits and vegetables each day). Individualized tailoring is based on the theoretical constructs (stage of change, decisional balance, self-efficacy, and processes of change) of the Transtheoretical Model of Behavior.</p>	<p>High</p>	<p>The treatment group reported greater numbers of days doing at least 60 minutes of physical activity at 2 months (3.38 versus 2.72) than the control group, and eating significantly more servings than the control group at 2 months (3.86 versus 3.0), 6 months (3.55 versus 2.73), and 12 months (3.67 versus 2.97). Limited TV viewing difference between groups was not significant at any time point. No effect on BMI</p>
<p>Shilts MK, Horowitz M, Townsend MS. Guided goal setting: effectiveness in a dietary and physical activity intervention with low- income adolescents. <i>Int J Adolesc Med Health</i>. 2009;21(1):111-22. Ref #104</p>	<p><b>Goal setting for dietary and physical activity behaviors</b> -5 weeks -Guided goal setting (school curriculum, web-based assessment, workbook with handouts)</p>	<p>Middle</p>	<p>Inconclusive. No significant difference between treatment and control conditions was found. Control participants receiving the intervention without goal setting reported they spontaneously set a dietary goal (62%) and a physical activity goal (60%). Subsample removing these controls that set goals did show a significant difference although sample very small (n=40 intervention and n=19).</p>

Full Citation	Intervention details (name, duration, key elements)	School Grade Level(s) (Elementary, Middle, High)	Results (effect size, if available) <sup>1</sup>
<p>Trevino RP, Hernandez AE, Yin Z, Garcia OA, Hernandez I. Effect of the Bienestar Health Program on physical fitness in low-income Mexican American children. <i>Hispanic Journal of Behavioral Sciences</i>. 2005 Feb;27(1):120-32. Ref #108</p>	<p><b>Bienestar Health Club, 1h/weekly after-school</b> -34 weeks -School food service promoted healthy food knowledge among staff and children -50 sessions over 7 months -Messages targeting decreased saturated fat and increased fiber.</p>	<p>Elementary</p>	<p>Non-significant change in % body fat in favor of the control. Adjusted difference: 0.18, (95% CI:-0.45 to 0.81); p=0.56</p> <p>No differences in BMI between control and intx groups</p>
<p>Treviño RP, Yin Z, Hernandez A, Hale DE, Garcia OA, Mobley C. Impact of the Bienestar school-based diabetes mellitus prevention program on fasting capillary glucose levels: a randomized controlled trial. <i>Arch Pediatr Adolesc Med</i> 2004; 158(9):911-7. Ref #109</p>	<p><b>Bienestar Health Club, 1h/weekly after-school</b> -34 weeks -School food service promoted healthy food knowledge among staff and children -50 sessions over 7 months -Messages targeting decreased saturated fat and increased fiber. <b>Know Your Body</b></p>	<p>Elementary</p>	<p>Non-significant change in % body fat in favor of the control. Adjusted difference: 0.18, (95% CI:-0.45 to 0.81); p=0.56</p> <p>No differences in BMI between control and intx groups</p> <p>Non-significant changes in skinfold thickness in favor of the intervention. Significant changes in HDL in favor of the control (p&gt;0.001). Non-significant changes in total cholesterol in favor of</p>

<b>Full Citation</b>	<b>Intervention details (name, duration, key elements)</b>	<b>School Grade Level(s)</b> (Elementary, Middle, High)	<b>Results</b> (effect size, if available) <sup>1</sup>
Bush PJ, Zuckerman AE, Theiss PK et al. Cardiovascular risk factor prevention in black schoolchildren: two-year results of the "Know Your Body" program. Am J Epidemiol 1989; 129(3):466-82. Ref #71	-104 weeks -Know Your Body curriculum focusing on nutrition		the control. Non-significant change in consumption of food high in fat in favor of the intx. No difference in energy intake from saturated fat between intx and control.

<sup>1</sup> For acronyms and definitions see Appendix 4, pg. 116

## Appendix 2: Case examples of promising practices

### Case example: Decreasing screen time (Group 1.4) by Robinson 1999.

Robinson (1999). Reducing children's television viewing to prevent obesity: a randomized controlled trial. *JAMA*, 282(16), 1561-1567.

#### Short description

This study was a randomized controlled study among 3rd and 4th graders in two public elementary schools in a middle-income area. The intervention was designed to reduce TV video tape and video game use to prevent increased adiposity, increase PA and improve dietary intakes. This was an intensive, 18 lesson classroom-based intervention designed based on evidence of strategies to change PA/sedentary behaviors.

#### Effects of intervention

The intervention resulted in a reduction in BMI in the intervention group and other measures of body fatness and cardiovascular fitness. Compared with controls, there were statistically significant decreases in:

- BMI:  $-0.45 \text{ kg/m}^2$ ,  $p = .002$ ; triceps skinfolds  $-1.47 \text{ mm}$   $p = .002$ .
- Waist circumference:  $-2.30 \text{ cm}$ ,  $p < .001$ .
- Waist to hip ratio:  $-0.02$ ,  $p < 0.001$ .
- Hours of TV viewing:  $-5.53$ ,  $p < .001$  (reduced by 1/3 from baseline).
- Number of meals eaten in front of the TV:  $-0.54$ ,  $p = .01$ .

#### Why is this a promising practice example?

- The intervention was successful in reducing weight and achieving other desired outcomes.
- There was a high dose of exposure to messages about reducing screen time among young elementary students with the potential to modify habits before the teen years.
- There was a focus on the how to do it, as well as the why do it.
- Goal setting, self-monitoring and feedback have been shown in many settings and for many behaviors to support health behavior change.
- While this study was conducted 20 years ago, (primary screen activities were TV and video games), screen time has increased substantially and has contributed to considerable reduction in PA, thus intensified efforts on this behavior are warranted.
- While the screen activity landscape has changed substantially, with smart phones, tablets and computers owned or accessible by many younger children, the principles underlying this intervention could inform contemporary interventions and potentially reduce the growing number of sedentary hours children spend in front of screens.

## **Key elements of the intervention**

- There was a high dose of exposure, with 18 lessons of 30-50 minutes in length over 6 months.
- The lessons were based on Bandura's social cognitive theory.
- Children were asked to track their screen time to raise awareness of their sedentary behavior.
- Children were challenged to turn off the TV and play no video games for 10 days.
- Children were encouraged to limit screen time to 7 hours per week and to become "intelligent viewers" by using their viewing and video game time more selectively.
- Each household received a device that monitored viewing time and locked the TV and games once the maximum time was reached. Families could request additional units for every television at no cost.

## **Implementation**

- Classroom teachers were trained by research staff to deliver the lessons.
- Most of the lessons were delivered in the first two months of the school year to ensure ample time for behavior change and weight outcome effects.

## **Further considerations in using/evaluating this model**

- This intervention could be used as developed for TV, video/DVD and video games, but would need adaptation for use with cell phones, tablets and computers, requiring a focus leisure use vs. use for school and essential communications.
- This study did not promote substitute PA for screen time (because they were studying efficacy of screen time component only), however, the promotion of alternative activities may be a useful adjunct.

## **Case example: Comprehensive school food changes, nutrition promotion and stakeholder involvement (Group 2.2) by Foster et al. 2008.**

Foster, et al. (2008). A policy-based school intervention to prevent overweight and obesity. *Pediatrics*, 121(4), e794-e802.

### **Short description**

An example of a comprehensive school nutrition policy implemented carefully and effectively over two years to prevent overweight in lower-income elementary schools with higher proportions of African American students. The School Nutrition Policy Initiative (SNPI) was SNAP-Ed funded to achieve changes in school food, nutrition promotion and physical activity offered and promoted. (In this report, this paper was classified as a “nutrition only” because the focus was on nutrition, with limited focus on PA).

### **Effects of intervention**

- Incidence of overweight and obesity. Significantly fewer children in intervention schools became overweight after 2 years (7.5% vs. 14.9%). The odds of becoming overweight were 33% lower in intervention than control schools.
- Prevalence of overweight and obesity. Prevalence of overweight decreased by 10% in intervention schools and increased by 26% in control schools. Odds of overweight were 35% lower for intervention schools. The intervention was particularly effective for African-American students (odds 41% lower). No effect on prevalence of obesity.
- Remission of overweight and obesity. No differences between intervention and control schools in remission rates.
- Hours of inactivity. Decreased in intervention group, increased in control group (odds 4% lower in intervention group).

### **Why is this a promising practice example?**

- A multicomponent school-based intervention with comprehensive nutrition and PA policy can be effective in curbing the development of overweight among children in grades 4 to 6 in lower-income urban schools including for African American students.
- Planning the intervention was thoughtful and based on previous evidence and experience. Aspects were designed to harmonize and reinforce (vs. stand-alone pieces) so that it was a truly comprehensive approach.
- Considerable planning and support went towards setting up effective structures and stakeholder engagement for implementation over the entire period.
- Now over 10 years old, this study of an intervention still has currency as a model intervention for SNAP-ed to consider in planning its work in California schools.

### **Key elements of the intervention design and planning, including stakeholder engagement**

- The intervention was developed and delivered by The Food Trust, a community-based organization with an excellent track record in innovative intervention design and implementation. They took past successes and failures of school interventions to influence weight into account, noting that failures may have been associated with insufficient dose of exposure, insufficiently addressing barriers to implementation and inability to effectively target children at greatest risk.
- In planning, The Food Trust convened a task force of stakeholders and partners from the CDC to ensure that current recommendations and guidelines for healthy school interventions were adapted for schools in the study. The task force took a year to discern how to best adapt CDC guidelines to promote lifelong healthy eating and PA to meet needs in the Philadelphia school district. They convened sub-committees of local stakeholders to provide input on each of the components, including consultation with Food Services to plan changes to adhere to nutrition standards and how to implement those changes.

### **Intervention elements**

- School self-assessment. Schools used CDC School Health Index. Each school formed a nutrition advisory group including administrators, teachers, nurses, coaches and parents to guide the assessment. After completing ratings, schools developed an action plan for change (e.g., breakfast in classroom, limits to using food for rewards and fundraising, promoting active recess, etc.).
- Nutrition education. The goal was to provide 50 hours of food and nutrition education per student per year, based on National Center for Education Statistics guidelines. It was designed to be integrative and interdisciplinary, with a focus on food and PA choices. Nutrition was integrated into classroom subjects, (e.g., students used food labels to practice fractions and nutrition topics were used for writing assignments).
- Nutrition policy. All foods sold and served were modified to meet nutritional standards based on DGAs. Allowable items included 100% juice, water, low-fat milk and snacks with less than 7g fat, 2g saturated fat, 360 mg sodium and 15g sugar per serving.
- Social marketing. Increased meal participation was promoted with raffle tickets, prizes for healthy eating (e.g., bicycles, indoor basketball hoops), messages (e.g., eat healthy foods if you want to be strong), incentives and frequent exposure to messages. Slogans and associated characters developed through focus groups of kids not in study schools, but with same demographics.
- Family/Parent outreach. Nutrition educators reached families at home, school and parent meetings, report card nights with encouragement to purchase healthy snacks to and from school, be less sedentary, be more physically active and eat more FV. Fewer unhealthy foods were sold at fundraisers and parents were discouraged from sending sweets to school at holiday time. Healthy breakfasts were held with local athletes weekly.



## **Implementation and stakeholder involvement**

- The sub-committees made recommendations and worked with school and district personnel regarding implementation.
- Teachers and support staff participated in an average of 10 hours of training during the first and second years. They received an average of 48 hours of nutrition education in year one and 44 hours in year two.

## **Further considerations in using/evaluating this model**

- In a policy model where schools are asked to be involved there is likely to be variation in implementation. It is important to conduct a process evaluation to document implementation and highlight lessons learned.
- The authors also suggest adding more emphasis to PE/PA and considering more intensity for greater impact.

## **Case example: School food changes and nutrition promotion (Group 2.2) by Scherr et al. 2017.**

Scherr, et al. (2017). A multicomponent, school-based intervention, the Shaping Healthy Choices Program, improves nutrition-related outcomes. *Journal of nutrition education and behavior*, 49(5), 368-379.

### **Short description**

A multi-faceted one-year intervention promoting improved nutrition-related outcomes among 4th grade students in northern and central California, by improving students' individual factors and factors in the home and school environments, while creating a community-based support system. Intervention components included garden-enhanced education, family and community partnerships, increased regionally procured produce in the lunchroom and school-site wellness committees.

### **Effects of intervention**

- Body mass index (BMI). There was a greater improvement in BMI percentile (-6.08;  $p < 0.01$ ), BMI Z-score (-0.28;  $p < .001$ ) and waist-to-height ratio (-0.02;  $p < .001$ ) in intervention compared with the control schools.
- Nutrition knowledge. The SHCP resulted in improvements in nutrition knowledge. Compared with control schools, students at the intervention schools demonstrated significant improvements in nutrition knowledge (2.2;  $p < .001$ ) (based on a maximum score 35).
- Science process skills. There was no significant improvement in Test of Basic Science Process Skills (BAPS) scores.
- Vegetable identification and preferences. The SHCP resulted in improvements in vegetable identification. Compared with control schools, students at the intervention schools demonstrated significant improvements total vegetable identification (1.18;  $p < .001$ ) (based on a maximum score of 6).
- Reported FV preferences and intake. There were no significant changes in vegetable preferences or reported FV intake.
- Parenting practices. There were no significant changes in self-reported general or dietary-related parenting practices, including measures of restriction, pressure to eat and authoritative parenting.

### **Why is this a promising practice example?**

- This study demonstrates that a one-year, multi-faceted school-based intervention, combining nutrition education (including cooking demonstrations, taste tests and health fairs), school gardens, regional produce in the lunchroom, parent education and policy can be effective in reducing BMI among 4th grade students in a relatively short period of time.

- The goal of the program is to provide students with knowledge and skills to make healthy choices in real-world settings, rather than recommending restrictions on food and beverage choices. That approach is consistent with recommendations by the US Department of Agriculture Food and Nutrition Service, which emphasizes consistent and positive nutrition messages to improve the American diet.
- A critical aspect of the intervention was continual reinforcement of classroom education by coordinated messaging throughout program components. For example, students grew and harvested their own vegetables, which were then used in cooking demonstrations or taken home. Produce served in the lunchroom reflected the garden harvest and was featured in family newsletters.
- A feature of this study that differentiated the SHCP from other multicomponent interventions was connections to the community through parent newsletters and health fairs, which communicated similar information.
- The intervention can be implemented at low cost. The main cost was procuring the salad bar and building a garden. The ongoing cost was related to the produce in the salad bar, which could be mitigated by students purchasing those items. Minimal supplies were required for the classroom, parent newsletters could be sent home electronically and all curricula and newsletters were available for free download.

### **Key elements of the intervention design and planning, including stakeholder engagement**

The intervention consisted of five overlapping components: (1) nutrition education and promotion, (2) family and community partnerships, (3) supporting regional agriculture, (4) foods available on the school campus; and (5) school wellness committees and policies. Those components were addressed through the implementation of nutrition education, cooking demonstrations, school gardens, family newsletters, health fairs, salad bars, procurement of regional produce and school-site wellness committees.

- Classroom education was implemented using Discovering Healthy Choices (DHC), an inquiry-based, garden-enhanced curriculum developed for the SHCP. The objectives of DHC were to help children learn nutrition concepts, make recommendations and develop reasoning skills to make healthy dietary and lifestyle choices. This curriculum contains 8 modules, including 15 classroom lessons and 19 take-home activities that encouraged completion of activities with family members. Nutrition education included cooking demonstrations and garden-based education:
- Cooking demonstrations were conducted using the Cooking Up Healthy Choices curriculum, which was developed to articulate with DHC. Cooking Up Healthy Choices is a series of 5 cooking demonstrations developed for the SHCP that allowed students to gain exposure to a variety of vegetables, observe cooking techniques, deepen understanding of nutrition concepts and experience the preparation of recipes using all 5 senses. Recipes were designed to align directly with DHC and were culturally diverse and highlighted produce grown in the school garden.

- Students interacted with the gardens as part of the nutrition education, harvesting vegetables for cooking demonstrations and sharing them with their families. All additional intervention activities occurred simultaneously with the education.
- Team Up for Families, a series of 8 newsletters, corresponded to the 8 modules of DHC. Each issue provided parents with information about positive parenting practices relevant to a healthy diet and physical activity, tailored to the middle childhood age group (ages 6–12). Parenting practices targeted included pressure to eat and restriction related to feeding, as well as general authoritative parenting skills focused on supporting warm and responsive interactions. The newsletters served as a bridge between the classroom and the home. Each issue included specific information about nutrition concepts and recommendations delivered in the classroom, corresponding activities for parents to perform with their children and recipes from the cooking demonstrations.
- Health fairs were held at each intervention school. The fairs were designed based on needs expressed by the school community and planned and implemented with support from the SHCP research team and school stakeholders. The goal of the health fairs was to bring together students, families, school staff and community partners such as University of California Cooperative Extension, 4-H, local safety and fire departments, farmers and retailers.
- Salad bars were installed to provide fresh seasonal FV in the lunchroom.
- School-site wellness committees were established with the goal of improving the school community by applying district wellness policies and reinforcing SHCP program objectives.

### **Further considerations in using/evaluating this model**

- One of the intervention schools implemented the program with a lower degree of fidelity: they did not use the salad bar, held only one health fair (compared to three at the other school) and did not allow cooking demonstrations to be conducted in the classroom. Improved outcomes were observed at the school that implemented the program with greater fidelity.
- The program is relatively low cost, however funding for procuring salad bars and school gardens is required, as well as on-going funds for purchasing produce for salad bars.
- The study did not ascertain the extent to which parents read the newsletters, which may be associated with the lack of change in parent outcomes. Alternative means of reaching parents should be explored.

**Case example: Cognitive behavioral skills building to promote healthy behaviors (Group 3.1) by Melnyk et al 2015.**

Melnyk, et al. (2015). Twelve-month effects of the COPE healthy lifestyles TEEN program on overweight and depressive symptoms in high school adolescents. *Journal of school health, 85*(12), 861-870.

**Short description:**

The COPE/Healthy Lifestyles TEEN (Thinking, Emotions, Exercise and Nutrition) program is an educational and cognitive-behavioral skills building program targeting high school students. The intervention includes 20 minutes of physical activity, such as dancing, walking and kick boxing movements, which is integrated into a health course and taught by teachers once a week for 15 weeks. COPE teaches adolescents that how they think is directly related to how they feel and how to turn negative beliefs into positive beliefs so that they feel emotionally better and engage in healthy behaviors. COPE also uses pedometers as cue recognition for increasing physical activity and instructs students to increase their step counts by 10% each week regardless of baseline steps.

**Effects of intervention**

- Body mass index (BMI). COPE teens had a significantly lower BMI at 12 months than a control group receiving the Healthy Teens curriculum. There were fewer COPE teens (4.8%) who moved into the overweight category and none who became obese during the 12-month study, versus the control group of Healthy Teens in which over 10% of the students moved from a healthy weight category to being overweight or obese.
- Physical activity. COPE students reported averaging over 4000 more pedometer steps per day than Healthy Teens at the end of the intervention phase of the study.
- Mental health. Overall, both groups had depressive scores in the normal range at 12 months. However, for youth who began the study with extremely elevated depressive symptoms, COPE teens had significantly lower depression at 12 months compared to the Healthy Teens control group.
- Academic performance. Intervention group students had higher health course grades than the control group.
- Social skills and alcohol use. COPE teens demonstrated higher social skills and reported less alcohol use than students in the control group.

**Why is this a promising practice example?**

- This study demonstrates that a one-year, multicomponent school-based intervention combining health education, PA and cognitive-behavioral skill building can have positive impacts on BMI, physical activity and depressive symptoms among students with severe depression.
- In addition to nutrition education, the intervention provides students with the skills to recognize and address the emotional triggers that can lead to unhealthy eating patterns.

The program also provides students with strategies to maintain a healthy diet during social situations.

- The program provides students with pedometers to measure their steps and encourages them to increase the number of steps by 10% each week.
- The program emphasizes the “thinking, feeling, behaving triangle.” Students learn that how they think directly relates to how they feel and behave and are taught how to engage in positive thinking using the “ABCs” (A=Activator event, B=Belief, C=Consequences of the belief).
- Students receive 20 minutes of physical activity in addition to PE class.
- The program is taught by school-based health education teachers rather than outside instructors. Research supports that teachers may be better at sustaining longer-term positive outcomes, because they can reinforce content in their classrooms and throughout the course curriculum.

**Key elements of the intervention: design and planning, including stakeholder engagement:**

- The COPE intervention is based on Cognitive Theory and includes all 12 key concepts used in cognitive-behavior therapy, the gold standard evidence-based treatment for a variety of mental health disorders, including depression.
- The program was developed by Bernadette Mazurek Melnyk, Dean and Professor, College of Nursing, Professor of Pediatrics and Psychiatry, College of Medicine, at The Ohio State University.
- Participating teachers were provided with a full-day training workshop on COPE, which introduced Cognitive Theory, the framework used to create and develop the COPE content and program. During the training workshop, the teachers engaged in cognitive-behavioral skills building practice exercises with the facilitators. Teachers integrated the COPE sessions into their health education course.
- Participating teens received a COPE manual that contained the content of the program along with the homework/cognitive-behavioral skills building activities to help them put into practice the content that they were learning in class.

**Further considerations in using/evaluating this model:**

- The COPE intervention is cost-effective and easily scalable, since it is taught by health education teachers. Costs include a one-day teacher training session and pedometers for students.
- Future efforts may wish to incorporate more empirical tracking of pedometer data, since steps data were self-reported.
- Some loss of fidelity was observed during the course of the study. Future efforts should include strategies to support implementation fidelity and quality.
- Student evaluations included numerous comments indicating that the teens and their families had adopted healthier eating habits. Future efforts may wish to incorporate diet inventories to assess changes in diet.

### **Case example: After-school PE intervention for elementary school children (Group 3.2) by Yin et al. 2005.**

Yin, et al. (2005). An environmental approach to obesity prevention in children: Medical College of Georgia FitKid Project year 1 results. *Obesity Research*, 13(12), 2153-2161.

#### **Short description**

An example of an after-school PE intervention for elementary school children. combining a two-hour daily after school program comprising at least 80 minutes of guided physical activity (40 minutes of MVPA), assistance with homework and a healthy snack in lower-income African American communities. The program was designed to maximize frequency and duration of, and participation in physical activity. Barriers to attendance were also addressed.

#### **Effects of intervention**

Findings from the first year of implementation indicated promising results among 3rd grade students (high proportion African American) who attended at least 40% of the sessions (182/260 or 70% of participating kids). Intervention effects were not related to children's overweight status at baseline.

- Body fat: significant reductions (-.76, 95% CI, -1.42, -0.09).
- Heart rate: significant reductions (-4.4, 95% CI, -8.2, 0.6).
- Bone mineral density: significant increase.
- There were positive, but not significant changes in BMI, cholesterol, blood pressure and waist circumference among intervention children relative to control students.
- The cost was approximately 500 dollars per child, including staff time, training and transportation home after the program.
- The adverse incident (injuries) rate was low and was comparable with other published studies.
- Academic performance was not negatively influenced by participation in PA, as measured by state required standardized test.

#### **Why is this a promising practice example?**

- The intervention focused on key elements shown to make the most difference to weight and clinical outcomes, i.e., frequency and duration of MVPA. Few programs aim for as much as 80 minutes of MVPA as this one did.
- Special attention was given to factors known to affect participation in the program and the activities, with a view to increasing participation.
- While a PE intervention during school hours may reach more students, there are many challenges in schools and many are not ready for this change. This after school program offers a moderately effective alternative and can promote activity among children who are at greatest risk of high BMI without singling them out.

## Key elements of the intervention design

- The intervention was offered after school hours at school. While increasing PE during school hours for all students is optimal, this intervention provided an opportunity to tailor classes to increase the intensity of exercise and to use various means of encouraging and sustaining participation among children at an age when physical activity begins to decline, particularly among girls.
- There was assistance with homework and transportation home, addressing key concerns of parents regarding child participation in after school programs. Funding to support transportation home was particularly important for lower-income children, who might not otherwise be able to participate. Participation rates were high among all participating 3rd graders in intervention schools.
- The program lasted 2 hours after each school day. It included 40 minutes of academic enrichment and homework assistance followed by an 80-minute period of PA, including 20 minutes of warm-up and skills instruction, 40 minutes of continuous MVPA and approximately 10 mins of calisthenics and cool-down. Children were transported home afterwards on school buses. The intervention was conducted on 128 school days over 8 months. Results were based on students who attended >40% of days.
- The goal of the MVPA activities was to increase heart rate to >140 bpm. There were selected age-appropriate activities to meet the “developmental needs of students.” Each month had a different activity theme (fitness, basketball, soccer, etc.) to keep students interested.
- A healthy snack based on USDA guidelines was offered, which averaged 250 calories, 7 gms fat, 10 mg cholesterol, 360 mcg sodium, 1 gm dietary fiber, 6 gms protein and 32 gms carbohydrate.
- Based on a formative study, the intervention aimed to send subjects “a clear message that it was important to try their best and have fun.” Subjects received \$40 to participate in baseline and follow up assessments. (Note: Measures made before and after the 8-month program may have also motivated attendees to fully participate in order to obtain improved measures).
- Measurements were taken on school grounds after school hours in a mobile research lab (a 38-foot trailer) using DXA, a weighing scale, stadiometers, waist circumference measurements, heart rate after step test, blood pressure, and non-fasting total cholesterol and HDL by finger stick.

## Implementation

- The program was implemented by FitKid instructors who were mostly certified school teachers and professional staff from intervention schools. Training was provided, but the nature and intensity of training was not described.
- The authors indicated that the program seeks to be institutionalized because its delivery is primarily based on existing infrastructure in most public schools.
- Child attendance was moderate (average 49% attendance).



- The gross cost of delivering the program was \$558 in intervention schools (63% for program staff salary, 4% for instructor training, 7% for intervention material and foods and 25% to transport children home).
- This may be a preferable way to reach overweight children without singling them out for special attention at school PE.

### **Further consideration**

In adapting this model program, further information would be useful regarding issues including how students were recruited, which physical activities were conducted, the training program and materials, which snacks were served and were popular, types of assistance were students given with homework, and how transport home after school be could be subsidized, especially in rural areas.

## Appendix 3. PubMed Boolean operator search strategy

### For the review articles

With a date restriction of 01/01/2005 to 12/31/2016 a search was performed using the following search strategy: ((School[tiab] OR schools[tiab] OR kindergarten[tiab] OR kindergartens[tiab])) AND (healthy eating index[tiab] OR energy intake[tiab] OR consumption[tiab] OR intake[tiab] OR feeding [tiab] OR eat\*[tiab] OR calorie[tiab] OR diet[tiab] OR nutrition[tiab] OR sweetened[tiab] OR sugar[tiab] OR carbonated beverages[tiab] OR soda pop[tiab] OR sugar sweetened beverages[tiab] OR water[tiab] OR junk food[tiab] OR snack[tiab] OR meal[tiab] OR breakfast[tiab] OR lunch[tiab] OR dinner[tiab] OR food[tiab] OR beverages[tiab] OR fruits[tiab] OR vegetables[tiab] OR healthy food[tiab] OR menus[tiab] OR physical activity[tiab] OR exercise[tiab] OR play[tiab] OR activity level[tiab] OR motor activity[tiab] OR vigorous[tiab] OR mvpa[tiab] OR physically active[tiab] OR energy expenditure[tiab] OR fitness[tiab] OR physical fitness[tiab] OR sedentary[tiab] OR inactive\*[tiab] OR body composition[tiab] OR body weight[tiab] OR body mass index[tiab] OR bmi[tiab] OR body fat[tiab] OR adiposity[tiab] OR growth[tiab] OR height[tiab] OR weight[tiab] OR weight gain[tiab] OR overweight [tiab] OR obese[tiab] OR obesity[tiab] OR waist circumference[tiab] OR skin fold[tiab] OR food security[tiab] OR food insecurity[tiab] OR hunger[tiab] OR competitive foods[tiab] OR wellness policy[tiab] OR wellness[tiab] OR physical education[tiab] OR active transport\*[tiab] OR activity breaks[tiab] OR playground[tiab] OR recess[tiab] OR lunchroom[tiab] OR cafeteria[tiab] OR marketing[tiab] OR garden\*[tiab] OR celebrations[tiab] OR National School Lunch Program[tiab] OR standards[tiab] OR National School Breakfast Program[tiab] OR Fresh Fruit and Vegetable Program OR farm-to-school [tiab] OR reward[tiab] OR salad bar[tiab])

### For the updated supplemental search of individual articles

With a date restriction of 01/01/2014 to 6/30/2018 a search was performed using the following search strategy:

#### Pubmed

```
((school*[Title/Abstract]) AND bmi[Title/Abstract]) AND ("2014/01/01"[Date - Publication] : "3000"[Date - Publication])) AND "evaluation studies"[Publication Type]
```

```
((school*[Title/Abstract]) AND "body mass index"[Title/Abstract]) AND ("2014/01/01"[Date - Publication] : "3000"[Date - Publication])) AND "evaluation studies"[Publication Type]
```

((school\*[Title/Abstract]) AND obes\*[Title/Abstract]) AND ("2014/01/01"[Date - Publication] : "3000"[Date - Publication])) AND "evaluation studies"[Publication Type]

((school\*[Title/Abstract]) AND overweight[Title/Abstract]) AND ("2014/01/01"[Date - Publication] : "3000"[Date - Publication])) AND "evaluation studies"[Publication Type]

Similar articles to: Burke, R. M., Meyer, A., Kay, C., Allensworth, D., & Gazmararian, J. A. (2014). A holistic school-based intervention for improving health-related knowledge, body composition, and fitness in elementary school students: an evaluation of the HealthMPowers program. *International Journal of Behavioral Nutrition and Physical Activity*, 11(1), 78.

### **Education Source**

AB (kindergarten or school or schools ) AND AB body mass index

Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20140101-20180630; Publication Type: Academic Journal; Document Type: Article; Language: English

## Appendix 4. Selected definitions & acronyms

**Body Mass Index (BMI):** A person's weight in kilograms divided by their height squared in meters.

**CV:** Cardiovascular

**Duration:** Length of time the intervention was implemented.

**Follow-up(s):** Length of time between the baseline and follow-up measurement(s).

**FV:** Fruits and vegetables

**Intervention (Intx):** Change in an exposure, either assigned by an investigator or naturally occurring.

**MET:** metabolic equivalent for task

**MVPA:** Moderate to vigorous physical activity

**NA:** Not applicable

**NR:** Not reported

**NS:** Not significant

**PA:** Physical activity

**RCT:** Randomized-Controlled Trial

**Sugar-sweetened beverages (SSBs):** Drinks with added sugar, including non-diet soft drinks/sodas, flavored juice drinks, sports drinks, sweetened tea and coffee, energy drinks and sweetened milks or milk alternatives.<sup>115</sup>

**WC:** Waist circumference, a measure of abdominal adiposity.

**Weight status:** Any body weight or body composition measure, including BMI, waist circumference, skinfold, etc.

**WHtR:** Waist-to-height ratio

**VPA:** Vigorous PA

**+**: Positive/desired/favorable result based on statistical significance.

**∅:** Null result based on statistical significance.

**-:** Negative/undesired/unfavorable result based on statistical significance.

**+/∅:** Mix of positive and null results based on statistical significance.

## References Cited

1. Fryar CD, Carroll MD, Ogden CL. Prevalence of overweight and obesity among children and adolescents aged 2–19 years: United States, 1963–1965 through 2013–2014. *Health E-Stats*. 2016.
2. Glickman D, Parker L, Sim LJ, et al., eds. *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation*. Washington: National Academies Press; 2012.
3. Healthy, Hunger-Free Kids Act of 2010. Pub L No. 111-296.
4. Baranowski T, Baranowski J, Cullen KW, et al. Squire's Quest!: Dietary outcome evaluation of a multimedia game. *Am. J. Prev. Med.* 2003;24(1):52-61.
5. Baranowski T, Davis M, Resnicow K, et al. Gimme 5 fruit, juice, and vegetables for fun and health: Outcome evaluation. *Health Educ. Behav.* 2000;27(1):96-111.
6. Bartholomew JB, Jowers EM. Increasing frequency of lower-fat entrees offered at school lunch: An environmental change strategy to increase healthful selections. *J. Am. Diet. Assoc.* 2006;106(2):248-252.
7. Cohen JF, Kraak VI, Choumenkovitch SF, et al. The CHANGE study: A healthy-lifestyles intervention to improve rural children's diet quality. *J. Acad. Nutr. Diet.* 2014;114(1):48-53.
8. Coleman KJ, Shordon M, Caparosa SL, et al. Changing Nutrition Policies and Environments in Low-Income Schools Using Implementation Models: The Healthy Options For Nutrition Environments in Schools (ONES) Intervention. Paper presented at: OBESITY2011.
9. Cullen KW, Watson K, Baranowski T, et al. Squire's Quest: Intervention changes occurred at lunch and snack meals. *Appetite.* 2005;45(2):148-151.
10. Foster GD, Sherman S, Borradaile KE, et al. A policy-based school intervention to prevent overweight and obesity. *Pediatrics.* 2008;121(4):e794-e802.
11. French SA, Story M, Fulkerson JA, et al. An environmental intervention to promote lower-fat food choices in secondary schools: Outcomes of the TACOS Study. *Am. J. Public Health.* 2004;94(9):1507-1512.
12. Giles CM, Kenney EL, Gortmaker SL, et al. Increasing water availability during afterschool snack: Evidence, strategies, and partnerships from a group randomized trial. *Am. J. Prev. Med.* 2012;43(3):S136-S142.
13. Gold A, Larson M, Tucker J, et al. Classroom nutrition education combined with fruit and vegetable taste testing improves children's dietary intake. *J. Sch. Health.* 2017;87(2):106-113.
14. Hanks AS, Just DR, Brumberg A. Marketing vegetables in elementary school cafeterias to increase uptake. *Pediatrics.* 2016;138(2):e20151720.
15. Hendy HM, Williams KE, Camise TS. "Kids Choice" school lunch program increases children's fruit and vegetable acceptance. *Appetite.* 2005;45(3):250-263.
16. Hendy HM, Williams KE, Camise TS, et al. Overweight and average-weight children equally responsive to "Kids Choice Program" to increase fruit and vegetable consumption. *Appetite.* 2007;49(3):683-686.
17. Hoffman JA, Franko DL, Thompson DR, et al. Longitudinal behavioral effects of a school-based fruit and vegetable promotion program. *J. Pediatr. Psychol.* 2009;35(1):61-71.
18. Hoffman JA, Thompson DR, Franko DL, et al. Decaying behavioral effects in a randomized, multi-year fruit and vegetable intake intervention. *Prev. Med.* 2011;52(5):370-375.
19. Kenney EL, Gortmaker SL, Carter JE, et al. Grab a cup, fill it up! An intervention to promote the convenience of drinking water and increase student water consumption during school lunch. *Am. J. Public Health.* 2015;105(9):1777-1783.

20. Larsen AL, Robertson T, Dunton G. RE-AIM analysis of a randomized school-based nutrition intervention among fourth-grade classrooms in California. *Transl. Behav. Med.* 2015;5(3):315-326.
21. Morrill BA, Madden GJ, Wengreen HJ, et al. A randomized controlled trial of the Food Dudes program: Tangible rewards are more effective than social rewards for increasing short-and long-term fruit and vegetable consumption. *J. Acad. Nutr. Diet.* 2016;116(4):618-629.
22. Perry CL, Bishop DB, Taylor GL, et al. A randomized school trial of environmental strategies to encourage fruit and vegetable consumption among children. *Health Educ. Behav.* 2004;31(1):65-76.
23. Resnicow K, Cohn L, Reinhardt J, et al. A three-year evaluation of the know your body program in inner-city schoolchildren. *Health Educ. Q.* 1992;19(4):463-480.
24. Scherr RE, Linnell JD, Dharmar M, et al. A multicomponent, school-based intervention, the Shaping Healthy Choices Program, improves nutrition-related outcomes. *J. Nutr. Educ. Behav.* 2017;49(5):368-379. e361.
25. Wansink B, Just DR, Hanks AS, et al. Pre-sliced fruit in school cafeterias: Children's selection and intake. *Am. J. Prev. Med.* 2013;44(5):477-480.
26. Wechsler H, Basch CE, Zybert P, et al. Promoting the selection of low-fat milk in elementary school cafeterias in an inner-city Latino community: Evaluation of an intervention. *Am. J. Public Health.* 1998;88(3):427-433.
27. Wilson DB, Jones RM, McClish D, et al. Fruit and vegetable intake among rural youth following a school-based randomized controlled trial. *Prev. Med.* 2012;54(2):150-156.
28. Gatto NM, Martinez LC, Spruijt-Metz D, et al. LA sprouts randomized controlled nutrition, cooking and gardening programme reduces obesity and metabolic risk in Hispanic/Latino youth. *Pediatr. Obes.* 2017;12(1):28-37.
29. Bayne-Smith M, Fardy PS, Azzollini A, et al. Improvements in heart health behaviors and reduction in coronary artery disease risk factors in urban teenaged girls through a school-based intervention: The PATH program. *Am. J. Public Health.* 2004;94(9):1538-1543.
30. Bleeker M, Beyler N, James-Burdumy S, et al. The impact of playworks on boys' and girls' physical activity during recess. *J. Sch. Health.* 2015;85(3):171-178.
31. Carrel AL, Clark RR, Peterson SE, et al. Improvement of fitness, body composition, and insulin sensitivity in overweight children in a school-based exercise program: A randomized, controlled study. *Arch. Pediatr. Adolesc. Med.* 2005;159(10):963-968.
32. Dishman RK, Motl RW, Saunders R, et al. Self-efficacy partially mediates the effect of a school-based physical-activity intervention among adolescent girls. *Prev. Med.* 2004;38(5):628-636.
33. Dishman RK, Motl RW, Saunders R, et al. Enjoyment mediates effects of a school-based physical-activity intervention. *Med. Sci. Sports Exerc.* 2005;37(3):478-487.
34. Donnelly JE, Greene JL, Gibson CA, et al. Physical Activity Across the Curriculum (PAAC): A randomized controlled trial to promote physical activity and diminish overweight and obesity in elementary school children. *Prev. Med.* 2009;49(4):336-341.
35. Dorgo S, King GA, Candelaria N, et al. The effects of manual resistance training on fitness in adolescents. *Journal of strength and conditioning research/National Strength & Conditioning Association.* 2009;23(8):2287.
36. Dziewaltowski DA, Estabrooks PA, Welk G, et al. Healthy youth places: A randomized controlled trial to determine the effectiveness of facilitating adult and youth leaders to promote physical activity and fruit and vegetable consumption in middle schools. *Health Educ. Behav.* 2009;36(3):583-600.
37. Elder JP, McKenzie TL, Arredondo EM, et al. Effects of a multi-pronged intervention on children's activity levels at recess: The Aventuras para Niños study. *Adv. Nutr.* 2011;2(2):171S-176S.

38. Eliakim A, Barstow TJ, Brasel JA, et al. Effect of exercise training on energy expenditure, muscle volume, and maximal oxygen uptake in female adolescents. *The Journal of pediatrics*. 1996;129(4):537-543.
39. Ewart CK, Young DR, Hagberg JM. Effects of school-based aerobic exercise on blood pressure in adolescent girls at risk for hypertension. *Am. J. Public Health*. 1998;88(6):949-951.
40. Fardy PS, White RE, Haltiwanger-Schmitz K, et al. Coronary disease risk factor reduction and behavior modification in minority adolescents: The PATH program. *J. Adolesc. Health*. 1996;18(4):247-253.
41. Flores R. Dance for health: Improving fitness in African American and Hispanic adolescents. *Public Health Rep*. 1995;110(2):189.
42. Fuchs RK, Bauer JJ, Snow CM. Jumping improves hip and lumbar spine bone mass in prepubescent children: A randomized controlled trial. *J. Bone Miner. Res*. 2001;16(1):148-156.
43. Gao Z, Podlog L. Urban Latino children's physical activity levels and performance in interactive dance video games: Effects of goal difficulty and goal specificity. *Arch. Pediatr. Adolesc. Med*. 2012;166(10):933-937.
44. Going S, Thompson J, Cano S, et al. The effects of the Pathways Obesity Prevention Program on physical activity in American Indian children. *Prev. Med*. 2003;37:S62-S69.
45. Goran MI, Reynolds K. Interactive multimedia for promoting physical activity (IMPACT) in children. *Obes. Res*. 2005;13(4):762-771.
46. Hergenroeder AC, Kozinetz C, Schoene RB. Skinfold measurements, oxygen uptake, and exercise in adolescents. *Clin. J. Sport Med*. 1993;3(3):153-160.
47. Jago R, McMurray RG, Bassin S, et al. Modifying middle school physical education: Piloting strategies to increase physical activity. *Pediatr. Exerc. Sci*. 2009;21(2):171-185.
48. Marks JT, Campbell MK, Ward DS, et al. A comparison of Web and print media for physical activity promotion among adolescent girls. *J. Adolesc. Health*. 2006;39(1):96-104.
49. McKenzie TL, Nader PR, Strikmiller PK, et al. School physical education: Effect of the Child and Adolescent Trial for Cardiovascular Health. *Prev. Med*. 1996;25(4):423-431.
50. McKenzie TL, Stone EJ, Feldman HA, et al. Effects of the CATCH physical education intervention: Teacher type and lesson location. *Am. J. Prev. Med*. 2001;21(2):101-109.
51. Mendoza JA, Watson K, Baranowski T, et al. The walking school bus and children's physical activity: A pilot cluster randomized controlled trial. *Pediatrics*. 2011;128(3):e537.
52. Pate RR, Saunders R, Dishman RK, et al. Long-term effects of a physical activity intervention in high school girls. *Am. J. Prev. Med*. 2007;33(4):276-280.
53. Pate RR, Ward DS, Saunders RP, et al. Promotion of physical activity among high-school girls: A randomized controlled trial. *Am. J. Public Health*. 2005;95(9):1582-1587.
54. Robbins LB, Gretebeck KA, Kazanis AS, et al. Girls on the move program to increase physical activity participation. *Nurs. Res*. 2006;55(3):206-216.
55. Robinson TN. Reducing children's television viewing to prevent obesity: A randomized controlled trial. *JAMA*. 1999;282(16):1561-1567.
56. Sadowsky HS, Sawdon JM, Scheinder ME, et al. Eight week moderate intensity exercise intervention elicits body composition change in adolescents. *Cardiopulm. Phys. Ther. J*. 1999;10(2):38.
57. Sallis JF, McKenzie TL, Alcaraz JE, et al. The effects of a 2-year physical education program (SPARK) on physical activity and fitness in elementary school students. Sports, Play and Active Recreation for Kids. *Am. J. Public Health*. 1997;87(8):1328-1334.
58. Sallis JF, McKenzie TL, Alcaraz JE, et al. Project SPARK: Effects of Physical Education on Adiposity in Children a. *ANYAS*. 1993;699(1):127-136.

59. Shimon JM, Petlichkoff LM. Impact of pedometer use and self-regulation strategies on junior high school physical education students' daily step counts. *Journal of Physical Activity and Health*. 2009;6(2):178-184.
60. Sirard JR, Alhassan S, Spencer TR, et al. Changes in physical activity from walking to school. *J. Nutr. Educ. Behav*. 2008;40(5):324-326.
61. Spruijt-Metz D, Nguyen-Michel ST, Goran M, et al. Reducing sedentary behavior in minority girls via a theory-based, tailored classroom media intervention. *Int. J. Pediatr. Obes*. 2008;3(4):240-248.
62. Stephens MB, Wentz SW. Supplemental fitness activities and fitness in urban elementary school classrooms. *Fam Med*1998.;30:220-223.
63. Webber LS, Catellier DJ, Lytle LA, et al. Promoting physical activity in middle school girls: Trial of Activity for Adolescent Girls. *Am. J. Prev. Med*. 2008;34(3):173-184.
64. Young DR, Phillips JA, Yu T, et al. Effects of a life skills intervention for increasing physical activity in adolescent girls. *Arch. Pediatr. Adolesc. Med*. 2006;160(12):1255-1261.
65. Annesi JJ, Smith AE, Walsh SM, et al. Effects of an after-school care-administered physical activity and nutrition protocol on body mass index, fitness levels, and targeted psychological factors in 5-to 8-year-olds. *Transl. Behav. Med*. 2015;6(3):347-357.
66. Annesi JJ, Walsh SM, Greenwood BL, et al. Effects of the Youth Fit 4 Life physical activity/nutrition protocol on body mass index, fitness and targeted social cognitive theory variables in 9- to 12-year-olds during after-school care. *J. Paediatr. Child Health*. 2017;53(4):365-373.
67. Arlinghaus KR, Moreno JP, Reesor L, et al. Compañeros: High school students mentor middle school students to address obesity among Hispanic adolescents. *Prev. Chronic Dis*. 2017;14.
68. Barbeau P, Johnson MH, Howe CA, et al. Ten months of exercise improves general and visceral adiposity, bone, and fitness in black girls. *Obesity*. 2007;15(8):2077-2085.
69. Bavarian N, Lewis KM, Acock A, et al. Effects of a school-based social-emotional and character development program on health behaviors: A matched-pair, cluster-randomized controlled trial. *The journal of primary prevention*. 2016;37(1):87-105.
70. Bogart LM, Elliott MN, Cowgill BO, et al. Two-year BMI outcomes from a school-based intervention for nutrition and exercise: A randomized trial. *Pediatrics*. 2016;137(5).
71. Bush PJ, Zuckerman AE, Theiss PK, et al. Cardiovascular risk factor prevention in black schoolchildren: Two-year results of the "Know Your Body" program. *Am. J. Epidemiol*. 1989;129(3):466-482.
72. Caballero B, Clay T, Davis SM, et al. Pathways: A school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. *The American journal of clinical nutrition*. 2003;78(5):1030-1038.
73. Centeio EE, McCaughtry N, Moore EWG, et al. Building healthy communities: A comprehensive school health program to prevent obesity in elementary schools. *Prev. Med*. 2018;111:210-215.
74. Crespo NC, Elder JP, Ayala GX, et al. Results of a multi-level intervention to prevent and control childhood obesity among Latino children: The Aventuras Para Niños Study. *Ann. Behav. Med*. 2012;43(1):84-100.
75. de Heer HD, Koehly L, Pederson R, et al. Effectiveness and spillover of an after-school health promotion program for Hispanic elementary school children. *Am. J. Public Health*. 2011;101(10):1907-1913.
76. Donnelly JE, Jacobsen DJ, Whatley JE, et al. Nutrition and physical activity program to attenuate obesity and promote physical and metabolic fitness in elementary school children. *Obes. Res*. 1996;4(3):229-243.



77. Dziewaltowski DA, Rosenkranz RR, Geller KS, et al. HOP'N after-school project: An obesity prevention randomized controlled trial. *International Journal of Behavioral Nutrition and Physical Activity*. 2010;7(1):90.
78. Foster GD, Linder B, Baranowski T, et al. A school-based intervention for diabetes risk reduction. *N. Engl. J. Med*. 2010;363(5):443-453.
79. Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch. Pediatr. Adolesc. Med*. 1999;153(4):409-418.
80. Greening L, Harrell KT, Low AK, et al. Efficacy of a school-based childhood obesity intervention program in a rural southern community: TEAM Mississippi Project. *Obesity*. 2011;19(6):1213-1219.
81. Harrell JS, McMurray RG, Bangdiwala SI, et al. Effects of a school-based intervention to reduce cardiovascular disease risk factors in elementary-school children: The Cardiovascular Health in Children (CHIC) study. *The Journal of pediatrics*. 1996;128(6):797-805.
82. Hendy HM, Williams KE, Camise TS. Kid's Choice Program improves weight management behaviors and weight status in school children. *Appetite*. 2011;56(2):484-494.
83. Himes JH, Ring K, Gittelsohn J, et al. Impact of the Pathways intervention on dietary intakes of American Indian schoolchildren. *Prev. Med*. 2003;37:S55-S61.
84. Hopper CA, Gruber MB, Munoz KD, et al. Effect of including parents in a school-based exercise and nutrition program for children. *Res. Q. Exerc. Sport*. 1992;63(3):315-321.
85. Hopper CA, Munoz KD, Gruber MB, et al. A school-based cardiovascular exercise and nutrition program with parent participation: An evaluation study. *Child. Health Care*. 1996;25(3):221-235.
86. Hopper CA, Munoz KD, Gruber MB, et al. The effects of a family fitness program on the physical activity and nutrition behaviors of third-grade children. *Res. Q. Exerc. Sport*. 2005;76(2):130-139.
87. Jago R, McMurray RG, Drews KL, et al. HEALTHY intervention: Fitness, physical activity, and metabolic syndrome results. *Med. Sci. Sports Exerc*. 2011;43(8):1513.
88. Johnston CA, Moreno JP, El-Mubasher A, et al. Impact of a school-based pediatric obesity prevention program facilitated by health professionals. *J. Sch. Health*. 2013;83(3):171-181.
89. Johnston CA, Tyler C, McFarlin BK, et al. Weight loss in overweight Mexican American children: A randomized, controlled trial. *Pediatrics*. 2007;120(6).
90. Jones D, Hoelscher DM, Kelder SH, et al. Increasing physical activity and decreasing sedentary activity in adolescent girls—The Incorporating More Physical Activity and Calcium in Teens (IMPACT) study. *International Journal of Behavioral Nutrition and Physical Activity*. 2008;5(1):42.
91. Killen JD, Telch MJ, Robinson TN, et al. Cardiovascular disease risk reduction for tenth graders: A multiple-factor school-based approach. *JAMA*. 1988;260(12):1728-1733.
92. Luepker RV, Perry CL, McKinlay SM, et al. Outcomes of a field trial to improve children's dietary patterns and physical activity: The Child and Adolescent Trial for Cardiovascular Health (CATCH). *JAMA*. 1996;275(10):768-776.
93. Madsen K, Linchey J, Gerstein D, et al. Energy balance 4 kids with play: Results from a two-year cluster-randomized trial. *Childhood Obesity*. 2015;11(4):375-383.
94. Mauriello LM, Ciavatta MMH, Paiva AL, et al. Results of a multi-media multiple behavior obesity prevention program for adolescents. *Prev. Med*. 2010;51(6):451-456.
95. Melnyk BM, Jacobson D, Kelly SA, et al. Twelve-month effects of the COPE healthy lifestyles TEEN program on overweight and depressive symptoms in high school adolescents. *J. Sch. Health*. 2015;85(12):861-870.
96. Nader PR, Sellers DE, Johnson CC, et al. The effect of adult participation in a school-based family intervention to improve children's diet and physical activity: The Child and Adolescent Trial for Cardiovascular Health. *Prev. Med*. 1996;25(4):455-464.

97. Nader PR, Stone EJ, Lytle LA, et al. Three-year maintenance of improved diet and physical activity: The CATCH cohort. *Arch. Pediatr. Adolesc. Med.* 1999;153(7):695-704.
98. Neumark-Sztainer D, Story M, Hannan PJ, et al. New Moves: A school-based obesity prevention program for adolescent girls. *Prev. Med.* 2003;37(1):41-51.
99. Neumark-Sztainer DR, Friend SE, Flattum CF, et al. New moves—preventing weight-related problems in adolescent girls: A group-randomized study. *Am. J. Prev. Med.* 2010;39(5):421-432.
100. Pbert L, Druker S, Barton B, et al. A school-based program for overweight and obese adolescents: A randomized controlled trial. *J. Sch. Health.* 2016;86(10):699-708.
101. Perry CL, Lytle LA, Feldman H, et al. Effects of the Child and Adolescent Trial for Cardiovascular Health (CATCH) on Fruit and Vegetable Intake. *J. Nutr. Educ.* 1998;30(6):354-360.
102. Rosenbaum M, Nonas C, Weil R, et al. School-based intervention acutely improves insulin sensitivity and decreases inflammatory markers and body fatness in junior high school students. *The Journal of Clinical Endocrinology & Metabolism.* 2006;92(2):504-508.
103. Sallis JF, McKenzie TL, Conway TL, et al. Environmental interventions for eating and physical activity: A randomized controlled trial in middle schools. *Am. J. Prev. Med.* 2003;24(3):209-217.
104. Shilts MK, Horowitz M, Townsend MS. Guided goal setting: Effectiveness in a dietary and physical activity intervention with low-income adolescents. *Int. J. Adolesc. Med. Health.* 2009;21(1):111-122.
105. Simons-Morton BG, Parcel GS, Baranowski T, et al. Promoting physical activity and a healthful diet among children: Results of a school-based intervention study. *Am. J. Public Health.* 1991;81(8):986-991.
106. Spiegel SA, Foulk D. Reducing overweight through a multidisciplinary school-based intervention. *Obesity.* 2006;14(1):88-96.
107. Stevens J, Story M, Ring K, et al. The impact of the Pathways intervention on psychosocial variables related to diet and physical activity in American Indian schoolchildren. *Prev. Med.* 2003;37:S70-S79.
108. Treviño RP, Hernandez AE, Yin Z, et al. Effect of the Bienestar Health Program on physical fitness in low-income Mexican American children. *Hispanic Journal of Behavioral Sciences.* 2005;27(1):120-132.
109. Treviño RP, Yin Z, Hernandez A, et al. Impact of the Bienestar school-based diabetes mellitus prevention program on fasting capillary glucose levels: A randomized controlled trial. *Arch. Pediatr. Adolesc. Med.* 2004;158(9):911-917.
110. Williamson DA, Champagne CM, Harsha DW, et al. Effect of an environmental school-based obesity prevention program on changes in body fat and body weight: A randomized trial. *Obesity.* 2012;20(8):1653-1661.
111. Williamson DA, Copeland AL, Anton SD, et al. Wise Mind project: A school-based environmental approach for preventing weight gain in children. *Obesity.* 2007;15(4):906-917.
112. Wright K, Giger JN, Norris K, et al. Impact of a nurse-directed, coordinated school health program to enhance physical activity behaviors and reduce body mass index among minority children: A parallel-group, randomized control trial. *Int. J. Nurs. Stud.* 2013;50(6):727-737.
113. Wright K, Norris K, Newman Giger J, et al. Improving healthy dietary behaviors, nutrition knowledge, and self-efficacy among underserved school children with parent and community involvement. *Childhood Obesity (Formerly Obesity and Weight Management).* 2012;8(4):347-356.
114. Yin Z, Gutin B, Johnson MH, et al. An environmental approach to obesity prevention in children: Medical College of Georgia FitKid Project year 1 results. *Obes. Res.* 2005;13(12):2153-2161.
115. Centers for Disease Control and Prevention. The CDC guide to strategies for reducing the consumption of sugar-sweetened beverages. Atlanta: CDC; 2010.

