

Obesity Prevention and Control: Multicomponent Interventions (Meal or Fruit and Vegetable Snack Interventions + Healthier Snack Foods and Beverages) Combined with a Physical Activity Intervention in Schools

Community Preventive Services Task Force Finding and Rationale Statement Ratified October 2018

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CPSTF Finding and Rationale Statement

Context

Consuming a healthy diet and participating in regular physical activity can build stronger bones and muscles, help control weight, and reduce the risk of developing health conditions such as heart disease, type 2 diabetes, high blood pressure, and osteoporosis (U.S. Department of Health and Human Services and U.S. Department of Agriculture 2015; 2018 Physical Activity Guidelines Advisory Committee, 2018). In the United States, the percentage of children and adolescents affected by obesity has more than tripled in the past 40 years (Fryar et al., 2014). Data from 2015–2016 show that nearly one in five school age children and adolescents (6 to 19 years) in the United States has obesity (Hales et al., 2017).

Consuming more energy than the body needs for healthy functioning and growth can lead to excess weight gain (Hill et al., 2012). Many factors contribute to excess weight gain such as consumption of high-calorie, low-nutrient foods and beverages, inadequate physical activity, short sleep duration, genetics, and metabolism (U.S. Department of Health and Human Services 2016, 2018a). When addressing obesity, a comprehensive approach should be considered such as the [Whole School, Whole Community, Whole Child](https://www.cdc.gov/healthyyouth/wsccl/) [https://www.cdc.gov/healthyyouth/wsccl/] model, which involves schools, parents, caregivers, community organizations, and healthcare providers (U.S. Department of Health and Human Services 2018b, 2018c).

Most U.S. children ages 5 to 18 years attend school for an average of six to seven hours a day during the school year (National Center for Education Statistics, 2010). This gives schools a chance to offer students nutritious foods and beverages and opportunities for physical activity. While there are many approaches available to schools, this CPSTF finding focuses on interventions that provide students healthier school meals or fruit and vegetable snack programs, healthier snack foods and beverages, and interventions that increase the amount of physical activity students get during the school day.

Intervention Definition

These multicomponent interventions combine (1) meal or fruit and vegetable snack Interventions, (2) interventions supporting healthier snack foods and beverages, and (3) a physical activity intervention.

- 1) **Meal or fruit and vegetable snack interventions** are designed to provide healthier foods and beverages* that will be consumed by students, limit access to less healthy foods and beverages in school meals, or both. Interventions must include one or both of the following components:
 - School meal policies that ensure school breakfasts or lunches meet specific nutrition requirements (e.g., School Breakfast Program, National School Lunch Program)
 - Fresh fruit and vegetable programs that provide fresh fruits or vegetables to students during lunch or as a snack
- 2) **Interventions supporting healthier snack foods and beverages sold or offered in school** are designed to provide healthier foods and beverages* that will be consumed by students, limit access to less healthy foods and beverages, or both. Interventions must include one or more of the following components:
 - Food and beverage policies that require foods and beverages sold during the school day, outside of school meal programs, meet established nutritional standards or guidelines. These are often referred to as

“competitive foods and beverages” because they are sold in competition with school meal programs, and are available through in-school fundraisers, à la carte options, vending machines, school stores, and snack bars.

- Celebration rules or policies that encourage healthy foods and beverages be served during classroom celebrations, parties, and special events
- Rules or policies that encourage nonfood items as alternative rewards for academic achievement

3) **Physical activity interventions** engage students in physical activity each day. Interventions must include only one of the following components:

- Physical education classes that engage students in physical activity
- School policies or practices that allow opportunities for physical activity during the school day (e.g., recess and classroom physical activity)

Interventions also may include one or more of the following:

- Healthy food and beverage marketing strategies
- Educational programs that address nutrition or build knowledge and skills needed to maintain physically active lifestyles
- Large-scale infrastructure changes that provide or improve space, facilities, or equipment to make physical activity easy and appealing (e.g., renovating a school playground)
- Addition of small-scale equipment to promote physical activity (e.g., jump ropes, balls, cones, team vests, pedometers)
- Staff involvement
- Family and community engagement

*Healthier foods and beverages include fruits, vegetables, whole grains, low-fat or fat-free dairy, lean meats, beans, eggs, nuts, and items that are low in saturated fats, salt, and added sugars, and have no trans fats. Less-healthy foods and beverages include those with more added sugars, fats, and sodium..

CPSTF Finding (October 2018)

The CPSTF finds insufficient evidence to determine the effectiveness of multicomponent meal and snack interventions combined with a physical activity intervention in schools. Evidence showed inconsistent results for weight-related outcomes and favorable, but small, changes for dietary and physical activity outcomes.

The CPSTF recommends the following related interventions in school settings:

Healthy Eating Interventions Combined with Physical Activity Interventions

- [Meal or Fruit and Vegetable Snack Interventions Combined with Physical Activity Interventions in Schools](https://www.thecommunityguide.org/findings/obesity-prevention-control-meal-fruit-vegetable-snack-interventions-combined-physical-activity-interventions-schools) [https://www.thecommunityguide.org/findings/obesity-prevention-control-meal-fruit-vegetable-snack-interventions-combined-physical-activity-interventions-schools]

Healthy Eating Interventions Alone

- [Meal or Fruit and Vegetable Snack Interventions to Increase Healthier Foods and Beverages Provided by Schools](https://www.thecommunityguide.org/findings/obesity-meal-fruit-vegetable-snack-interventions-increase-healthier-foods-beverages-schools) [https://www.thecommunityguide.org/findings/obesity-meal-fruit-vegetable-snack-interventions-increase-healthier-foods-beverages-schools]
- [Multicomponent Interventions \(Meal or Fruit and Vegetable Snack Interventions + Healthier Snack Foods and Beverages\) to Increase Availability of Healthier Foods and Beverages in Schools](https://www.thecommunityguide.org/findings/obesity-multicomponent-interventions-increase-availability-healthier-foods-and-beverages) [https://www.thecommunityguide.org/findings/obesity-multicomponent-interventions-increase-availability-healthier-foods-and-beverages]

Physical Activity Interventions

- [Enhanced School-based Physical Education](https://www.thecommunityguide.org/findings/physical-activity-enhanced-school-based-physical-education) [https://www.thecommunityguide.org/findings/physical-activity-enhanced-school-based-physical-education]

Rationale

Basis of Finding

The CPSTF finding is based on evidence from a systematic review of 14 studies with 17 study arms (search period 1990–July 2017).

BMI z-scores and the combined prevalence of overweight and obesity were the most commonly reported weight-related outcomes. Less commonly reported weight-related outcomes included overweight prevalence, obesity prevalence, skinfold thickness, BMI percentile, and percent body fat standard deviation score. Included studies that had control groups considered results favorable when there were decreases in weight-related outcomes among the intervention group. Included studies that did not have control groups considered results favorable when the overall population reported no change or decreases in weight-related outcomes. Based on national trends that show modest increases in obesity prevalence among children (Ogden, 2016), these studies demonstrate potential to slow the rate of change in obesity prevalence.

Dietary outcomes included intake of fruits and vegetables, sugar-sweetened beverages (SSB), and low nutrient foods (e.g., high energy, dense foods of low nutrient value such as chips or candy). Increases in fruit and vegetable consumption were considered favorable. Decreases in SSB and low nutrient food intake were considered favorable.

Physical activity outcomes included cardiorespiratory fitness, steps or counts of physical activity, time spent in physical activity, and percentage of students who were active throughout the day. An increase in any measure was considered favorable.

Intervention effects on weight-related, dietary, and physical activity outcomes are shown in the table. It was not always possible to calculate summary effect estimates due to the variability of reported outcome measures. In these instances, an overall direction for the outcome is provided. Study design indicates whether there was a control group.

Table. Intervention Effects on Weight-related, Diet, and Physical Activity Outcomes

Outcome	Key Study Findings
Weight-related Outcomes	
Combined Overweight and Obesity Prevalence 6 studies*	<i>Percent of students with BMI-for-age and sex $\geq 85^{th}$ percentile:</i> Median decrease of 0.4 percentage points (IQR: -1.9 to 1.0 percentage points) 6 studies: 3 group RCT, 1 other design with concurrent comparison, 1 repeat cross-sectional with comparison, 1 before-after (no control)
Overweight Prevalence 3 studies*	<i>Percent of students with BMI-for-age percentile $\geq 85^{th}$ and $< 95^{th}$ percentile:</i> Median increase of 1.3 percentage points (Range: -3.7 to 2.3 percentage points) 3 studies: 3 group RCT
Obesity Prevalence 3 studies*	<i>Percent of students with BMI-for-age and sex $\geq 95^{th}$ percentile:</i> Median decrease of 1.7 percentage points (Range: -2.3 to 1.5 percentage points) 3 studies: 3 group RCT
BMI z-score 7 studies (8 arms)*	Median increase of 0.005 (IQR -0.05 to 0.04) 7 studies (8 arms): 4 (5 arms) group RCT, 1 other design with concurrent comparison, 2 before-after (no control)
Skinfold measure 2 studies	<i>Sum of four skinfolds:</i> Girls: decrease of 2.3 mm (95% CI: -4.3, -0.3) Boys: decrease of 1.0 mm (95% CI: -2.4, 0.5) 1 study: group RCT <i>Sum of five skinfolds:</i> no statistically significant changes 1 study: group non-RCT
BMI Percentile 1 study	Decrease of 0.13 (95% CI: -1.04, 0.78) 1 study: repeat cross-sectional
Percent body fat standard deviation score 1 study	Results stratified by age: 5 to 7 year olds: decrease of 0.14 (p=0.03) 10 to 12 year olds: increase of 0.03 (p=0.69) 1 study: group RCT
Dietary Outcomes	
Fruit and Vegetable Intake 8 studies (9 arms)	<i>Servings of fruits and vegetables per day:</i> Median increase of 0.10 servings/day (IQR: 0.08 to 0.25) 5 studies (6 arms): 1 (2 arms) group RCT, 1 repeat cross-sectional with comparison, 1 repeat cross-sectional without comparison, 2 before-after (no control) <i>Fruit and vegetable consumption at home:</i> No change (p=0.47) 1 study: group RCT <i>Percent of students consuming ≥ 2 servings fruit per day:</i> decrease of 3.7 percentage points (p=0.50) <i>Percent of students consuming ≥ 2 servings of vegetables per day:</i> decrease of 1.10 percentage points (p=0.14) 1 study: other design with concurrent comparison <i>Percent of students consuming ≥ 5 fruits and vegetables per day:</i> no change 1 study: before-after (no control)

Outcome	Key Study Findings
Sugar Sweetened Beverage Intake 4 studies (5 arms)	<i>Glasses of sugar sweetened beverages per day:</i> Median decrease of 0.08 (IQR: -0.1 to -0.02) 4 studies (5 arms): 2 (3 arms) group RCT, 1 repeat cross-sectional, 1 before-after (no control) <i>Times per week drinking sweet drinks at home:</i> No change (p=0.75) 1 study: group RCT <i>Consuming sugar-sweetened soft drinks ≥3 days per week:</i> Adjusted OR: 1.21 (p=0.17) 1 study: other design with concurrent comparison group <i>Percent of students who report consuming soda daily:</i> Decrease of 0.90 pct pts (NS) 1 study: before-after (no control)
Low Nutrient Food Intake 3 studies	<i>Decrease in consumption of ice cream, cookies, buns, and sweets at home (p=0.002)</i> 1 study: group RCT <i>Portions of sweet and savory snacks:</i> Boys: no change (NS); Girls: increase of 0.1 portions/day (NS) 1 study: group RCT <i>Servings per day of chocolate, fries, chips, cookies:</i> Black students: decrease of 0.18 servings/day (NR); Nonblack students: decrease of 0.16 servings/day (NR) 1 study: before-after (no control)
Physical Activity Outcomes	
Cardiorespiratory Fitness 2 studies	<i>Physical Work Capacity 170: no significant change</i> 1 study: group non-RCT <i>Maximum oxygen consumption (calculated):</i> Decrease of 3.4 mL/kg/min (p<0.001) 1 study: before-after (no control)

Outcome	Key Study Findings
Time Spent in Physical Activity (pedometer, accelerometer and self-report) 7 studies (10 arms)	<i>Steps per day</i> (pedometer): Range increase of 886 steps/day (95% CI: 485, 2,312) to 1,399 steps/day ($p<0.001$) 2 studies: 1 repeat cross sectional with comparison; 1 before-after (no control) <i>Counts per day</i> (accelerometer): Increase of 18 counts/day ($p=0.10$) 1 study: group RCT <i>Moderate to vigorous physical activity throughout day</i> (accelerometer): Range: increase of 4.8 min/day (NS) to 10.60 min/day ($p<0.02$) 1 study (2 arms): group RCT <i>Moderate to vigorous physical activity:</i> Black students: increase of 0.51 sessions/week ($p<0.01$); Non-black students: increase of 0.57 sessions/week ($p<0.0001$) 1 study: before-after (no control) <i>Vigorous physical activity lasting 20 min:</i> Increase of 0.05 day/week 1 study: repeat cross sectional <i>Vigorous physical activity yesterday lasting 20 min or longer:</i> School 1: increase of 11 percentage points ($p<0.05$) School 2: increase of 1 percentage point (NS) School 3: increase of 1 percentage point (NS) 1 study (3 arms): repeat cross sectional with concurrent comparison
Percent of Students Active and Other Measures of PA 3 studies	<i>Active during recess:</i> aOR: 1.05 (NS) <i>Walk/cycle to school:</i> aOR: 1.49 ($p<0.01$) 1 study: other design with concurrent comparison group <i>Report one hour of physical activity:</i> 20.6% ($p<0.001$) 1 study: before-after (no control) <i>Active commuting to school:</i> Girls: decrease of 1 min/day (NS); Boys increase of 1 min/day (NS) 1 study: group RCT

aOR = adjusted odds ratio

BMI = body mass index

CI = confidence interval

IQI = interquartile interval

NS = not significant

RCT = randomized control trial

*Studies that report BMI z-score and prevalence data are represented in each outcome category.

Applicability and Generalizability Issues

Applicability was not assessed because the CPSTF did not have enough information to determine if the intervention works.

Data Quality Issues

Study designs included group randomized controlled trials (5 studies with 6 arms), non-randomized group trials (1 study), other designs with a concurrent comparison group (1 study), repeat cross-sectional with comparison (2 studies with 4 arms), repeat cross-sectional (1 study), and before-after (no control; 4 studies).

Dietary outcomes were based on self-reported data, physical activity outcomes were measured or self-reported, and weight-related outcomes were directly measured by trained staff. Common limitations of self-reported dietary data included participants forgetting about consumption of specific foods or beverages, inaccurately estimating portion sizes, and inadvertently or intentionally failing to report specific items (Grandjean, 2012). Studies addressed these limitations by using age-appropriate, validated instruments.

When it was not possible to calculate an effect estimate because inconsistent measures were reported, findings were summarized narratively.

Other Benefits and Harms

Other benefits include reductions in recreational screen time and improvements to home nutrition environments. Five included studies reported on different combinations of recreational screen time such as TV, DVD, video games, and computer use (Millar et al., 2011; Saksvig et al., 2005; Jamerson et al., 2017; Nanney et al., 2014; Singh et al., 2008). Results were generally favorable for reductions in recreational screen time. One study found the intervention improved parent or guardian purchases of healthier foods (Saksvig et al., 2005). One postulated benefit is student enjoyment of the intervention.

Postulated harms include the development of body size dissatisfaction or dieting behavior and overexertion from physical activity. Included studies were examined for measures of body size dissatisfaction, dieting behaviors such as food restriction, or similar measures. Three studies in the review measured body image satisfaction or dieting to lose weight (Benamins et al., 2010; Marcus et al., 2009; Millar et al., 2011). Two of the studies reported no difference. However, one of the studies, a before-after (no control) in a private school, found an 8.4 percentage point increase (not significant) in the number of students who reported exercising or dieting to lose weight. None of the studies stratified results by gender.

Economic Evidence

An economic review was not done for this intervention because the CPSTF did not have enough information to determine if the intervention works.

Other Considerations

Although the CPSTF found insufficient evidence, results showed some small improvements in select dietary and physical activity outcomes. Many school obesity prevention interventions have been implemented with mixed results (Amini et al., 2015). Communities and schools implementing interventions should promote adoption of intervention components, train appropriate staff, and ensure there is sufficient funding for implementation. Some groups may resist program implementation including teachers, staff, parents, or students. Groups resistant to change may need additional education about the potential health-related benefits of these interventions as well as the connection between health and academic achievement. This may lead to their buy-in and support of the intervention.

The [Whole School, Whole Community, Whole Child](https://www.cdc.gov/healthyyouth/wsccl/) [https://www.cdc.gov/healthyyouth/wsccl/] model provides additional information about the school nutrition environment, nutrition services, physical education, and physical

activity (National Association of Chronic Disease Directors, 2017). The school nutrition environment gives students opportunities to learn about and practice healthy eating. Activities may include providing nutrition education and messaging and increasing the availability of healthier foods and beverages (e.g., in vending machines, as classroom rewards, for parties, school celebrations). School nutrition services include meals and snacks that meet federal nutrition standards such as those outlined in the National School Lunch Program and Smart Snacks. Several healthy eating intervention approaches are promoted by the Centers for Disease Control and Prevention's (CDC) [School Nutrition Environment Framework](https://www.cdc.gov/healthyschools/nutrition/pdf/School_Nutrition_Framework_508tagged.pdf) [https://www.cdc.gov/healthyschools/nutrition/pdf/School_Nutrition_Framework_508tagged.pdf].

The physical education and physical activity components in the Whole School, Whole Community, Whole Child model are addressed in the [Comprehensive School Physical Activity Program](https://www.cdc.gov/healthyschools/physicalactivity/cspap.htm) [https://www.cdc.gov/healthyschools/physicalactivity/cspap.htm], which is a framework to increase physical education and youth physical activity. It reflects coordination across five components: physical education, physical activity during school, physical activity before and after school, staff involvement, and family and community engagement.

Researchers and practitioners should also consider potential consequences related to body size dissatisfaction or harmful weight control behaviors before intervention implementation. The Academy for Eating Disorders developed Guidelines for Childhood Obesity Prevention Programs to help address the increase weight in children and adolescents. Some of their guidelines advise that interventions focus on health and health-promoting behaviors rather than weight to avoid body size dissatisfaction and interventions focus only on modifiable behaviors where there is evidence for improvement in children's health (Danielsdottir et al 2009).

Evidence Gaps

Additional research and evaluation are needed to determine if these interventions are effective, and to fill existing gaps in the evidence base.

- Are programs implemented at some system levels (i.e., Federal, state, district, school, classroom) more effective than others? This may only apply to U.S. studies?
- What combinations of dietary and physical activity intervention approaches are most effective?
- How effective are these interventions across different populations, including students with disabilities?
- What other physical activity opportunities could be combined with healthy eating interventions?
- Do students find the healthier foods and beverages offered appealing?
- Do interventions lead to body dissatisfaction? If so, future interventions should address body image and promote a healthy relationship with food.
- What are the best measures for dietary intake, physical activity, and weight-related outcomes? Increased consensus on definitions would improve comparability and the ability to synthesize evidence.
- What is the best way to measure the combined effect of intervention approaches and determine which approaches are driving results?
- Do interventions lead to other benefits (e.g., academic achievement) or harms (e.g., overexertion from physical activity)?
- How do interventions affect families when children bring intervention messages of healthier eating and active living home?
- Will intervention effects be greater if home and community components are combined with school components?

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Disclaimer

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