

Appendix E-2.31: Evidence Portfolio

Part D. Chapter 4: Food Environment and Settings

What is the impact of school-based approaches on the weight status of school-aged children?

Conclusion Statement: Moderate and generally consistent evidence indicates that multi-component school-based approaches have beneficial effects on weight status (BMI or BMI-z reduced on average by 0.15 kg/m²), especially for children ages 6 to 12 years.

DGAC Grade: Moderate

Conclusion Statement: The body of evidence regarding the impact of school-based approaches on weight status among adolescents is limited due to an insufficient number of studies.

DGAC Grade: Not Assignable

Key Findings

- This evidence portfolio includes two systematic reviews (Water, 2011; Wang, 2013); one of which included a meta-analysis (Waters, 2011). Collectively, 108 studies targeting children in school published prior to August 2012 were evaluated. Forty-nine studies were conducted in the United States and the remaining studies were completed in other highly developed countries. The systematic reviews examined the impact of school-based approaches targeting obesity prevention among school-aged children.
- The studies used a variety of intervention strategies targeting behaviors related to dietary intake and/or physical activity. Some approaches were multi-component, with a combination of interventions targeting children, their parents, and/or the school environment. The primary outcomes of interest were BMI, changes in BMI, rate of weight gain, body fat percentage, waist circumference, skin fold thickness, and prevalence of overweight and obesity.
- In the body of evidence available, the school-based approaches were diverse, making comparison across studies challenging. Despite this variability, school-based interventions significantly improved weight-related outcomes. Multi-component interventions, and in particular those implemented longer term (>6 months), were more effective than single-component and short-term (3-6 months) interventions. Evidence supporting the effectiveness of school-based interventions among children aged 6-12 years was robust; while findings among children aged 13-18 years were weaker, but trend toward effectiveness.
- The evidence base includes two reviews evaluating several studies by independent investigators with sufficient sample sizes. Although findings indicate that school-based approaches effectively improve weight-related outcomes, in particular among children between the ages of 6 and 12, a high degree of heterogeneity means these findings should be interpreted cautiously. While the magnitude of the effect is clinically meaningful, the public health significance is difficult to ascertain.

Description of the Evidence

This evidence portfolio includes 2 systematic reviews (Waters, 2011; Wang, 2013), of which one includes a meta-analysis (Waters, 2011). The Waters *et al* review included 55 studies; 47 were conducted among children aged 6 to 18 years; 37 studies were included in the meta-analysis. The Wang *et al* review included 124 studies; 104 studies evaluated school-based interventions, 61 of which were conducted at schools. Thirteen studies were included in both reviews. Study designs included randomized controlled trials (RCTs) and non-randomized controlled trials. The systematic reviews had low risk of bias, as evidenced by AMSTAR scores of 11 points out of 11 possible points.

Population

The studies examined generally healthy children, with the majority of findings pertaining to children aged 6 to 12 years. Forty-nine studies were conducted in the United States, while 67 were conducted in other highly developed countries. The Waters *et al* review used the PROGRESS (Place, Race, Occupation, Gender, Religion, Education, Socio-economic status, Social status) checklist to collect data relevant for equity. Twenty-six of the studies targeting children aged 6 to 18 years (n=47) analyzed outcomes by at least one PROGRESS item; 25 studies did so by gender. Some studies also analyzed outcomes by race (n=5), socio-economic status (n=3), and education (n=2). The review by Wang *et al* included diverse populations based on race/ethnicity; however, the findings were not reported by these subgroups. (See the Overview Table for review-specific details).

Exposures

The studies included in the reviews examined a variety of school-based approaches assessing the effectiveness of childhood obesity prevention interventions. Waters *et al* updated a previous Cochrane review of childhood obesity prevention research and determined the effectiveness of interventions intended to prevent obesity in children. The approaches included educational, health promotion and/or psychological, family, behavioral therapy, counseling, or management interventions that focused on diet, physical activity, or lifestyle support, or a combination. A secondary aim of this review was to identify program characteristics and strategies that work for specific populations, the reasons for their success, and the cost associated with them. The studies included in the Wang *et al* review assessed the effectiveness of childhood obesity prevention interventions that aimed to improve diet, physical activity, or both and were conducted in schools, homes, primary care clinics, childcare settings, the community, or combinations of these settings in the US and other very high-income countries. Only the data from school-based studies were included in this evidence base.

Outcomes

Weight outcomes reported in the Waters *et al* review include changes in BMI, rate of weight gain, and prevalence of obesity. The weight-related outcomes addressed by Wang *et al* were BMI, body fat percentage, waist circumference, skin fold thickness, and prevalence of overweight and obesity. Obesity-related clinical outcomes, such as blood pressure and blood lipids, and behavioral outcomes related to energy balance, such as dietary intake, physical activity, and sedentary behavior, also were addressed by Wang *et al*.

Evidence Synthesis

Findings from the Waters *et al* review and meta-analysis of school-based programs designed to prevent obesity in children demonstrated effectiveness as assessed by change in BMI or BMIz. The effect estimate was a BMI/BMIz reduction of 0.15 kg/m² (95% CI: -0.21, -0.09) which corresponds to a small but clinically important shift in population BMI/BMIz if sustained long term. The intervention effects by age subgroups were: -0.26 kg/m² (95% CI: -0.53, 0.00) for ages 0 to 5; -0.15 kg/m² (95% CI: -0.23, -0.08) for ages 6 to 12; and -0.09 kg/m² (95% CI: -0.20, 0.03) for ages 13 to 18.

Heterogeneity was apparent in all three age groups and could not be explained by randomization status or the type, duration, or setting of the intervention.

Over half of the school-based interventions included in Wang *et al* reported statistically significant beneficial effects of the intervention compared with a control group in at least some of the body weight–related measures, such as BMI, BMI z-score, prevalence of overweight and obesity, waist circumference, skinfold thickness, and body fat percentage. In general, intervention groups experienced a smaller increase over time relative to the control group. Additionally, almost all of the studies that reported results regarding intermediate outcomes detected some statistically significant desirable effects, such as increased fruit and vegetable consumption or increased physical activity. Approximately half of the studies that evaluated clinical outcomes reported some statistically significant desirable effects, predominantly regarding blood pressure reduction.

Evidence indicates that multi-component school-based interventions, combining strategies targeting diet and physical activity at school, at home, and/or within a community are most effective for preventing childhood obesity. In addition, longer term interventions (>6 months) are more likely to have lasting effects than short-term interventions (3-6 months). A wide range of strategies was implemented in these studies. While it is not possible to distinguish which of these components contributed most to the beneficial effects observed, the synthesis indicates the following to be promising policies and strategies:

- School curricula that includes healthy eating, physical activity, and body image;
- Increased opportunities for physical activity throughout the school week;
- Improvements in the nutritional quality of foods available in schools;
- Environments that support healthier eating behaviors and physical activity throughout the day;
- Support for teachers and other school staff to implement health promotion strategies and activities (e.g., professional development and capacity building activities); and
- Parental support and home activities that encourage children to be more active, eat more nutritious foods, and spend less time being sedentary.

Overview Table

Summary of systematic review examining school-based approaches and dietary intake, quality and behavior			
Author, Year Study Design AMSTAR Score* Number of Included Studies	Purpose of Review Subject Population Location of Included Studies	Independent Variable Outcomes	Results
<p>Waters, 2011</p> <p>Systematic review/meta-analysis</p> <p>AMSTAR Score: 11/11</p> <p>55 studies (81 papers): all randomized controlled trials or controlled trials</p> <p>Meta-analysis included 37 studies</p>	<p>Updated Cochrane review of childhood obesity prevention research to determine the effectiveness of interventions intended to prevent obesity in children, assessed by change in Body Mass Index (BMI).</p> <p>Meta-analysis: included 27,946 children; majority of studies targeted children aged 6-12 y: Aged 0-5 y - 8 studies Aged 6-12 y - 39 studies Aged 13-18 y - 8 studies</p> <p>Location: 26 studies in the US 6 studies in the UK 4 each in Australia/New Zealand, France 2 each in Canada, Germany, the Netherlands 1 each in Belgium, Italy, Spain, Sweden</p>	<p>Independent variables: educational, health promotion and/or psychological, family, behavioral therapy, counseling or management interventions that focused on diet, PA or lifestyle support, or both</p> <p>Outcomes: changes in BMI,</p>	<p>The best estimate of effect on BMI was of a 0.15kg/m² reduction (95% confidence interval (CI): -0.21 to -0.09), which would correspond to a small but clinically important shift in population BMI if sustained over several years.</p> <p>Intervention effects by age subgroups 0-5 y: -0.26kg/m² (95% CI:-0.53, 0.00) 6-12 y: -0.15kg/m² (95% CI -0.23, -0.08) 13-18 y: -0.09kg/m² (95% CI -0.20, 0.03)</p>

	4 in upper middle-income countries (2 in Brazil; 1 each in Chile, Mexico) 1 in lower middle-income country (Thailand)	prevalence of obesity and rate of weight gain	
<p>Wang, 2013</p> <p>Systematic review</p> <p>AMSTAR Score: 11/11</p> <p>61 studies: randomized controlled trials, controlled trials and natural experiments</p>	<p>Assess effectiveness of childhood obesity prevention interventions that aimed to improve diet, PA or both, that were conducted in schools, homes, primary care clinics, childcare settings, the community or combinations of these settings in the US and other very high-income countries.</p> <p>For school-based questions, children aged 5-18 y</p> <p>Location: 23 studies in the US 4 each in Australia, Germany, Greece 3 each in Canada, Spain, Sweden, UK 2 each in France, Italy, New Zealand 1 each in Austria, Belgium, Chile, Iceland, Norway, Poland, Portugal, Switzerland</p>	<p>Independent variables: school-based obesity prevention interventions;</p> <p>Outcomes: BMI, waist circumference, % body fat, skinfold thickness, prevalence of obesity and overweight</p> <p>37 studies assessed the effect of a combined diet and physical activity intervention on weight-related outcomes</p>	<p>Two RCTs, described in three articles, evaluated the effects of diet interventions on weight-related outcomes and showed a decrease in BMI or BMI z-score measures over a period of at least 1 year. These studies were specifically designed to prevent weight gain, and focused on promoting a healthy diet and reducing the consumption of carbonated drinks.</p> <p>Intervention studies with significant impact had a duration of 52 to 156 weeks. Children who followed long-term intervention programs showed significant positive changes in physical performance, whereas children in shorter studies had non-significant results. Similarly, the long studies had a significant effect on energy intake, reduced consumption of sweetened beverages, and increased FV intake.</p> <p>Combination interventions show a low strength of evidence that they are effective at reducing BMI, BMI z-score, prevalence of obesity and overweight, percent body fat, waist circumference, and skinfold thickness. Studies reporting on these outcomes were designed to affect weight gain and included intensive classroom physical activity lessons led by trained teachers, moderate to vigorous physical activity sessions, nutrition education materials, and promoting and providing a healthy diet.</p>
<p>*Quality assessed by AMSTAR (Shea, 2007: http://www.ncbi.nlm.nih.gov/pubmed/17302989)</p>			

Assessment of the Body of Evidence

Quality and Quantity: Collectively, the evidence base includes 108 independent, controlled trials among school-aged children, evaluated in two rigorous systematic reviews, one of which includes a quantitative meta-analysis. The reviews/meta-analysis are of high-quality with AMSTAR scores of 11 out of 11 possible points.

Consistency: Across individual studies and reviews, school-based approaches consistently improved weight-related outcomes among children aged 6-12 years. Data were limited among adolescents. Both reviews indicate that multi-component approaches are more effective than single-component programs. A high degree of heterogeneity of results and variable (mostly moderate) risk of bias among the included studies warrant interpreting the findings with caution.

Impact: The studies included in the reviews specifically evaluated the impact of the interventions on weight-related outcomes. The magnitude of effect was deemed to be clinically significant; yet the public health significance is difficult to assess because of different approaches and methodology.

Generalizability: Collectively, the studies included in the reviews were geographically diverse (both nationally and internationally) and applicable to school-aged children throughout the U.S. Some studies specifically targeted groups of

children who were disadvantaged and/or racially or ethnically diverse. Despite some studies analyzing the outcomes by gender, race, and/or socio-economic status, strong conclusions could not be drawn for any subgroups.

Limitations: While the included reviews were of high quality, the authors of the individual reviews noted the high heterogeneity of results among studies.

Implications*

Existing evidence indicates that school-based programs designed to improve the food environment and support healthy behaviors may effectively promote improved dietary intake and weight status of school-aged children. Programs that emphasize multicomponent, multidimensional approaches (including increased physical activity) are important to changing behavior and need to be reinforced within the home environment, as well as the community, including neighborhood food retail outlets that surround schools. Policies should strive to support effective programs that increase availability, accessibility, and consumption of healthy foods and beverages, while reducing less healthy competitive foods and beverages. The combination of economic incentives along with specific policies can increase the likelihood that specific approaches will be effective.

The recently updated USDA nutrition standards for school meals and snacks and beverages sold in schools will ensure that students throughout the U.S. will have healthier school meals and snack and beverage options, but schools need support and active engagement from students, parents, teachers, administrators, community members, and their districts and states to successfully implement and sustain them.

Research Recommendations*

1. New research is needed to document the types and quantities of foods and beverages students consume both at school and daily before, during and after school-based healthy eating approaches and policies are implemented.

Rationale: Effective school-based approaches and policies to improve the availability, accessibility, and consumption of healthy foods and beverages, and reduce competition from unhealthy offerings, are central to improving the weight status and health of children and adolescents. Accurate quantification of the types and quantities of foods and beverages students consume before, during, and after approaches and policies are implemented is fundamental to assessing effectiveness. However, many of the studies included in the systematic reviews and meta-analyses used by the 2015 DGAC to address this issue did not comprehensively measure or report dietary information. While the USDA/FNS-sponsored School Nutrition Dietary Assessment (SNDA) series collects student dietary intake data every 10 years, the DGAC recommends more frequent and consistent data collection, especially before and periodically after implementation of school-based nutrition and physical activity policy and program changes.

2. Improvements are needed in the quality of research studies designed to assess the effects of school-based approaches and policies on dietary behaviors and body weight control to reduce the risk of bias, with an emphasis on randomized control trials.

Rationale: While the methodological quality of the systematic reviews and meta-analyses used by the 2015 DGAC to evaluate school-based approaches and policies on dietary intake and body weight outcomes was high, the authors of these reviews commented that the scientific quality of individual studies was generally poor and the risk of bias high. Many of the studies were done using quasi-experimental (with or without control), pre-post intervention, or cross-sectional designs. Future research should prioritize using prospective, repeated measures, randomized control trial experimental designs, with randomization at the individual, classroom, school, or school

district level. Feasibility studies may also be helpful to more quickly identify promising novel approaches to improve dietary intake and weight control outcomes.

3. Post-program follow-up assessments lasting >1 year are needed to determine the longer-term retention of changed nutrition behaviors as well as the usefulness of continuing to offer the programs while children advance in school grade. Also, more research is needed in adolescents (grades 9-12).

Rationale: Literature supports that eating and physical activity behaviors and body weight status of children are predictive of changes over time as they progress into adolescence and adulthood. Ideally, improvements in dietary intake and weight status achieved due to a given school-based approach or policy would be sustained over time and progressive improvements would occur long-term. The vast majority of published research focuses on children in grades K-8, or ages 4-12 years, and new and improved data are needed on adolescents and the transition from childhood to adolescence.

4. A wider variety of innovative school-based approaches and policies are needed to increase vegetable intakes.

Rationale: Consumption of non-potato vegetables is below 2010 Dietary Guidelines for Americans recommendations in both children and adolescents. Published research indicates that school-based approaches and policies designed to increase fruit and vegetable intakes are generally more effective at increasing fruit intake – the documented exceptions being school gardens and economic incentives, which increase vegetable intake among school-aged children. Some past public policies (e.g. the Basic 4) treated fruits and vegetables as a single food group, which prompts the need for new research using prospective, repeated measures, randomized control trial experimental designs specifically targeting increased consumption of healthy vegetables.

*Because the schools questions are complementary, the Dietary Guidelines Advisory Committee chose to develop only one implication statement for the four questions along with collective research recommendations.

References

1. Wang Y, Wu Y, Wilson RF, Bleich S, Cheskin L, Weston C, Showell N, Fawole O, Lau B, Segal J. Childhood obesity prevention programs: comparative effectiveness review and meta-analysis. Comparative effectiveness review No. 115. AHRQ Publication No. 13-EHC081-EF. Rockville, MD: Agency for Healthcare Research and Quality; June 2013. <http://www.ncbi.nlm.nih.gov/pubmedhealth/PMH0057623/pdf/TOC.pdf>
2. Waters E, de Silva-Sanigorski A, Hall BJ, Brown T, Campbell KJ, Gao Y, et al. Interventions for preventing obesity in children. Cochrane Database of Systematic Reviews. 2011; (12). Available from: <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD001871.pub3/abstract>