Comparative Effectiveness Review
Number 204

Methods for Evaluating Natural Experiments in Obesity: Systematic Evidence Review

Agency for Healthcare Research and Quality

Effective Health Care Program

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Purpose of Review

To characterize studies of programs and policies in obesity prevention and control in terms of data sources, data linkages, measures reported, study designs, and analytic approaches, and to identify needed methodological advances.

Key Messages

- Relevant programs, policies, or built environment changes were evaluated in 156 natural experiments, 118 experimental studies, and 20 other studies.
- Criteria for a data system (source exists, is available for research, is sharable, and has outcomes of interest) were met by 106 data sources.
- Thirty-seven percent of U.S. data systems were linked to secondary data.
- Outcome measures included dietary behavior (148 studies), physical activity (152 studies), childhood weight (112 studies), and adult weight (32 studies).
- Natural experiments most commonly used regression models comparing exposed and unexposed groups at one time.
- Natural experiments generally had moderate risk of selection bias and high risk of bias for losses to follow-up.
- Research could be advanced by more use of data dictionaries, reporting standards on data linkage, long-term obesity-related outcomes, and study designs with multiple pre- and post-exposure time points.

This report is based on research conducted by the Johns Hopkins University Evidence-based Practice Center (EPC) under contract to the Agency for Healthcare Research and Quality (AHRQ), Rockville, MD (Contract No. 290-2012-00007-I). The findings and conclusions in this document are those of the authors, who are responsible for its contents; the findings and conclusions do not necessarily represent the views of AHRQ. Therefore, no statement in this report should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services.

None of the investigators have any affiliations or financial involvement that conflicts with the material presented in this report.

The information in this report is intended to help health care decisionmakers—patients and clinicians, health system leaders, and policymakers, among others—make well-informed decisions and thereby improve the quality of health care services. This report is not intended to be a substitute for the application of clinical judgment. Anyone who makes decisions concerning the provision of clinical care should consider this report in the same way as any medical reference and in conjunction with all other pertinent information, i.e., in the context of available resources and circumstances presented by individual patients.

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This report may periodically be assessed for the currency of conclusions. If an assessment is done, the resulting surveillance report describing the methodology and findings will be found on the Effective Health Care Program Web site at www.effectivehealthcare.ahrq.gov. Search on the title of the report.

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Preface

The Agency for Healthcare Research and Quality (AHRQ), through its Evidence-based Practice Centers (EPCs), sponsors the development of systematic reviews to assist public- and private-sector organizations in their efforts to improve the quality of health care in the United States. These reviews provide comprehensive, science-based information on common, costly medical conditions, and new health care technologies and strategies.

Systematic reviews are the building blocks underlying evidence-based practice; they focus attention on the strength and limits of evidence from research studies about the effectiveness and safety of a clinical intervention. In the context of developing recommendations for practice, systematic reviews can help clarify whether assertions about the value of the intervention are based on strong evidence from clinical studies. For more information about AHRQ EPC systematic reviews, see www.effectivehealthcare.ahrq.gov/reference/purpose.cfm.

AHRQ expects that these systematic reviews will be helpful to health plans, providers, purchasers, government programs, and the health care system as a whole. Transparency and stakeholder input are essential to the Effective Health Care Program. Please visit the Web site (www.effectivehealthcare.ahrq.gov) to see draft research questions and reports or to join an email list to learn about new program products and opportunities for input.

If you have comments on this systematic review, they may be sent by mail to the Task Order Officer named below at: Agency for Healthcare Research and Quality, 5600 Fishers Lane, Rockville, MD 20857, or by email to epc@ahrq.hhs.gov.

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Technical Expert Panel

In designing the study questions and methodology at the outset of this report, the EPC consulted several technical and content experts. Broad expertise and perspectives were sought. Divergent and conflicted opinions are common and perceived as healthy scientific discourse that results in a thoughtful, relevant systematic review. Therefore, in the end, study questions, design, methodological approaches, and/or conclusions do not necessarily represent the views of individual technical and content experts.

Technical Experts must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential conflicts of interest identified.

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Prior to publication of the final evidence report, EPCs sought input from independent Peer Reviewers without financial conflicts of interest. However, the conclusions and synthesis of the scientific literature presented in this report do not necessarily represent the views of individual reviewers.

Peer Reviewers must disclose any financial conflicts of interest greater than $10,000 and any other relevant business or professional conflicts of interest. Because of their unique clinical or content expertise, individuals with potential nonfinancial conflicts may be retained. The TOO and the EPC work to balance, manage, or mitigate any potential nonfinancial conflicts of interest identified.

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Methods for Evaluating Natural Experiments in Obesity: Systematic Evidence Review

Structured Abstract

Objectives. Obesity is an enormous public health problem among adults and children. Our objective was to systematically review studies evaluating programs and policies addressing obesity prevention and control in terms of their population-based data sources, use of data linkages, measures reported, study designs, and analytic approaches. The overarching goal of the review was to identify methodological advances that could strengthen research that uses natural experiments to evaluate the effectiveness of policies and programs to prevent and control obesity.

Data sources. We systematically searched PubMed®, CINAHL®, PsycINFO®, and EconLit from 2000 to August 21, 2017, to identify all U.S. and non-U.S. studies of programs or policies targeting obesity prevention and control in people of all ages and in any setting.

Review methods. Two independent reviewers screened abstracts and full-text articles. We required articles to be in English; address a program, policy, or built environment change; include 100 or more study subjects; and have a defined comparison or unexposed group. We used the Effective Public Health Practice Project (EPHPP) tool to rate studies for their risk of bias. This tool rates studies for their ability to draw causal inferences about program effectiveness.

Results. The search identified 26,316 unique citations. Of the 294 studies (reported in 312 articles) eligible for inclusion (188 U.S. and 106 non-U.S.), 156 (53%) were natural experiment studies, 118 (40%) were experimental studies (randomized or nonrandomized controlled trials), and 20 (7%) had other study designs that did not fall into either of the other categories.

Data sources: We identified 143 secondary data sources and 26 sharable primary data sources, totaling 116 sharable data sources after duplicates were removed. Criteria for a data system (data source exists, is available for research, is sharable, and contains outcomes of interest) were met by 106 data sources (71 U.S. and 35 non-U.S.). Sixty-two percent of the U.S. data systems contained at least one of the main measures for weight or body mass index in adults or children, or dietary or physical activity behaviors. Fifty-three percent of the U.S. data systems included at least one outcome related to the food environment, physical activity environment, commuting behavior, or purchasing behavior, or included information about a relevant exposure in a policy, program, or built environment change. These 71 U.S. data systems often reported more than one outcome. Thirty-seven percent of the U.S. data systems were linked with a secondary data source or system other than the primary data source. Most studies that linked their data systems with external data systems used an individual-level key or a geographic allocation.

Outcomes/measures: Of the 294 included studies, we identified 112 studies with childhood weight measures, 32 studies with adult weight measures, 152 studies with physical activity measures, and 148 studies with dietary measures. Thirty-seven of the 294 studies reported on

outcomes related to the food environment, physical activity environment, commuting behavior, or purchasing behavior.

Study design and methods: Natural experiment studies most commonly used cross-sectional comparisons of exposed and unexposed groups (n=55; 35%). Difference-in-differences approaches that compared exposed and unexposed groups before and after an exposure were used in 45 studies (29%), while 48 studies (31%) used pre/post designs that compared one group before and after an exposure. Most natural experiment studies were rated as having a "weak" global rating (i.e., high risk of bias), with 63 percent having a weak rating for handling of withdrawals and dropouts, 42 percent having a weak rating for study design, 40 percent having a weak rating for confounding, and 26 percent having a weak rating for data collection. Experimental studies were rated as "strong" (low risk of bias) in study design, control of confounding, and data collection methods, but were weaker in blinding and selection bias. We identified methodological and analytic advances that would help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control, such as consistent use of data dictionaries, reporting standards on linkage methods of data sources, data sources with long-term public health surveillance of obesity and health behavioral outcomes, and use of study designs with multiple pre- and post-exposure time points.

Conclusions. Our systematic review identified numerous natural experiment studies (n=156) and data sources, including sharable and non-sharable data sources (n=216), that have been used to estimate the effect of programs, policies, or built environment changes on obesity prevention and control. The studies used a wide variety of outcome measures and analytic methods, often with substantial risk of bias. The findings reinforce the need for methodological and analytic advances that would strengthen efforts to improve obesity prevention and control.

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Introduction

Background

Obesity and Its Public Health Consequences

The prevalence of overweight and obesity among adults and children has increased dramatically in the United States in recent years.[1] Seventeen percent of U.S. children and adolescents are obese[2, 3] and 69 percent of adults are overweight or obese.[4] Obesity is now a worldwide epidemic, according to the World Health Organization, with an estimated 1.9 billion adults overweight or obese globally.[5, 6] Obesity is associated with multiple adverse health consequences, including type-2 diabetes, cardiovascular disease, and many cancers,[7-10] which have, in part, led to rising health care costs.[8, 11] Economic implications of obesity also include higher absenteeism and reduced work productivity.[12]

The drivers of the obesity epidemic are complex, and involve intertwined, multilevel, and dynamic forces that influence health behaviors related to eating and physical activity, food systems, and access to physical activity-friendly environments.[13, 14] Therefore, the search for effective solutions to prevent and control obesity needs to extend beyond the focus on the individual, to address the local neighborhood context, as well the social/cultural/political context unique to regions and countries.[6] Since obesity is associated with racial and socioeconomic disparities,[15] to successfully address obesity, we ultimately need programs and policies that can also reduce social and health inequities.

Framework for Change: Public Health Policy and Neighborhood Approaches to Obesity Prevention and Control

In 2012, the Institute of Medicine (IOM) (see Appendix A for a list of acronyms) released a report entitled *"Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation."*[16] The goal of the report was to evaluate strategies for their potential to prevent obesity. The Report identified several broad policy and programmatic goals, including making physical activity a routine part of life, creating a food/beverage environment that includes healthy options, creating messaging that can help to improve physical activity and nutrition, and using schools as an important focus. In addition, the report presented a "systems approach," suggesting five critical areas—or environments for change: (1) environments for physical activity, (2) food and beverage environments, (3) message environments, (4) health care and work environments, and (5) school environments.

Aligned with the targets recommended by the IOM Report, non-governmental and governmental policies have been enacted and implemented. Examples include a sugar-sweetened beverage tax in Berkeley, California,[17] menu or calorie-labeling regulations in New York City,[18-20] and supporting new supermarkets in food deserts.[21] In addition, many school systems have developed programs aimed at increasing children's fruit and vegetable consumption, and increasing time spent outside during recess.[22, 23] Rigorous published evaluations of these policies and programs, including those whose goal is to promote increased physical activity and active transportation, are enhancing the evidence base and increasing the ability of policymakers and funders to adapt, scale and disseminate those that are effective.[24]

Individual or group-based behavioral programs have been the cornerstone of effective weight loss interventions in adults.[25] In their recommendations to increase physical activity and improve nutrition, the Centers for Disease Control and Prevention (CDC) included both the “systems” approach, as well as individually-focused, behaviorally-oriented programs to guide individuals in making changes in behavior.[26, 27] Many behavioral interventions involve in-person or remotely delivered (phone/ mobile phone/ internet based) behavioral counseling to enhance individuals’ motivation to make and sustain decreased caloric intake and increased physical activity.[28] Though often effective for short-term weight loss, the challenge with individually-focused interventions has been our ability to scale and sustain them in a community or healthcare setting. One example of a successfully scaled program is called CHAMPS (Community Healthy Activities Model Program for Seniors). After it was shown to be effective in a randomized controlled trial (RCT), CHAMPS was adapted for diverse communities and scaled for delivery in senior centers in San Francisco, California.[29] The most recognizable behavioral weight loss trial, aimed at preventing type 2 diabetes in overweight adults, was the Diabetes Prevention Program (DPP).[30] This intervention has been adapted as a community program and is being widely disseminated through the CDC’s National DPP program, with in-person and remotely-delivered classes in over 1,200 programs in the United States.[31]

Challenges in Evaluating Programs, Policies, and Built Environment Changes Aimed at Preventing or Controlling Obesity

Challenges in evaluating obesity interventions stem in part from the complexity of the obesity problem, which tends to thwart interventions that focus on single and even multiple drivers of the problem, and in part from a lack of standards for designing and evaluating interventions.[6] Evaluations need to take advantage of existing data sources; link policy, program or transportation data with clinical or health data, such as electronic health records (EHRs); and follow populations over time to assess impact. The National Institutes of Health, through multiple funding opportunity announcements and meetings, and the Patient Centered Outcomes Research Institute have invested in two types of studies to tackle the obesity epidemic: 1) traditional study designs involving a pragmatic clinical trial to integrate obesity care into primary care for underserved populations;[32] 2) enhancement of the infrastructure of EHR data linked between health systems (called the Clinical Data Research Networks), to support observational studies about obesity.[33] However, RCTs of obesity-prevention and control policies and programs may not always be feasible or appropriate. Economic, urban planning, systems-modeling and legislative policy evaluation approaches are being adapted to answer questions about the health impact, as well as the environmental and unintended positive and negative consequences of programs and policies.[34, 35]

Natural Experiments To Address Obesity Prevention and Control

Novel approaches are needed to evaluate the effect of population health policies and programs, which are not always under the control of researchers using experimental designs. An important focus of this review is the opportunity to appraise and evaluate the approach known as a “natural experiment,” as well as other non-experimental designs, designed to study the effects of programs, policies, and changes to the built environment and social structures. Although natural experiments and other non-experimental designs are not new to public health, more publications are using the term "natural experiment," and non-experimental designs are growing in popularity.[36] For example, researchers used natural experiment approaches to examine the effect of regulation limiting the use of serotonin reuptake inhibitors in youth on suicide rates in the United Kingdom (UK),[37] and of tobacco control policies on hospitalizations for acute myocardial infarction.[38-40]

To summarize the methodology and provide a standard definition, The UK's Medical Research Council (MRC) recently released guidance to assist researchers in conducting and evaluating the rigor of natural experiment designs.[41, 42]According to the MRC, the key features of a natural experiment are that "(1) the intervention is not undertaken for the purposes of research, and 2) the variation in exposure and outcomes is analyzed using methods that attempt to make causal inferences."[41, 42] Their natural experiment study definition was not limited to specific study designs. Applying the MRC definition to categorize existing studies is challenging, as few studies are explicitly labeled as natural experiments. In addition, the stage at which researchers and evaluators became involved with policies or programs may not always be clear, and even when it is, the degree of "control" the research team has may not be well described. Finally, although most studies using natural experiment approaches use non-experimental designs, it is also possible to embed a natural experiment within an RCT, such as the Moving to Opportunities study.[43] In this study, the U.S. Department of Housing and Urban Development randomly assigned people to receive a rental subsidy in a low poverty neighborhood, with the goal of assessing social and economic outcomes. While not explicitly calling their work a natural experiment, health researchers took advantage of a randomized design to collect data about diabetes and obesity. They showed that the group with the voucher had a lower prevalence of severe obesity and diabetes.[43]

The goal of natural experiment designs is to obtain an approximate estimate of causality of a policy, program, or built-environment change on a public health outcome. The major challenge is in the selection of an "unexposed" comparison group. Selection bias is a common source of bias in natural experiment approaches. Many non-experimental study designs, such as use of propensity scores, interrupted time series, and regression discontinuity, are useful in identifying appropriate comparison groups.[44] Most, but not all, natural experiment studies rely on existing data sources, and evaluating the strengths and limitations, and the types of measures these sources contain, is important to advancing future research.

The overarching goals of this review were to 1) improve understanding of the population-based data sources that have been used to evaluate programs, policies, and built environment changes designed to prevent or control obesity, and 2) identify methodological/analytic advances that would help strengthen future efforts to evaluate the programs, policies, and built environment changes related to obesity prevention and control. This review focuses on methods and does not evaluate the effectiveness of the programs and policies on the outcomes of interest. The review has a broad scope, including both natural experiment and experimental studies, to identify evaluations of programs, policies and built environment changes that aimed to prevent or control obesity in children and adults.

Approach to Review and Identification of Key Questions

The Key Questions were identified to inform the *Pathways to Prevention* Workshop *Methods for Evaluating Natural Experiments in Obesity*. The results of this systematic review will provide background on the state of the evidence for this Workshop. To assist the reader, we also developed a glossary with definitions of key terms (Appendix B).

Our project sought to address the following Key Questions (KQs):

KQ1. What population-based data sources have been used in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

KQ2. What methods have been used to link different population-based data sources?

KQ3. What obesity measures, dietary and physical behaviors, and other outcomes have been assessed in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control?

KQ4. Which experimental and non-experimental methods have been used in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

KQ5. What are the risks of bias in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

KQ6. What methodological/analytic advances (e.g., data system features, approaches to linking data sources, or analytic methods) would help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control?

Scope of Review and PICOTS

We used the PICOTS typology (Populations, Interventions, Comparators, Outcomes, Timing, Setting) as a framework to define the scope of the review and inform the selection of studies of programs, policies or built environment changes targeting obesity. The PICOTS typology is a standard framework used in systematic reviews to be explicit and transparent about the inclusions/exclusions, search methods, study selection and data extraction, and is informative for discussions with stakeholders. Below we provide a rationale for the inclusion/exclusion criteria by PICOTS category,[45] displayed in Table 1.

Populations

Studies were included if they targeted a community, school, or worksite population, with participants of any age. We included studies focused on one sub-population, i.e., studies conducted only within overweight or obese people. We excluded studies focused within other clinical sub-populations, such as people who had bariatric surgery or children with Prader-Willi syndrome, a genetic disorder.

Interventions

We included studies of programs, policies or built environment changes targeting population-level behavior change, such as increased physical activity or healthier diet. We included programs, policies or built environment changes that may not have been originally developed for obesity control or prevention purposes, but were evaluated for this purpose. We excluded very broad policies that had very diffuse effects, such as the impact of cigarette taxes on obesity.[46] We also excluded individually-focused behavioral interventions such as individual or group-based counseling programs.

Table 1. PICOTS framework applied to Key Questions, with inclusions and exclusions described

PICOTS	Inclusions and Exclusions
Population(s)	**Include**: • All ages, general population; and sub-populations of obese and overweight individuals **Exclude**: • Studies within specific clinical populations only, other than obese/overweight populations (e.g., severe mental illness, people with genetic predispositions for obesity).
Intervention(s)	**Include**: • U.S. and non-U.S. policies, programs, and built environment changes targeting a population. **Exclude**: • Programs or policies targeting individual-level intervention and change (not a system or population-level), e.g., Weight Watchers with individual or group-based behavioral counseling. [Note: if the program or policy includes multiple levels of intervention (e.g., population-level and individual-level) it would be included.] • School-based studies that occur in a single school in the district. • School-based studies that only involve a change to the curriculum without an environmental or systems change (e.g., nutrition education change in the health class).
Comparator(s)	**Include**: • Studies with a clearly defined concurrent or non-concurrent comparison group either prior to the policy or a defined group without exposure to the policy or program • Observational or cohort studies that use regression models to assess the association of a policy or program on an exposed versus an unexposed group. **Exclude**: • Studies without a comparison or unexposed group.
Outcome(s)	**Include**: *Outcomes of interest:* • Body weight • Body mass index • Individual physical activity behavior assessed using a validated questionnaire that assesses both quantity and type of activity, or measures physical activity objectively (e.g., step counts). • Individual dietary intake assessed using a validated questionnaire or 24-hour dietary recall, measuring one or more of the following: - Total daily caloric intake, - Specific dietary macronutrients related to obesity: vegetable, fruit, or fiber intake. - Specific eating behaviors associated with obesity: sugar sweetened beverage intake, or fast food frequency. *Co-outcomes*: Co-outcomes were described among included studies which had at least one “outcome of interest.” Co-outcomes were defined by the following categories: food-environment (e.g., perceived access to fruits and vegetables), physical activity environment (e.g., walkability, observed physical activity at a park or bike path), commuting behavior, and food purchasing behavior. **Exclude**: • Studies without reference for validation or use of a validated instrument to measure diet or physical activity. • Studies with observed behaviors as their only outcomes, such counts of people using a park or walking path, and studies using the SOPARC/SOPLAY tool for assessing physical activity at a park.
Timing	Programs and policies enacted or implemented in 2000 or later. The *U.S. Surgeon General's Call To Action To Prevent and Decrease Overweight and Obesity* was published in 2001 and marked a turning point to raise public health awareness about obesity.[47]

PICOTS	Inclusions and Exclusions
Setting	**Include**: • U.S. and non-U.S. settings at all levels (e.g., national, state, community/neighborhood). **Exclude**: • Studies in specific settings that would not be generalizable to a free-living population or community (e.g., prison, nursing home) • Studies in countries listed below the 2016 "human development index" (HDI) of "very high".[48]

PICOTS: populations, interventions, comparators, outcomes, timing, setting;SOPARC/SOPLAY=system for observing play and recreation in communities/system for observing play and leisure activity in youth

Comparators

We required studies to have a concurrent or non-concurrent comparison or unexposed group. We did not exclude studies based on other elements of study design, as the goal was to broadly describe the obesity natural experiment field and all study design approaches ranging from the strongest designs like RCTs to non-experimental approaches that defined an unexposed group. We did not want to exclude any study designs that had a comparison group, but rather wanted to describe the strengths and limitations of all approaches identified. In addition, evaluations of community- or school-based programs, policies and built environment changes employ a wide range of study designs from experimental to non-experimental. Community-wide obesity prevention studies, like The Massachusetts Childhood Obesity Research Demonstration Study, contain multiple programmatic and policy components, making it more difficult to discern at what point researchers become involved in the design and implementation.[49-51] Therefore, we sought to describe the breadth of these approaches, the data sources and outcome measures they used, and the risks of bias associated with the designs, ultimately, to inform future research to advance obesity prevention and control.

Outcomes and Measures

We focused on clinically relevant outcomes in adults and children, including weight and body mass index. We also included studies that reported on two main weight-related individual health behaviors, diet and physical activity. Defining the behavioral outcomes of dietary change and physical activity was challenging because many instruments rely on self-report, resulting in varying degrees of comprehensiveness, validity, and reliability.[52] We categorized measures consistent with The National Collaborative on Childhood Obesity Research (NCCOR) Measures Registry[53] for children's measures, as well as the literature for adult measures.[54] The NCCOR organizes the measures into Individual Diet, Food Environment, Individual Physical Activity, and Physical Activity Environment. We applied similar categories.[53]

The field of obesity control and prevention has advanced to having a large number of natural experiment studies that address weight, dietary intake and physical activity behaviors,[18, 43, 55-62] so we excluded studies that only reported the food or physical activity environment or intermediate outcomes, such as measures of access to healthy food (e.g., stocking of shelves), fruit/vegetable purchases, distance to a park, or "walkability" of a neighborhood. We also excluded studies that only reported observed behaviors, such as the System for Observing Play and Recreation in Communities (SOPARC/SOPLAY),[63] which assesses usage of park and recreation areas by observation rather than quantitative measurement of an individual's change in type and quantity of physical activity. These studies record numbers of individuals engaged in certain activities, and do not measure duration of any of the activities. Finally, for all included studies, we reported on measures of the food-environment (e.g., perceived access to fruits and vegetables), physical activity environment (e.g., walkability, observed physical activity at a park or bike path), commuting behavior, or purchasing behavior, which we considered to be relevant “co-outcomes.”

Timing

We focused on programs and policies enacted or implemented in 2000 or later. The *U.S. Surgeon General's Call To Action To Prevent and Decrease Overweight and Obesity* was published in 2001 and marked a turning point to raise public health awareness about obesity. A previous systematic review also used 2000 as a starting date.[64] We also performed preliminary searching that showed an exponential increase in studies meeting our search criteria were published each year after 2000, with an increase in natural experiment approaches after 2005.[36]

Setting

We included studies evaluating policies, programs, and built environment changes within and outside the U.S. We excluded policies, programs, and built environment changes in countries below the 2016 “human development index” (HDI) of “very high,” to enhance consistency between programs and policies being evaluated across studies. The HDI is a composite statistic of life expectancy, education, and income per capita indicators. A country has a higher HDI when the life expectancy at birth is longer, the education period is longer, and the income per capita is higher. Fifty-one countries are listed in the “very high” HDI category.[48]

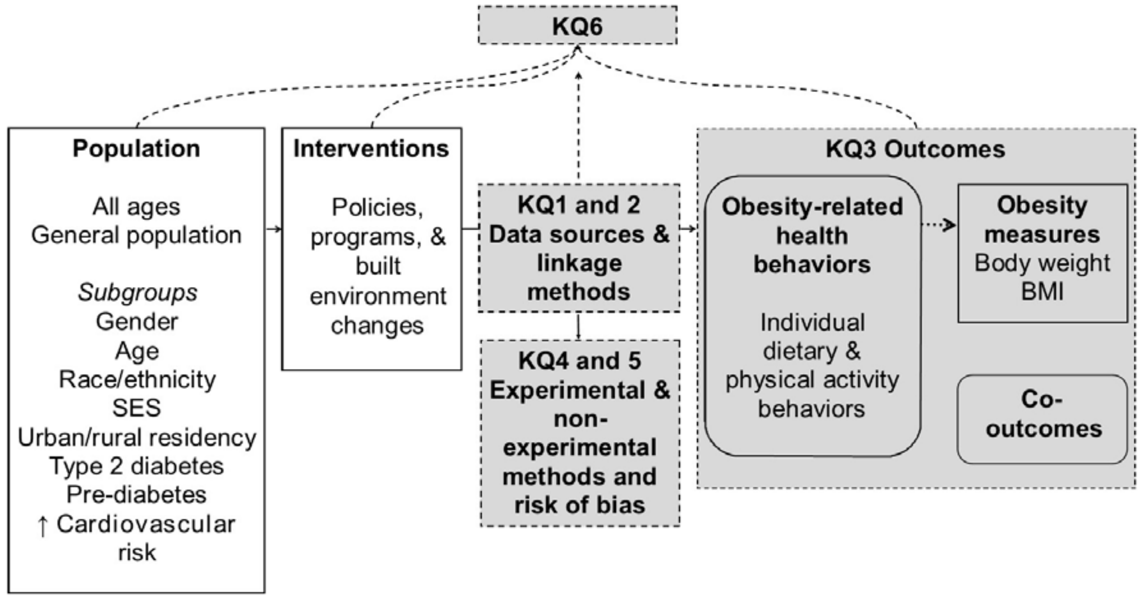
Analytic Framework

Figure 1 depicts the KQs within the context of the PICOTS described in the previous section (Table 1). The figure illustrates the review’s focus on identifying data sources and linkages. It also shows that the review assesses the study designs and analytic methods that have been used to evaluate these programs and policies so that future research opportunities can be identified.

Organization of Report

This report is organized by chapter. Each chapter represents either a main section of the report (i.e., Introduction, General Methods), or a KQ. Due to the complexity of the report, we present general methods and results in one chapter, and KQ-specific methods and results in their own chapters.

Figure 1. Analytic framework for obesity prevention and control



KQ=Key Question; SES=socioeconomic status

General Methods and Results

Methods

Search Methods

We conducted a systematic search of the published literature to identify studies focusing on programs and policies implemented for obesity prevention and control, including changes in the built environment. The results of this phase were used to address Key Questions (KQs) 1 through 5.

We searched PubMed, CINAHL, PsycINFO, and EconLit. A search strategy was developed for PubMed and used as a guide to develop search strategies for the other search engines. This search focused on identifying studies addressing obesity and behavioral changes impacting obesity. All databases were searched through August 21, 2017. Ten index articles identified by internal experts as applicable to this study were used during the search development. Terms used in the titles and abstracts, as well as relevant medical subject headings were identified in the index articles and used to develop the main search strategy. After the search strategy was developed, we tested it to ensure all index articles were captured.[18, 43, 55-62] Detailed search strategies are described in Appendix C, Tables C1 and C2.

The search was supplemented with a hand search to identify references in other relevant systematic and narrative reviews. This hand search was conducted in two phases. The first phase involved searching the references of relevant systematic reviews captured in the main search strategy. Reference articles were selected through independent screening by two trained and experienced co-investigators with backgrounds in adult and child obesity prevention. These individuals identified potentially relevant articles based on the inclusion and exclusion criteria described below. Titles identified in this phase of the hand searching process were added to the main database of studies for full inclusion/exclusion review.

The second phase of the hand search involved a search for systematic reviews in PubMed focusing on change in diet and physical activity outcomes without requiring any mention of obesity (detailed search strategy is described in Appendix C, Table C3). This search was developed using an additional set of index articles suggested by experts. Those index articles had not been identified by the original search strategy (which focused on finding articles that referred to obesity, overweight, or body mass index (BMI)).[65-71] If we had expanded the original search by not requiring any mention of obesity, overweight or BMI, we would have had an unmanageable number of citations to review. We decided that the best way to identify eligible studies that focused on diet and physical activity outcomes was to search for relevant systematic reviews from 2013 through July 2017. The systematic reviews were evaluated for applicability to this study by two individuals who were involved in the main search and screening protocol. If a systematic review was considered applicable after the abstract and full text was reviewed, references for the included articles in each review were identified, and added to the main pool of articles for inclusion or exclusion.

We limited the search to studies published between 2000 and August 21, 2017. This time frame was selected to encompass the U.S. Surgeon General's report, "The Surgeon General's Call To Action To Prevent and Decrease Overweight and Obesity," released in 2001 and calling attention to the major public health problem of obesity.[47] The publication of this report marked a shift toward directing public health funding and policies toward the prevention and control of obesity and sparked new research in this area. We gathered information on the number of articles captured using the original search strategy, and we identified the number of articles published per year. In 2000, the search captured 286 titles. This number steadily increased to 2698 in 2016.

Inclusion and Exclusion Criteria

The inclusion and exclusion criteria for the systematic review were derived from the PICOTS (populations, interventions, comparators, outcomes, timing, setting) framework (Table 1). We searched for all studies of programs, policies, or changes in the built environment targeting obesity prevention and control, change in physical activity behaviors, or change in diet behaviors, in people of any age to identify potential data sources.

Abstracts and full text articles were screened by two types of people (screeners). We included screeners who are considered "junior," meaning they are not experts in the field, are experienced research assistants working in systematic reviews, and are trained by the program manager to understand the inclusion and exclusion parameters of this project. "Senior" screeners are project leaders (principal investigators, investigators, and senior-level managers) who have either a clinical background on the topic of obesity prevention, or multiple years of experience developing and conducting systematic review screening processes. All abstracts, and all potentially relevant full text articles were reviewed by one junior screener and one senior screener. Agreement on inclusion or exclusion was required. Disagreements between screeners were discussed and, if they could not be resolved, were adjudicated by a third-party screener.

Abstracts were excluded for the following reasons:

- No original data
- Study of fewer than 100 participants total
- Does not address a change in the built environment or is not a population-based program or policy
- No comparison group, unexposed group, or pre-post comparison
- Studies in a setting not generalizable to a free-living population or community
- Study *only* targets a specific clinical sub-population (e.g., children with Prader Willi syndrome or people with severe mental illness) other than obese and overweight populations. Note if a sub-population was included within the broader population, study was not excluded.
- Not relevant to the KQs
- No abstract
- No human data reported
- Not in English
- Protocol of a relevant study not reporting preliminary data

Full-text articles were excluded for the reasons above as well as the following:

- Outcomes were outside of the parameters of this review (see Table 1 for outcomes list)
- Study measured only a specific micro/macronutrient or dietary health behavior
- Meeting abstract
- Policy or program was not focused on obesity or nutrition-related structural or environmental changes

- Programs and policies enacted or implemented prior to 2000
- Study conducted in a single school.
- A school-based policy or program that only included a curriculum change without evidence of a structural or environmental component
- Study took place in a country that does not have a "very high Human Development Index (HDI)," based on the United Nations Development Programme, Human Development Reports.[72] The HDI is a composite statistic of life expectancy, education, and income per capita indicators. A country has a higher HDI when the life expectancy at birth is longer, the education period is longer, and the income per capita is higher.

We included studies that reported on at least one of the following outcomes of interest: obesity measures (either body weight or BMI in adults or BMI z-score or BMI percentile in children) or obesity-related individual health behaviors (dietary and physical activity) (Table 1 lists the outcomes of interest in detail).

Data Abstraction and Data Management

We used Distiller SR software (Evidence Partners, Ottawa, Canada) for data collection and reporting during the review process. Distiller SR is a Web-based data management program for systematic reviews and literature reviews that manages all levels of the review process. Data from applicable studies was abstracted in Distiller SR using predefined data abstraction forms (Appendix D) and will be uploaded to the Systematic Review Data Repository™ (SRDR), a Web-based data repository, at the completion of this project. This source serves as both an archive and a data abstraction tool. Data will be exported to SRDR in a project-specific database to serve as archived or backup copies and to create detailed evidence and summary tables.

Data Abstraction Overview and Process

For each included study, two trained research assistants abstracted data about the study's characteristics (e.g., year of publication, country), study design, participants and populations, the policy and/or program evaluated, year of enactment, type of legislation/policy, location of policy (e.g., state, country, locality), original goal of policy/program (diet, physical activity, both, other), data sources and linkages, and analytic methods. See below for additional data abstraction elements by KQ. We also assessed how each of the outcomes was measured and whether a validated reference for instruments was provided.

After the data were abstracted, an independent data abstraction expert reviewed a random sample for quality assurance. Data abstraction experts were project leaders (principal investigators, investigators, and senior-level managers) who have either a clinical background on the topic of obesity prevention, or multiple years of experience developing and conducting systematic review screening processes. Inconsistencies in data abstraction were resolved by a consensus approach involving the research assistants and the expert reviewer. If consensus was not attainable for a specific case, it was discussed among the project leaders (principal investigators, investigators, and senior-level managers) and resolved by a majority vote. The same process was used for all data abstraction activities throughout this project.

Grading Strength of Evidence

We assessed the overall risk of bias in the studies as described above. We did not evaluate the overall strength of evidence for a particular comparison or outcome as we are not assessing the comparative effectiveness of policies or programs (interventions) in this review. Thus, we did not assess other domains of strength of evidence, such as consistency between studies, precision of estimated effects, or whether studies provided direct estimates of effects on the most important outcomes of interest.

Assessing Applicability

We assessed applicability in terms of the PICOTS framework, as well as in terms of each of the KQs.

General Data Abstraction

Study and Participant Characteristics

Study and participant characteristics were abstracted for all included studies. Table 2 lists the study and participant characteristic categories and details abstracted. See Appendix D for the data abstraction form.

Because of the focus of this review on methods for natural experiment studies on obesity, we classified studies as either natural experiment studies, experimental studies, or other study designs. We used the definition of a natural experiment as proposed by the MRC (see Appendix B).[41] Studies in which the researchers had control of the intervention and assigned participants or communities to intervention and control conditions were classified as experimental studies, which included both RCTs and controlled clinical trials. When the intervention was assigned to intervention and control groups by factors outside of the control of investigators, we classified the study as a "natural experiment study." Studies for which there was not sufficient information on the assignment mechanism to determine whether a natural experiment or experiment approach was used were labeled as "other study design." Study designs were further classified in the description of Methods for KQ 4.

Interventions: Policy, Program, or Built Environment Change

Intervention details were abstracted for all included studies. A number of studies included multiple interventions. Each intervention was abstracted. Table 3 lists the information abstracted about the interventions. The categories for the intervention targets were based on the 2012 Institute of Medicine (IOM) Report.[16] See Appendix D for the data abstraction form.

Table 2. Study and participant characteristics abstracted

Study Characteristic	**Details**
Study Design (see below)	Natural experiment study Experimental study Other study design
Study Dates	Start date End date Not reported
Community Type	Urban Suburban Rural Not described
Study Setting	Early childhood education or daycare (e.g., pre-school, Head Start) School: elementary (K-5); middle (6-8); high (9-12); other University After school or summer school Senior center Community center (e.g., job training, youth) Community or neighborhood (e.g., parks, farmers markets) Employer or worksite Transportation (e.g., train, bus, car, walking) Other Settings
Inclusion and Exclusion Criteria	● Define whether the criteria applied to individuals, site, or not specified ● Specific criteria: Sex Age Race/ethnicity Other
Participant Characteristics	
Comparison Group	Identification of all comparison groups in the study
Population Size	Baseline N, follow-up period, and N at last follow-up for each comparison group.
Baseline Data	Sex Age category or grade category Pre-intervention weight or BMI (adult): weight; BMI; BMI category Pre-intervention BMI (child): BMI z-score; BMI percentile

BMI=body mass index; N=number

Table 3. Intervention details abstracted

Study Characteristic	**Details**
Goal of the program, policy, or built environment change	Physical activity environment (e.g., increasing opportunities for walking in low resource areas) Food and beverage environment (e.g., food assistance programs, farmers market) Messaging environment, about nutrition or physical activity (e.g., food labeling, food marketing) Healthcare environment (health insurance, health system, or healthcare providers) Work environment (e.g., active living; healthy living at work) Physical and built environment (e.g., transit, park, other outdoor spaces, farmers' markets, new supermarkets) Other

Was a policy evaluated?	If yes:
	  Name of the policy
	    Governmental
	      Federal/National (specify country)
	        If United States, provide bill name and number
	        Date of passage, date of enactment
	        Is the policy still in effect?
	      State/province/region (specify)
	        If U.S. State, provide bill name and number
	        Date of passage, date of enactment
	        Is the policy still in effect?
	      Local/community (specify)
	        Date of passage, date of enactment
	        Is the policy still in effect?
	    Non-governmental
	      Organization implementing the policy
	      Policy start and end year

Was a program evaluated?	If yes:
	  Name of the program
	    Governmental
	      Federal/National (specify country)
	        Program start and end date
	      State/province/region (specify)
	        Program start and end date
	      Local/community (specify)
	        Program start and end date
	    Non-governmental
	      Organization implementing the program
	      program start and end year

Was a built environment or other change evaluated?	If yes:
	  Name and nature of the built environment or other change
	      Federal/National (specify country)
	        Built environment start and end date
	      State/province/region (specify)
	        Built environment start and end date
	      Local/community (specify)
	        Built environment start and end date

Results

Results of Literature Search

The literature search identified 26,316 unique citations, of which 294 studies (reported in 312 articles) were eligible for inclusion (Figure 2). See Appendix G for a list of included studies

General Study Details

We included studies that occurred in both the United States and other countries. The majority of studies were within the United States (n=188). One hundred and six were included from outside the United States, with Canada, the UK, and Italy most common after to the United States.

We classified all studies by study design. The methods section describes the classification process (see Appendix B, Glossary). About half of the studies were natural experiment studies (n=156, 53%), followed by experimental studies (randomized controlled trials or non-randomized controlled trials) (n=118, 40%), and other study designs that did not fall into either of the other categories (n=20, 7%). Results that follow from each of the KQs are also described within these study design classifications, followed by a description by population and setting.

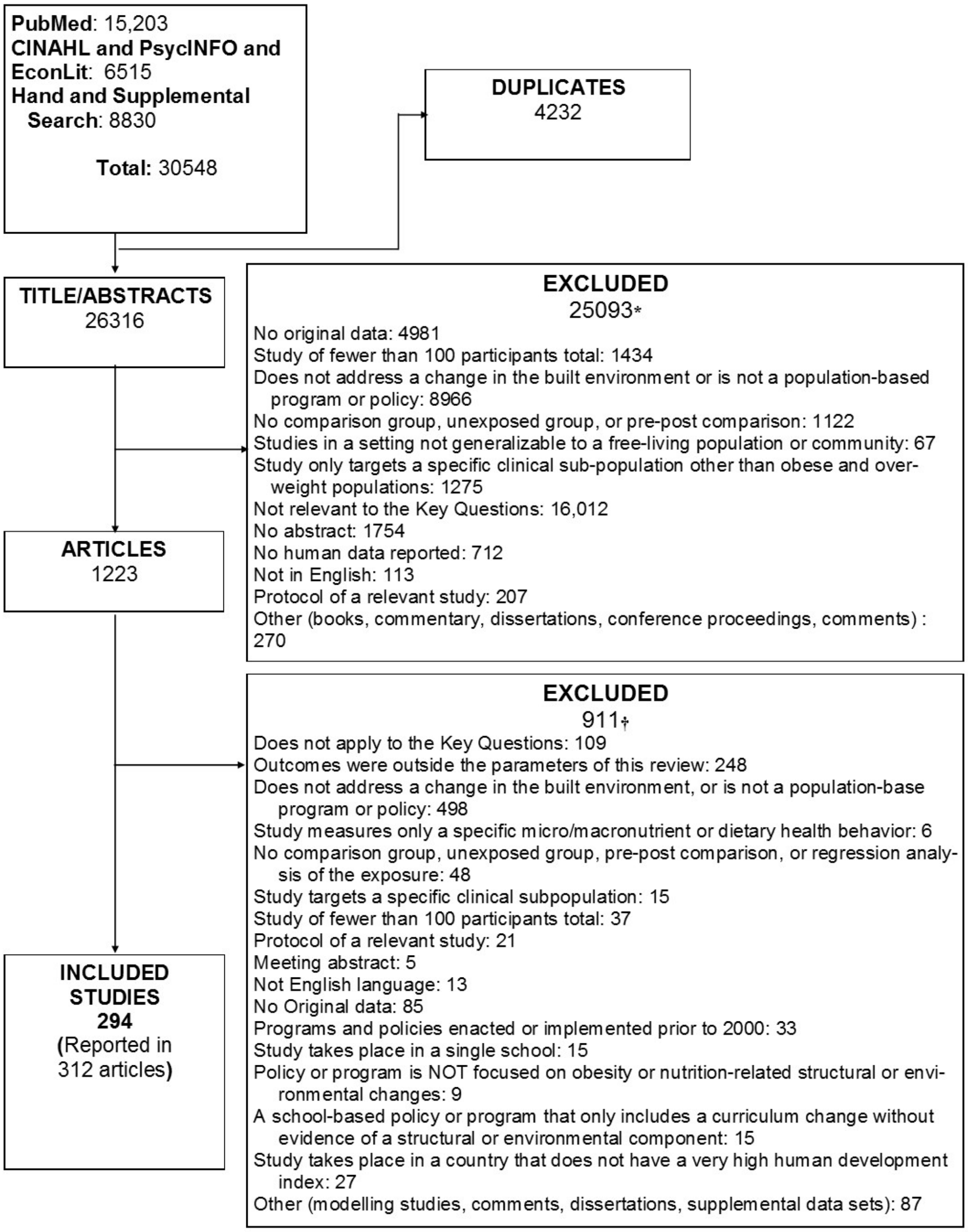
We included detailed information on each study, the participant characteristics, and information on policy, program and built environment interventions in Appendix H (Evidence Tables H1 and H2).

Programs, Policies, and Built or Environmental Changes Identified in Included Studies

We identified the original programmatic or policy goals of the program, policy or built environment change in reported in each study based on critical areas (or environments) for change from the IOM Report (2012).[16] These included: environments for physical activity, food and beverage environments, message environments (posted flyers or information campaigns), health care environments and work environments, transportation environments, parks and recreation environments (See Methods for Data Abstraction and Appendix B for Glossary); studies often were classified as having more than one goal. In addition, studies were described by target setting, such as work, school or community. Table 4 provides information on the number of studies classified by study method, program, policy, or built environmental goals, and the target settings.

Eighty-six studies out of 294 reported having multiple programmatic, policy or environmental goals. Most studies, regardless of study design, targeted schools and addressed changes in the environments for physical activity or the food and beverage environment. Nearly all of the studies addressing changes in the transportation or parks and recreation environments (n=27) followed a natural experiment method and targeted communities or neighborhoods (Table 4).

Figure 2. Results of literature search



* Sum of excluded abstracts exceeds 25093 because reviewers were not required to agree on reasons for abstract exclusion.

†Sum of excluded articles exceeds 911 because reviewers were not required to agree on reasons for exclu-

Table 4. Summary of study methods; programs, policies, and built environment goals; and targets of intervention (N=294)

Study design, n Studies	Programmatic, Policy, or Built Environment Goal, n Studies*	Target Setting of the Program, Policy or Built Environment Change, n Studies
Natural experiment studies, n=156	Physical activity environment, 43	School, 34 Community or neighborhood, 8 Transportation, 1
	Food and beverage environment, 78	School, 50 Food assistance program†, 9 Community or neighborhood, 19
	Transportation, 17	Community or neighborhood, 17
	Parks and recreation, 8	Community or neighborhood, 8
	Messaging environment,‡ 9	School, 4 Community or neighborhood, 5
	Physical and built environment, 33	School, 4 Community or neighborhood, 28 Employer or worksite, 1
	Policy, 11	School, 8 Community or neighborhood, 3
Experimental studies, n=118	Physical activity environment, 57	School, 50 Community or neighborhood, 4 Employer or worksite, 3
	Food and beverage environment, 65	School, 48 University, 1 Community or neighborhood, 10 Employer or worksite, 7
	Transportation, 1	Employer of worksite 1
	Parks and recreation, 1	Community or neighborhood, 1
	Messaging environment, ‡ 16	School, 4 University, 2 Community or neighborhood, 6 Employer or worksite, 4
	Healthcare, 1	Other (National Health Service intervention), 1
	Work, 1	Community or neighborhood, 1
	Physical and built environment, 16	School, 5 Community or neighborhood, 10 Employer or worksite, 1
	Other Policy, 2	School, 2
Other study designs, n=20	Physical activity environment, 11	School, 8 Food assistance program†, 1 Community or neighborhood, 2
	Food and beverage environment, 6	School, 1 Food assistance program†, 1 Community or neighborhood, 1 Employer or worksite, 3
	Messaging environment, ‡ 4	School, 2 Community or neighborhood, 2
	Transportation, 1	School, 1
	Physical and built, 2	School, 1 Community or neighborhood, 1

N=total population; n=number of studies

* Some studies include multiple program, policy, or built environmental goals; some studies include multiple intervention targets
† Examples of food assistance programs include SNAP (Supplemental Nutrition Assistance Program), a federal level program; Health Bucks, as local-level farmer's market incentive program
‡ Consistent with the 2012 IOM Report that described "Message Environments", policies and programs were classified as having specific messages or information about nutrition and /or physical activity (e.g., posted flyers or informational campaigns), which included social marketing strategies.

The majority (n=152 studies) of the 188 U.S. studies across all study designs evaluated governmental programs or policies at the local, state/regional, or federal levels. Of these, we identified 139 unique policy or program evaluations (Appendix I, Table I1). Eighty-five of these studies evaluate programs, and fifty-five are evaluations of policies. For example, polices included those addressing food policy (sugar-sweetened beverage bans;[73] competitive food laws[74]; calorie labeling laws;[19, 20] Women, Infants, and Children and Supplemental Nutrition Assistance Program,[61, 75, 76] physical activity policy joint use policies;[77] state policies on physical education;[78, 79] physical activity in daycare centers[80]). Additionally, we identified 36 non-governmental programs (Appendix I, Table I2).

Forty-eight (31%) of the 156 natural experiment studies took place outside of the United States, and 62 percent focused primarily on children. Sixty-three percent of the natural experiment studies taking place in the United States (n=108) focused on children. Fifty (42 %) of the 118 experimental studies took place outside of the United States, and 73 percent focused primarily on children. Sixty-nine percent of the experimental studies taking place in the United States (n=68) focused on children. Seven of the 20 studies with other study designs took place outside of the United States, and 4 of them focused primarily on children, while the rest were in the United States, of which 7 focused on children.

The natural experiment studies most commonly evaluated national, state, and local policies such as the UK's provision of free local bus passes to retirees [81] or the 2008 legislation requiring chain restaurants in New York City to provide calorie information to be posted on menus [20]. Researchers also commonly capitalized on changes to local built environments such as the addition of new supermarkets in food deserts[21, 55, 82] or new transportation systems.[56, 66, 83] We included evaluations of programs that were not originally intended for research, such the Centers for Disease Control and Prevention's HealthMPowers program [84] to improve physical activity and nutrition in the school setting and Jamie Oliver's cooking skills program.[85]

Key Question 1: Population-Based Data Sources

Key Question (KQ) 1: What population-based data sources have been used in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

Overview

To improve our understanding of which population-based data sources have been used in obesity prevention and control studies, KQ1 identified all data sources and encoded them based on whether they meet criteria to be a data system (i.e., most usable for obesity researchers), their original purpose and outcomes they contained.

Key Findings

- 294 studies reported one or more population-based data sources. The majority (216 of 294) of the U.S. and non-U.S. studies included some primary data collection and most of these 216 primary data sources were not sharable (e.g., did not have a public or transferable license to allow data to be used for research purposes).
- 93 U.S. and non-U.S. studies included secondary and/or sharable primary data sources.
- Of these 93 studies, we identified 143 secondary data sources and 26 sharable primary data sources (totaling 116 data sources after duplicates were removed).
- Of the 116 data sources, 106 (71 U.S. and 35 non-U.S. data systems) met the four criteria for data system (data source exists, is available for research, is sharable and contains outcomes or co-outcomes of interest).
- 96 of the 106 data systems were used in natural experiment studies, 7 were used in experimental studies, and 3 were used in studies with other study designs.
- Among the 71 U.S. data systems, 28 (39%) were originally designed for administrative purposes and 22 (31%) for public health operations. More than half of the 71 U.S. data systems had national coverage (57%).
- 44 (62%) of the 71 U.S. data systems contained at least one of the main outcomes of weight or BMI or dietary or physical activity behaviors, while 40 data systems (53%) included at least one of the co-outcomes or exposures, such as information about the policy, program, built environment, or other geographical information.

Methods

Data Abstraction

We abstracted and generated a list of all data sources reported in included studies. We identified each data source (U.S. and non-U.S.), with all duplicate data sources removed, and provided a count of the number of studies that used each data source. A primary data source was defined as one primarily collected for the purpose of a study (e.g., collecting survey data from participants to test the hypothesis of a study). If the data of a primary data source was being shared with other researchers, in any form including a public use dataset, we considered it to be a sharable primary data source.

We used this list of data sources to apply a set of criteria (Table 5) to determine if a data source is a data system that is actively maintained, can be acquired or accessed by researchers, and contains the outcomes of interest. The 'data system' criteria (Table 5) were developed for a previous project that our team conducted for the Pathways to Prevention program focused on data sources used to evaluate suicide prevention programs.[86] A data system represents one or more organized and accessible data sources that go beyond just collecting and managing data, but also contain some degree of an information technology infrastructure to maintain and operate the system. We applied these criteria to data sources identified in KQ 1 to inform obesity researchers not only about which data sources have been used in prior studies, but also what data sources are still available and can be used by researchers (i.e., meeting the data system criteria), which are key characteristics that make these data systems useful for future research.

Table 5. Criteria to determine whether a data source meets the criteria of a data system related to obesity

1	Data source is still in existence (e.g., information about the data system can be found on the Web)
2	Data are available and accessible in digital format (e.g., datasets are downloadable from a current Web site)
3	Data are sharable and can be acquired by others for research purposes (e.g., has a public or transferable license that allows the data to be used for research purposes)
4	Data system collects/contains at least one of the outcomes of interest (e.g., primary outcomes, such as weight and height, or secondary outcomes, such as policy and built environment)

Data sources not meeting the data system criteria (Table 5) were not further coded as they were deemed impractical for research (e.g., the data source does not exist anymore, or it cannot be shared with other researchers). Data sources meeting the data system criteria (Table 5; referred to as 'data systems') were further coded based on information collected from the studies and information found on the Web. NonU.S. data systems were coded in a limited manner due to language barriers and other issues with data access. U.S. data systems were further coded according to a coding and classification schema that was adapted and modified from a framework previously developed to review and evaluate community-based data sources (Appendix E).[87] These data coding schema include items such as data granularity (population- or individual-level), denominator coverage, data collection method, data scalability, data governance, data uses and functions, and data linkage mechanisms (see KQ2). To complete the data coding schema for each of the identified U.S. data systems, we located and accessed publicly available information (e.g., data dictionaries) of the data systems after we obtained as much information as possible from the studies. We did not download and analyze the data systems, as that was out of the scope of this review (e.g., conducting statistical analyses of the data systems to compute data quality measures).

Data Synthesis

We encoded each of the U.S. data systems identified in the studies using the coding schema (Appendix E). This process produced a list and description of all data systems, the categories of variables they contain, and various data specifications as described in the coding schema. The coding schema included a number of coding items grouped in various categories such as: data system specification and meta-data; geographical coverage (e.g., country, state, community); demographic coverage; data granularity; variables and outcomes of interest; data system scalability; and data system governance. See Appendix E for the detailed list of items used to encode the U.S. data systems.

Results

Identification of Data Sources and Data Systems

Of 294 included studies, all reported at least one data source (Figure 3). We identified 216 studies with at least one data source from primary data collection performed for that study. A primary data source was defined as one primarily collected for the purpose of a study (e.g., collecting survey data from participants to test the hypothesis of a study). Primary data sources were used by the researchers to conduct the project but were not made sharable for other researchers (e.g., has a public or transferable license that allows the data to be used for research purposes). Non-sharable primary data sources were excluded from the next steps of the data source abstraction, as by definition, they did not qualify as a data system (e.g., are not sharable; see Table 5). See Appendix B for definition of data system.

If the data of a primary data source was being shared with other researchers, in any form including a public use dataset, we considered it to be sharable primary data source. Ninety-three studies contained a total of 169 data sources that were sharable, of which 26 were sharable primary data collection sources and 143 were secondary data sources. We defined secondary data sources as those used in the studies but not directly collected by the study researchers (i.e., data source was external to the study). After removing the duplicates (n=53) and data sources that did not meet all data system criteria (n=10) (data source exists, is available for research, is sharable and contains outcomes or co-outcomes of interest) (Table 5), 106 unique data systems (71 U.S. and 35 non-U.S.) were identified for the final review and detailed coding (Appendix J). Appendix J lists all the data sources that met criteria for a data system (data source exists, is available for research, is sharable and contains outcomes or co-outcomes of interest) reported in the included studies, stratified by U.S. and non-U.S. data studies, and by natural experiment studies, experimental studies, and studies with other study designs (see Appendix J). These 106 unique data systems included 20 sharable primary data sources and 86 secondary data sources (Figure 3). Of the 106 data systems, 96 of the data systems were used in natural experiment studies, 7 were used in experimental studies, and 3 were used in studies with other study designs.

The 71 U.S. data systems underwent detailed coding to characterize the level of information available (see KQ 1 Methods and Appendix E) and were used as the denominator for all results reported in this section. Figure 4 shows results of the coding. Most of the 71 U.S. data systems had a dedicated Web page (73%), but most of these Web pages only included high-level summaries or limited details about the data systems (32%). Only 19 percent of the Web pages about the data systems included highly detailed information, such as data quality (e.g., completeness, accuracy, and timeliness of the data). For example, the National Health and Nutrition Examination Survey– maintained by the CDC – provides detailed information about data quality issues and potential analytical pitfalls if data are not used properly.

More than half of the 71 U.S. data systems (59%) were available for download but some (about 14%) required a form of registration or permission before accessing the data. Although 70 percent of the data systems had some level of information about their data structure (e.g., survey questionnaires, summary reports), only 15 percent of them presented a formal data dictionary on their Web pages (e.g., auto generated code books reflecting the database structure, variables, ranges, and definitions). Most data systems used unconventional documentation (i.e., not a data dictionary) to inform the users about their data structure and variables. For example, 25 percent provided only informal documentation about their data structure (which did not qualify as a data dictionary), and 29 percent offered survey instruments and other documentation that could be used to infer data structure and variables.

Figure 3. Identification and classification of data sources and systems in included studies

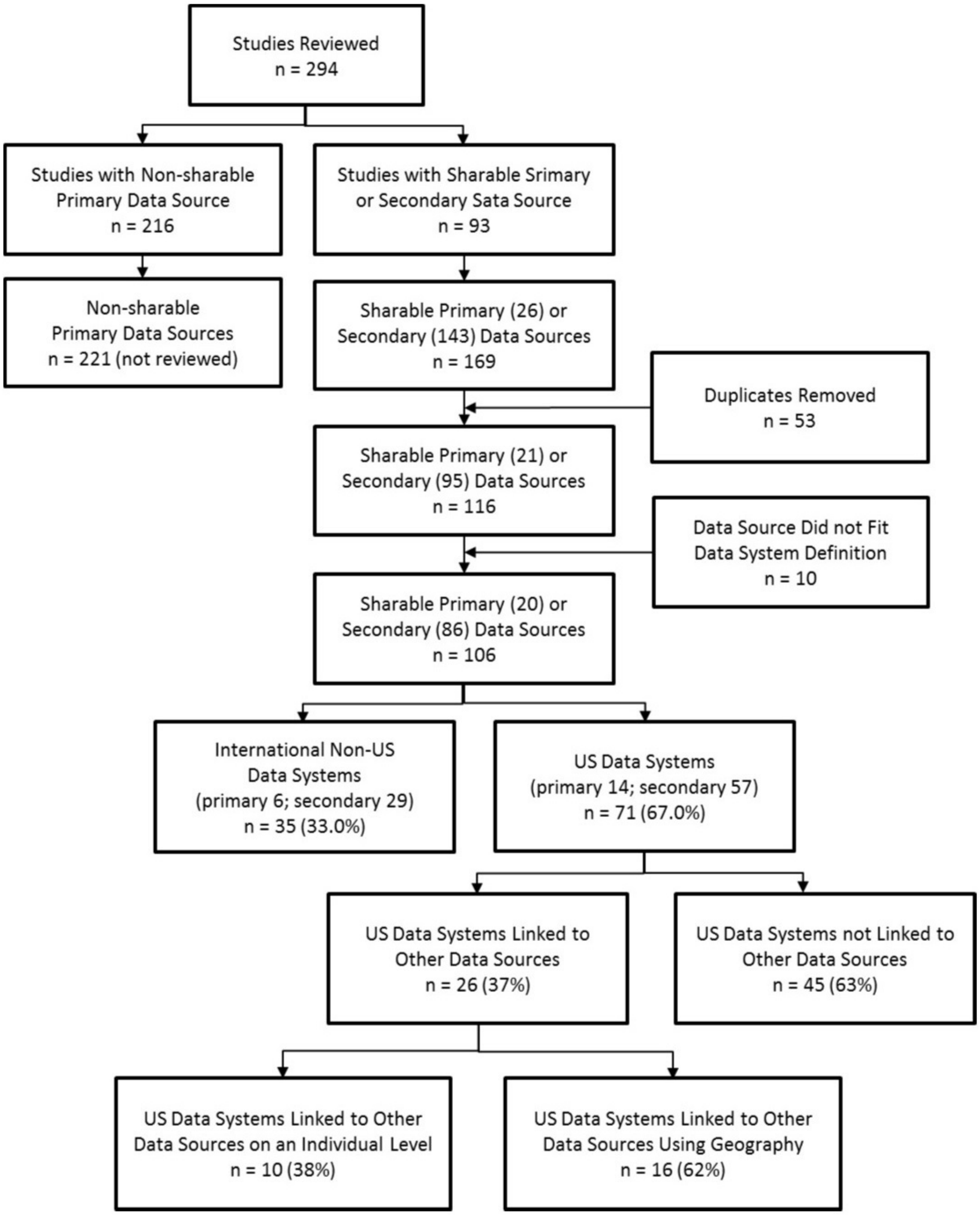
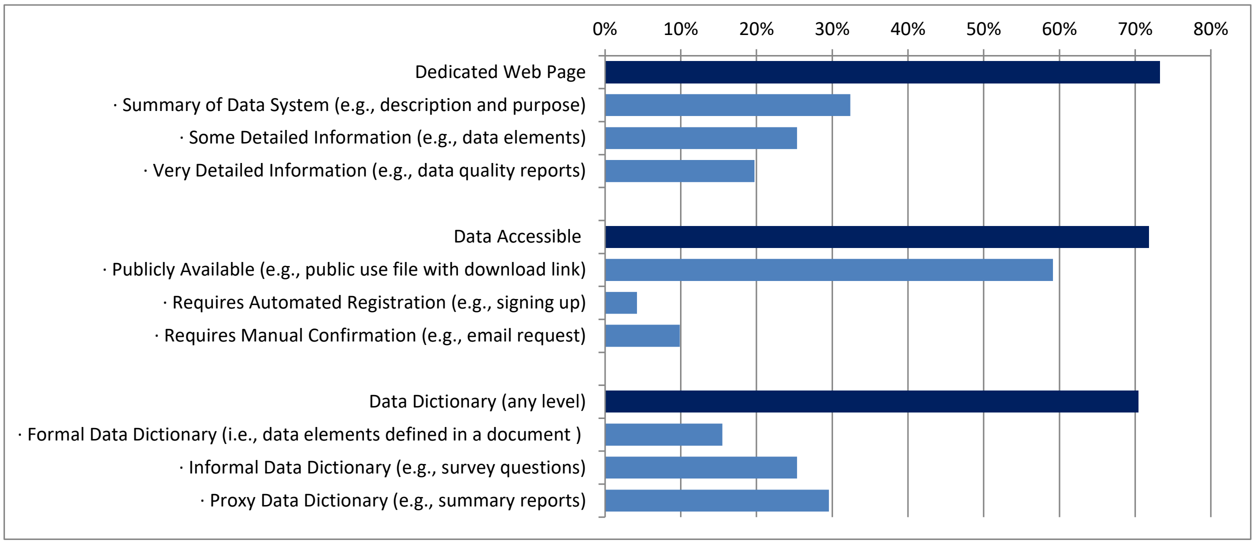


Figure 4. Level of information available for U.S. data systems (n=71)



Note: Values in each group that are depicted by the lighter color are mutually exclusive

Figure 5 shows the original purpose for data use and function for the 71 U.S. data systems. Most of the data systems were designed for administrative purposes (39%) or public health operations such as surveillance (31%). About 29 percent of the data systems identified were primarily developed and maintained for research purposes. Only about 2 percent of the data systems were originally developed and maintained for clinical care purposes.

Figure 6 displays the demographic coverage of the 63 U.S. data systems. Fifteen (21%) of the U.S. data systems have the general population as their denominator. Most of the data systems focused on schools (n=26), communities (n=16), or other specific programs (n=5). Most of the data systems included data on school-age children: 22 (31%) in elementary schools, 26 (37%) in middle schools, and 23 (32%) in high schools. Fewer than 21 percent of the U.S. data systems focused on the adult population. None of the data systems were designed to capture outcomes of interest for older adults or other special populations. Socio-economic status was captured in 20 (28%) data systems. Race and ethnicity variables were available in 24 (34%) and 22 (31%) data systems, respectively.

The geographic scope was varied for many of the data sources, or provided coverage of multiple geographical granularities. In the data sources pulled, 57 percent provided national coverage, 50 percent state coverage, and 32 percent county or city. Few or no data sources provided zip code (3%) or census block (0%) data.

Figure 5. Original purpose for data use and function for U.S. data systems (n=71)

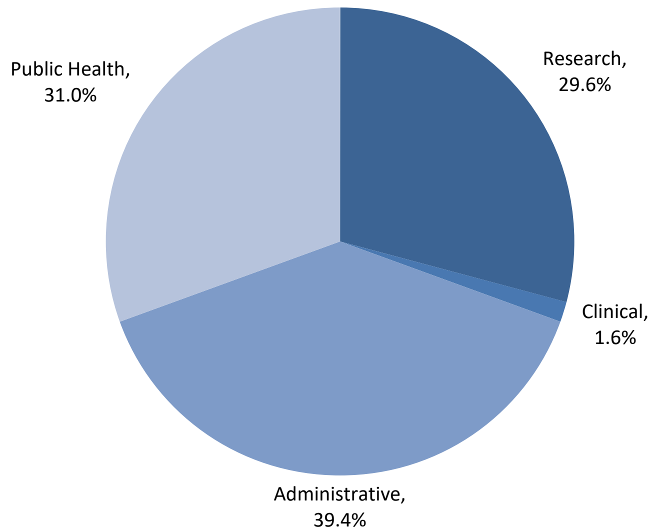
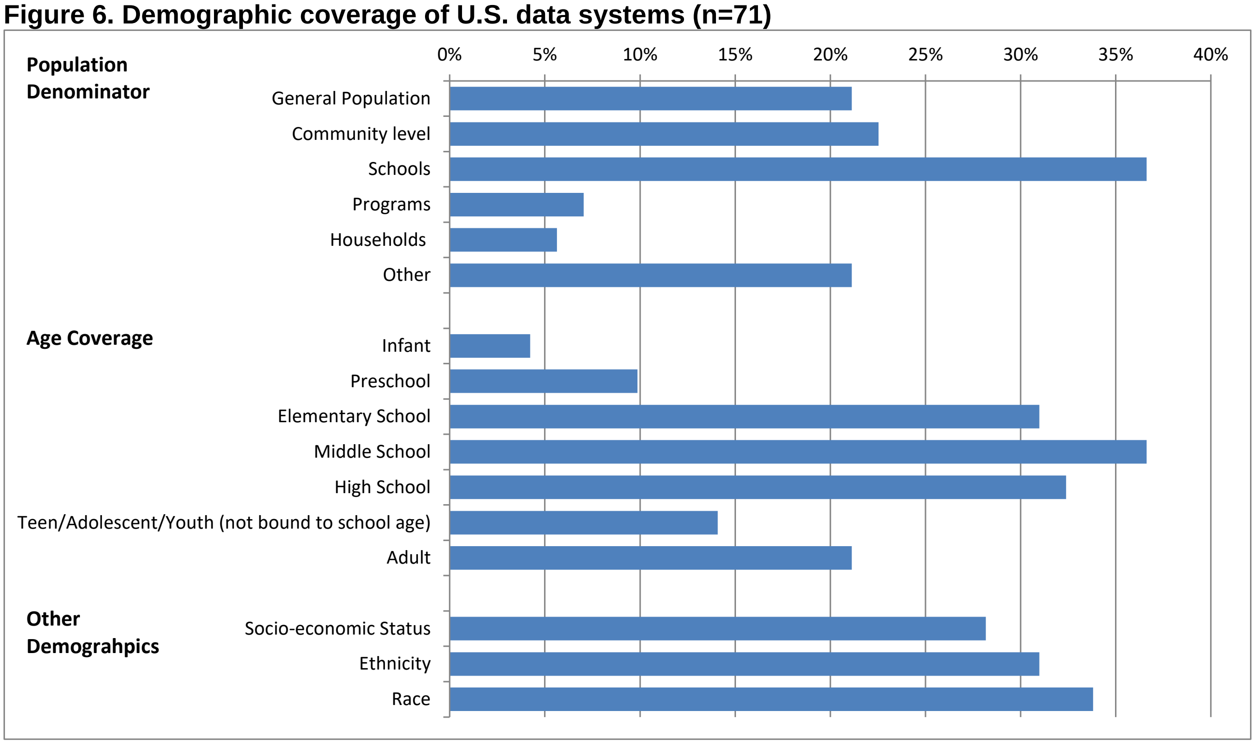


Figure 6. Demographic coverage of U.S. data systems (n=71)

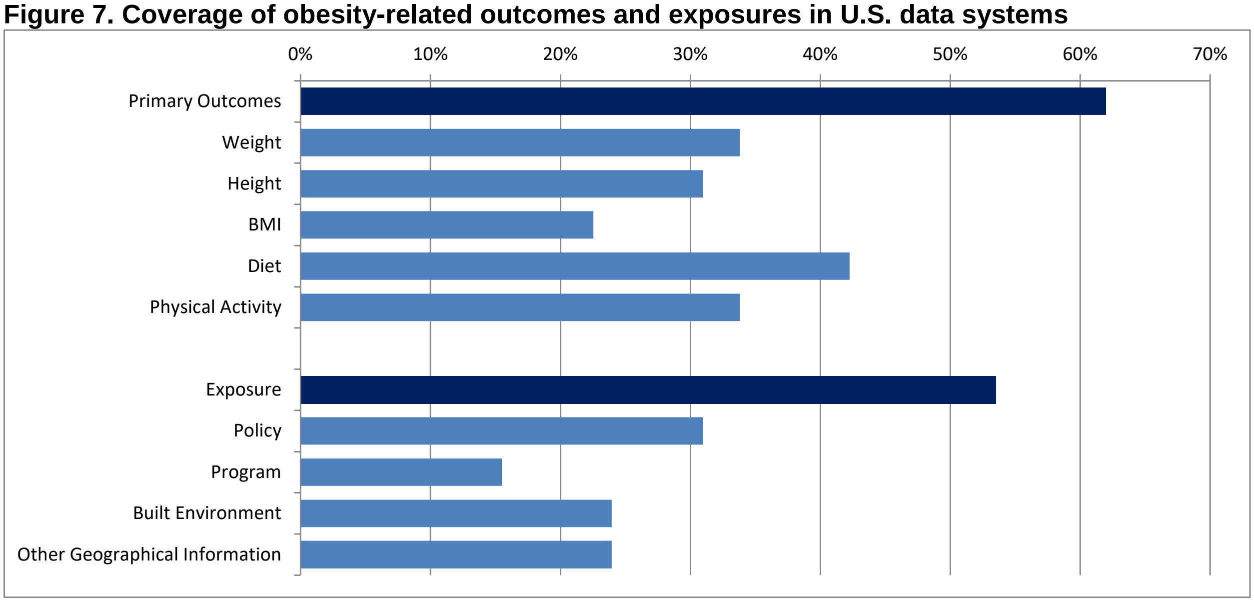


Note: Values in each group are not mutually exclusive and do not sum up to 100 percent, as a data system may cover multiple groups.

Twenty-seven (38%) of the data systems contained individual-level data. However, some studies cannot share individual-level data due to Health Insurance Portability and Accountability Act restrictions and, thus, only offered aggregated-level data for sharing. In fact, 53 (74%) of the identified U.S. data systems offered aggregated data instead of individual-level data.

Figure 7 displays the outcome and exposure variables of interest in the U.S. data systems. Among data systems reporting the primary outcomes of interest in this report, weight was captured in 34 percent of the identified data systems, while height was available in 31 percent of them. Only 23 percent of the data systems offered a calculated BMI, while 42 percent of the data systems included information about dietary behaviors and 34 percent included information about physical activity. Almost half of the data systems contained information about at least one of the exposures with details about the studied policy, program, or built environment change, or contained geographical information. More than 31 percent of the data systems contained information about policies, 15 percent contained program-level information, and 48 percent contained geographical data [either as built environment data (24%) or other geographically encoded information (24%). Around 59 percent of the data systems included an objective approach (e.g., measurement by a healthcare provider; with or without other methods) to collect some of the outcome variables (not shown in the figure).

Figure 7. Coverage of obesity-related outcomes and exposures in U.S. data systems



BMI=body mass index
Note: Values in each group are not mutually exclusive and do not sum up to 100 percent, as a data system may cover multiple outcomes.

Key Question 2: Linking Data Sources

Key Question (KQ) 2: What methods have been used to link different population-based data sources?

Overview

Policy makers have expressed increasing interest in linking population-based data sources to address questions about the effectiveness of policies and programs in obesity prevention and control. The goal of KQ2 was to assess and describe data linkages between data systems identified in KQ1.

Key Findings

- 26 (37%) of the 71 U.S. data systems were linked with a secondary data source or system other than the primary data sources for the purposes of the research study.
- Studies that linked their data systems with multiple external data systems either used an individual-level key (14%; e.g., patient identifiers) or a geographic allocation (23%; e.g., patient resides in a specific county thus mapping the county specifications extracted from other data sources for that individual).
- One study used statistical models to link primary data sources with external data sources and adjust for potential covariates.

Methods

Data Abstraction

For each U.S. data system identified in KQ 1, we assessed whether and how the data systems have been linked together, using information obtained from the study and, as described above, using publicly available information. The coding schema (see Appendix E) included a series of coding items to identify how the identified studies linked data sources together.

Results

For KQ 2 we qualitatively described the methods used to link these data systems (see KQ2 data abstraction). We aggregated and summarized the data across various coding schema attributes. The summary report includes various data system attributes across the entire list of data systems and is accompanied with notations about which data specifications (e.g., linkage methods) were found to be effective and which ones have faced challenges.

Of the 71 U.S. data systems reported in KQ 1, 26 data systems (37%) linked their data system with another data source. These data sources were linked for the purposes of the research study and had not been previously linked. All 26 data systems occurred in natural experiment studies.

Ten (14%) of the 71 U.S. data systems used an individual-level linkage. Most of the survey-based studies used existing data from other surveys to locate potential participants and import already captured data about those participants in their study. Examples of these external surveys that were used for individual-level linkage include: Women, Infants, and Children, Supplemental

Nutrition Assistance Program, Common Core Data, Early Childhood Longitudinal Study-Kindergarten, The Military Teenagers' Environments, Exercise, and Nutrition Study, and vital records.

Sixteen (23%) of the 71 U.S. data systems used a geographical-level linkage to capture additional data about their denominator of participants. These added variables were eventually used as direct, indirect, or adjustment variables for the studies. Most of the studies using a geographical-level linkage used a simple geographical name match (e.g., zip code match), but two used more advanced methods (e.g., locating an address within a geographical boundary). Examples of the external geographical data systems they linked to included: U.S. Census, Dun and Bradstreet, National Household Travel Survey, Trip Identification and Analysis System, and local, state or national maps for food retails, property and sales taxes, and crime rates. Two studies used statistical models (i.e., regression models) to link a primary data source with external geographical data sources to adjust for potential confounders in the statistical models. Regression models are considered a standard approach.[88]

Key Question 3: Assessment Measures

Key Question (KQ) 3: What obesity measures, dietary and physical activity behaviors, and other outcomes have been assessed in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control?

Overview

The goal of KQ 3 was to describe and synthesize what obesity, dietary and physical activity measures were used to assess childhood and adult obesity outcomes, dietary and physical activity behaviors, and other co-outcomes (e.g., commuting behavior). For each measure, we described the type of measure (e.g., the name of the questionnaire used to assess fruit and vegetable intake), how the data was collected (e.g., trained study staff for height/weight vs. self-reported questionnaires) and the data source that contained the measure when it was obtained from a secondary data source. We presented the results by population (children and adults) and study design (natural experiment, experimental, other study design).

Key Findings

- One hundred twelve studies out of 294 (38%) reported on childhood weight outcomes, primarily body mass index (BMI) z-score or BMI percentile. Most studies reporting childhood weight outcomes assessed the outcomes using direct measurement from trained staff.
- Thirty-two studies reported adult weight outcomes and these were mostly conducted in community or worksite settings.
- One hundred forty-eight studies reported dietary behavioral outcomes in terms of change in the intake of fruits and vegetables (n=147), sugar-sweetened beverages (n=54), total daily caloric intake (n=17), fast food intake (n=16), and fiber (n=12).
- One hundred fifty-two studies reported physical activity measures. Most studies reporting physical activity outcomes took place in school (n=89) or community (n=40) settings.

Methods

Data Abstraction

We abstracted detailed information about which of the following obesity measures, dietary or physical activity behavioral measure and other co-outcomes were reported in the studies:

- Adult body weight and BMI
- Childhood BMI (z-score and percentile)
- Individual dietary intake and behaviors. We included measure of total daily caloric intake; specific macronutrients related to obesity (including vegetable, fruit, or fiber intake); sugar-sweetened beverage intake; or fast food intake.
- Individual physical activity behavior, in terms of both activity type and quantity

- Co-outcomes: food environment, physical activity environment, other outcomes (e.g., housing, economic)

We abstracted which measures and/or questionnaires were used to assess the outcomes and which of the data sources from KQ1 contained the measures.

Data Synthesis

We counted the number of studies that reported each outcome and categories of outcomes of interest. We described the types of measures or instruments used to assess these outcomes, based on categories from the National Collaboration on Childhood Obesity Research Measures Registry.[53] Definitions of these categories are provided in Appendix B. The data sources and questionnaires used for these measures were also reported and described. We stratified this section by study design: natural experiment studies, experimental studies, and other study designs.

Results

We identified 112 studies reporting on childhood weight outcomes, 32 studies on adult weight outcomes, 152 studies on physical activity outcomes, and 148 studies on dietary outcomes. Forty-seven studies reported both diet and physical activity outcomes. Thirty-seven studies reported on co-outcomes, such as commuting behaviors, food environment, physical environment, and food purchasing behavior (see Appendix H, Evidence Tables H3-H15).

Obesity Measures: Weight and BMI in Children and Adults

Table 6 displays the obesity measures used to assess weight and BMI in adults and children. For children, 112 studies reported body weight, BMI percentile, and/or BMI-z score in children: 57 in terms of BMI z-score, 46 in terms of BMI percentile change, and 27 with other childhood weight outcomes. For adults, 32 studies reported body weight in adults: 31 in terms of BMI and 6 in terms of weight change.

Table 6. Weight outcomes and measures in adults and children, by study design

Method and Population	Outcome	Measure, n (%)* Measured by Trained Staff	EHR	Self-Reported	Other
Natural Experiment Studies					
Children 50 studies	Change in BMI z-score	14 (60.9)	1 (4.3)	3 (13)	5 (21.8)
	Change in BMI percentile	15 (55.6)	0	6 (22.2)	6 (22.2)
	Change in weight	7 (87.5)	0	0	1 (12.5)
Adult 17 studies	Change in body weight	0	0	1 (100)	0
	Change in BMI	6 (37.5)	0	10 (62.5)	0
Experimental Studies					
Children 48 studies	Change in BMI z-score	27 (84.4)	0	2 (6.3)	3 (9.4)
	Change in BMI percentile	13 (76.5)	1 (5.9)	2 (11.8)	1 (5.9)
	Change in weight	7 (77.8)	0	0	2 (22.2)
Adult 13 studies	Change in body weight	5 (100)	0	0	0
	Change in BMI	7 (53.8)	0	6 (46.2)	0
Other Study Designs					
Children 6 studies	Change in BMI z-score	3 (100)	0	0	0
	Change in BMI percentile	3 (100)	0	0	0
	Change in weight	1 (100)	0	0	0
Adult 2 studies	Change in body weight	0	0	0	0
	Change in BMI	0	0	1 (50)	1 (50)

*Many studies included more than one type of weight measure or weight outcome.

BMI=Body Mass Index; BMI-z=Body Mass Index z-score; EHR=electronic health records; n=number of measures reported;

BMI Measures in Children

Of the 95 studies reporting weight or BMI in children, 46 were natural experiment studies, 44 were experimental studies (randomized controlled trials (RCTs) and controlled clinical trials), and 5 were classified as "other study designs" (see Methods for definitions of study designs). Fifty-seven studies reported BMI z-score and 46 reported on BMI percentile. Most studies reporting weight measures in children were conducted in a school setting (n=88).

Natural Experiment Studies Reporting BMI in Children

Of the 46 natural experiment studies reporting data on BMI z-score or BMI percentile in children, 25 studies reported the outcome based on direct measurement from trained staff, one study used an EHR, 8 studies used self-reported data, and 8 studies used other measures (e.g., FitnessGram assessment). Out of the total reported measures, natural experiment studies commonly reported using trained staff to measure BMI in children (BMI percentile: 55.6 percent, BMI-z score: 60.9%) (Table 6, Appendix H, Evidence Tables H3-H4)

Evidence Table H16 in Appendix H displays details about U.S. secondary data sources containing each of the weight measures, by study design (natural experiment, experimental, other design). Natural experiment studies used 26 different U.S. data sources for childhood weight measures, including the National Survey of Children's Health, Early Childhood Longitudinal Study-Kindergarten Cohort, and School Health Policies and Programs Study (Appendix H, Evidence Table H16).

Experimental Studies Reporting BMI in Children

Of the 39 experimental studies reporting on children's BMI-z or BMI percentile, 33 studies reported the outcome based on direct measurement from trained staff, 1 study used an EHR, 3 studies used self-reported data, and 3 studies used other measures (i.e., body composition analyzer). Out of total reported measures, experimental studies commonly reported using trained staff to measure BMI in children (BMI percentile: 76.5%, BMI-z score: 84.4%) (Table 6; Appendix H, Evidence Tables H3-H4).

Other Weight Outcomes in Children

Twenty-five studies either directly captured child weight (n=17) or reported other weight outcome measurements (n=8). Of the 17 studies reporting child weight, 8 were natural experiment studies and 9 were other experimental methods. All but three studies reported outcomes based on direct measurement by trained staff (Table 6).

Eight studies reported other child weight outcomes not designated in our populations, interventions, comparators, outcomes, timing, setting framework. These included BMI (not BMI-z score or BMI percentile), rates of BMI change in participants, and probability of obesity (see Appendix H, Evidence Tables H5-H6).

Weight and BMI in Adults

Thirty-two studies reported on adult body weight and BMI outcomes. Thirty-one studies reported on change in adult BMI, and 6 studies reported on change in adult weight. Most studies reporting weight measures in adults were conducted in community (n=15) or worksite (n=10) settings. Seventeen studies reporting adult weight or BMI were natural experiment studies, 13 were experimental studies, and 2 were other study designs.

Natural Experiment Studies Reporting Weight or BMI in Adults

Of the 17 natural experiment studies reporting data on change in body weight or BMI, 6 studies reported this outcome based on direct measurement from trained staff and 11 studies used self-reported data. None of the studies used an electronic health record (EHR) for weight or BMI measures in adults.

Evidence Table H16 in Appendix H shows details about U.S. secondary data sources containing each of the weight measures, by study design (natural experiment, experimental, other design). Natural experiment studies used 12 different U.S. data sources for adult weight and BMI measures, including the Behavioral Risk Factor Surveillance System (BRFSS) and the L.A. County Food Retail database. (Appendix H, Evidence Table H17).

Experimental Studies Reporting Weight or BMI in Adults

Of the 13 experimental studies reporting data on change in body weight or BMI, 9 studies reported the outcome based on direct measurement from trained staff (BMI: n=7; weight: n=2), no studies used an EHR, and 6 studies used self-reported data (BMI: n=6).

Measures of Dietary Behaviors in Adults and Children

One hundred forty-eight studies reported dietary behavioral outcomes in terms of change in the intake of fruits and vegetables (n=147), sugar-sweetened beverages (n=54), total daily caloric intake (n=17), fast food intake (n=16), and fiber (n=12). Most studies reporting dietary behavioral outcomes conducted their study within the school (n=86) or community (n=42) setting. In general, studies used measures to assess only some key aspect of these dietary behaviors rather than the total diet comprehensively, such as through repeated 24-hour recalls or food frequency questionnaires (for definitions, see Appendix B). For example, the Pittsburgh Hill/Homewood Research on Eating, Shopping and Health[21] was a natural experiment that examined the effect of a full-service supermarket on diet and other outcomes using the 24-hour recall. The Norwegian School Fruit Program[23] study was an experimental study that evaluated a fruit and vegetable program in schools, also using the 24-hour recall.

Table 7 shows the dietary measures used in studies of children and adults by study design. Overall, 77 studies were natural experiment studies, 63 were experimental studies, and 11 were other study designs (several studies collected adult and child data). Among the 107 studies in children, 95 studies reported on intake of fruits and vegetables, 45 on sugar-sweetened beverages, 11 on total calories, 12 on fast food, and 9 on fiber. Among the 50 studies in adults, 43 studies reported on intake of fruits and vegetables, 11 on sugar-sweetened beverages, 6 on total calories, 5 on fast food, and 3 on fiber.

Dietary Behaviors in Children

Table 7 shows the methods for assessing dietary behaviors in children. The most commonly used method for assessing diet was through brief dietary questionnaires (e.g., The Boston Youth Survey). Of the 52 natural experiment studies reporting data on diet in children, 6 studies used a 24-hour recall, 7 studies used a food frequency questionnaire, 34 studies used other questionnaires, and 5 used a record/log.

Evidence Table H16 in Appendix H provides details about U.S. secondary data sources containing each of the dietary measures, by study design (natural experiment, experimental, other design). In U.S. studies in children, the natural experimental studies used data sources with dietary measures such as the National Survey of Children's Health and the National Youth Physical Activity and Nutrition Study (Appendix H, Evidence Table H16).

Among the natural experiment studies, commonly used questionnaires that assessed dietary behaviors in children included the School Physical Activity and Nutrition (SPAN) Questionnaire, Youth Risk Behavior Survey (YRBS) Questionnaire, and the Boston Youth Survey.

Of the 47 experimental studies (RCTs and non-randomized controlled trials) reporting on children's diet, 12 reported the outcome based on 24-hour recall, 17 used a food frequency questionnaire, 15 used other questionnaires, one used a record/log, 5 used observation, and 7 used other measures (i.e., structured interviews, digital images).

Experimental studies used questionnaires such as The Child and Adolescent Trial for Cardiovascular Health After-School Student Questionnaire (ASSQ) (Appendix H, Evidence Table H17).

Dietary Behaviors in Adults

Table 7 shows the methods for assessing dietary behaviors in adults. The most commonly used method for assessing diet was through food frequency or brief dietary questionnaires such as the National Health and Nutrition Examination Survey, as well as internally designed questionnaires (Table 7). Of the 30 natural experiment studies reporting measures of dietary behaviors in adults, 4 used a 24-hour recall, 10 used a food frequency questionnaire, 18 used other questionnaires, 3 used a record/log, and none used observation.

Evidence Table H16 displays details about U.S. secondary data sources containing each of the dietary measures, by study design (natural experiment, experimental, other study design).

Among the U.S. studies in adults, the most frequently used data source reporting adult diet behavioral measures was the brief diet screener of the BRFSS, which was used in four natural experiment studies. Both experimental and other study designs used primary data collection as their source (Appendix H, Evidence Table H16). Examples of questionnaires used by experimental and other study designs are the Customer Impact Questionnaire and the Five-a-day Community Evaluation Tool, respectively (Table 8).

Of the 17 experimental studies (RCTs and non-randomized controlled trials) reporting data on diet, one reported the outcome based on 24-hour recall, 7 used a food frequency questionnaire, 6 used other questionnaires, one used a record/log, none used observation, and 4 used other measures.

Measures of Physical Activity in Adults and Children

One hundred fifty-two studies reported physical activity measures. Most studies reporting physical activity outcomes took place in school (n=89) or community (n=40) settings. All 42 of the studies with a goal of changing the parks and recreation, or transportation environment, measured physical activity. In general, studies used measures to assess only some key aspect of physical activity behavior rather than total physical activity comprehensively.

An example is the use of a pedometer to count steps as a proxy measurement of physical activity. Studies that used this type of measure include the Great Fun 2 Run study,[89] which is a natural experiment looking at increasing physical activity levels in schools through physical education lessons. Another example is the Healthy Schools Project,[90] which uses an experimental method to observe if augmented recess sessions increase physical activity over standard sessions.

Table 8 shows the physical activity measures in studies of children and adults by study design. Overall, 71 studies were natural experiment studies, 66 were experimental studies, and 15 were other study designs.

Table 7. Dietary outcomes and measures for children and adults, by study design

Method and Population	Outcome	24-Recall, n (%)	FFQ, n (%)	Questionnaire, n (%)	Record/Log, n (%)	Observation, n (%)	Other, n (%)
Natural Experiment Studies							
Children	Caloric intake	3 (50)	1 (16.7)	0	2 (33.3)	0	0
52 studies	Fast food	1 (14.3)	1 (14.3)	4 (57.1)	1 (14.3)	0	0
	SSB	1 (4.8)	2 (9.5)	16 (76.2)	2 (9.5)	0	0
	Fruit/veg	5 (11.6)	6 (14)	29 (67.4)	3 (7)	0	0
	Fiber	1 (20)	0	2 (40)	2 (40)	0	0
Adult	Caloric intake	2 (66.6)	0	0	1 (33.3)	0	0
30 studies	Fast food	0	1 (25)	3 (75)	0	0	0
	SSB	1 (10)	3 (30)	5 (50)	1 (10)	0	0
	Fruit/veg	5 (15.6)	10 (331.3)	14 (43.8)	3 (9.4)	0	0
	Fiber	0	0	0	1 (100)	0	0
Experimental Studies							
Children	Caloric intake	0	1 (20)	1 (20)	1 (20)	1 (20)	1 (20)
47 studies	Fast food	1 (25)	0	3 (75)	0	0	0
	SSB	4 (18.2)	7 (31.8)	9 (40.9)	0	1 (4.5)	1 (4.5)
	Fruit/veg	12 (23.1)	15(28.8)	14 (26.9)	1 (1.9)	5 (9.6)	5 (9.6)
	Fiber	0	3 (75)	1 (25)	0	0	0
Adult	Caloric intake	1 (50)	0	0	0	0	1 (50)
17 studies	Fast food	0	1 (100)	0	0	0	0
	Sugar sweetened beverage	0	1 (100)	0	0	0	0
	Fruit/veg	0	7 (46.7)	5 (33.3)	1 (6.7)	0	2 (13.3)
	Fiber	0	1 (50)	1 (50)	0	0	0
Other Study Designs							
Children	Caloric intake	0	0	0	0	0	0
8 studies	Fast food	0	0	1 (100)	0	0	0
	SSB	1 (20)	2 (40)	2 (40)	0	0	0
	Fruit/veg	2 (25)	2 (25)	4 (50)	0	0	0
	Fiber	0	0	0	0	0	0
Adult	Caloric intake	0	0	0	0	0	0
3 studies	Fast food	0	0	0	0	0	0
	SSB	0	0	0	0	0	0
	Fruit/veg	0	2 (66.6)	1 (33.3)	0	0	0
	Fiber	0	0	0	0	0	0

Many studies included more than one type of diet measure or diet outcome.

FFQ=food frequency questionnaire; Fruit/veg=fruit and vegetables; n=number of measures reported; N=number of studies; SSB=sugar sweetened beverage

Table 8. Physical activity outcomes and measures, by study design

Method and Population	Electronic Monitor, n (%)	Questionnaire, n (%)	Record/Log, n (%)	Observation, n (%)	GIS, n (%)	Other, n (%)
Natural Experiment Studies						
Children 43 studies	17 (32.7)	27 (51.9)	1 (1.9)	4 (7.7)	0	3 (5.8)
Adult 32 studies	6 (13)	35 (76.1)	2 (4.3)	1 (2.2)	0	2 (4.3)
Experimental Studies						
Children 53 studies	22 (33.8)	21 (32.3)	6 (9.2)	6 (9.2)	0	10 (15.4)
Adult 13 studies	3 (20)	10 (66.7)	1 (6.7)	1 (6.7)	0	0
Other Study Designs						
Children 10 studies	3 (27.2)	5 (45.5)	0	0	0	3 (27.2)
Adult 5 studies	1 (12.5)	5 (62.5)	1 (12.5)	0	0	1 (12.5)

*Many studies included more than one type of physical activity measure.

GIS=Geographic Information System; n=number of measures reported; N=number of studies

Measures of Physical Activity in Children

In children, the most commonly used methods for assessing physical activity were questionnaires (n=46) and electronic monitoring (n=32) (Table 8). Of the 43 natural experiment studies reporting data on physical activity in children, 16 measured physical activity using electronic monitoring (accelerometer n=13, pedometer n=2, telemeter n=2, global positioning system (GPS) n=1), 25 used a questionnaire, one used a record/log, 4 used observation, and 3 used other measures.

U.S. studies varied considerably in the physical activity questionnaires used with children in natural experiment studies. Examples included the SPAN Questionnaire and the National Youth Risk Behavior Survey among many others. The International Physical Activity Questionnaire was the most used questionnaire (n=3), followed by the YRBS) Questionnaire (n=2). The first publication describing the use of electronic monitoring in natural experiment studies with children was in 2005 and use of such monitoring peaked in 2014 (n=7).

Evidence Table H16 in Appendix H shows details about U.S. secondary data sources containing each of the physical activity measures, by study design (natural experiment, experimental, other design). In U.S. studies conducted in children, natural experiment studies most commonly used data sources such as the Physical Education-Related State Policy Classification System, Family Activity Study (FAS) data, or the School Nutrition-Environment State Policy Classification. (Appendix H, Evidence Table H16).

Of the 53 experimental studies reporting on children's physical activity, 22 used electronic monitoring (accelerometer n=13, pedometer n=7, motion sensor n=1, telemetry n=1), 21 used a questionnaire (i.e., Test of Gross Movement Development), 6 used a record/log, 6 used observation, none used geographic information systems, and 10 used other measures (i.e., Chinese National Measurement Standards on People's Physical Fitness). (Table 8)

Experimental studies in the U.S. in children used tools such as the Self-Administered Physical Activity Checklist and the Test of Gross Movement Development checklist. No questionnaire was used in more than one study. Eight of the questionnaires were self-reported, 3 were recorded by parents or teachers, and the reporting participant in 7 questionnaires could not be determined (Appendix H, Evidence Table H17). The use of electronic monitoring in experimental studies involving children began in 2003 and peaked in 2015 (n=5).

Measures of Physical Activity in Adults

In adults, the most commonly used method for assessing physical activity was through questionnaires (n=40) (Table 8). Of the 32 natural experiment studies reporting data on physical activity in adults, 5 reported the outcome based on electronic monitoring (accelerometer n=4, GPS n=1, unreported n=1), 24 used a questionnaire, 2 used a record/log, one used observation, and 2 used other measures (e.g., Compendium of Physical Activities metabolic equivalent of task values).

Data sources with measures of physical activity in U.S. studies of adults using natural experiment studies include the FAS, National Household Travel Survey, and the Trip Identification and Analysis System (Appendix H, Evidence Table H16). The most frequently used questionnaires to assess physical activity were the International Physical Activity Questionnaire (n=3) and BRFSS (n=2) for the natural experimental studies conducted in U.S. adult populations (Table 8). Studies using electronic monitoring in natural experiments with adults were first published in 2014 (n=2), and use has remained low.

Of the 12 experimental studies (RCTs and non-randomized controlled trials) reporting on physical activity in adults, 3 used electronic monitoring (accelerometer n=2, laser counter n=1), 10 used a questionnaire (i.e., International Physical Activity Questionnaire), one used a record/log, one used observation, and none used geographic information system or other measures (Table 8). Experimental studies in the United States used measures such as the Godin Leisure Time Physical Activity Questionnaire (Appendix H, Evidence Table H17). Few experimental studies in adults used electronic monitoring and the first ones were published in 2012 (n=2).

Other Co-Outcomes

Thirty-seven studies reported on co-outcomes such as commuting behavior, food purchasing behavior, physical environment, and food environment (see Table 9). Overall, most (n=26) of the studies reporting co-outcomes were natural experiment studies. The most common co-outcome was food purchasing behavior (n=17) (e.g., purchasing of healthy and unhealthy food score). Four studies reported on commuting behavior (e.g., average daily commute mode of transport). 6 studies reported on the food environment (e.g., school-reported soda availability), and 8 studies evaluated the physical activity environment (e.g., neighborhood characteristics to facilitate walking).

Table 9. Summary of the distribution of co-outcomes among study designs (N=37 studies)

Co-Outcome	n
Natural Experiment Studies	
Commuting behavior	3
Food environment	3
Physical activity environment	4
Physical or built environment	0
Food purchasing behavior	12
Other	3
Experimental Studies	
Commuting behavior	1
Food environment	3
Physical activity environment	2
Physical or built environment	0
Food purchasing behavior	5
Other	1
Other Study Designs	
Commuting behavior	0
Food environment	0
Physical activity environment	1
Physical or built environment	0
Food purchasing behavior	0
Other	0

N=number of studies

Key Question 4: Experimental and Non-Experimental Methods

Key Question (KQ) 4: Which experimental and non-experimental methods have been used in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

Overview

While randomized controlled trials (RCTs) and other experimental approaches can provide strong evidence of the effectiveness of some interventions, not all interventions are amenable to randomization. An alternative approach involves use of natural experiment designs, which aim to approximate casual effects by capitalizing on existing variation in an exposure or intervention. Natural experiment studies use a wide range of analytic approaches, which are further described in this section. The goal of KQ 4 was to describe experimental and non-experimental methods in terms of study design and analytic approach.

Key Findings

- Of the 294 studies included in this review, 156 were natural experiment studies (53%), 118 were experimental studies (40%), and 20 provided insufficient information to determine if a natural experiment took place (7%) and were classified as "other study designs."
- Natural experiment studies evaluating policies, programs, and built environment changes most commonly used cross-sectional comparisons of exposed and unexposed groups (n=55, 35%).
- Difference-in-differences approaches that compared exposed and unexposed groups before and after an exposure were used in 45 studies (29%), and pre/post designs that compared one group before and after an exposure were used in 48 studies (31%).
- A small number of natural experiment studies in this review used other non-experimental designs including 4 instrumental variable approaches, 1 regression discontinuity approach, and 4 interrupted time series analyses with more than 2 time points pre- and post-intervention.

Methods

Data Abstraction

To address KQ 4, we abstracted details of the natural experiment studies, experimental studies, and other study designs and analytic approaches. After determining whether a study met the UK's Medical Research Council criteria for a "natural experiment study," we further classified study designs using the Effective Public Health Practice Project Quality Assessment (EPHPP) tool:[91] RCT, controlled clinical trial, cohort, case-control, interrupted time series, cross-sectional, and "other". Definitions of these designs are provided in Appendix B.

Given that some study designs (such as cohort studies) could be used in multiple ways to estimate effects, we further distinguished the analytic approach of each study. While the EPHPP tool collects information regarding the data collection structure, our risk of bias forms additionally focused on the analytic tools used to analyze data. For each study, we classified the analytic approach as an RCT, instrumental variables design, regression discontinuity, interrupted time series, cross-sectional comparison of exposed and unexposed groups, controlled clinical trial, pre/post comparison, difference in differences, or "other" approach.

Data Synthesis

We described the types of study designs and analytic methods being used, and their frequency of use, by study design.

Results

Description of Methods Used in Natural Experiment Studies

Over half of the studies (n=156) included in this review met the main criterion for natural experiment studies, based on the MRC Report,[41] clearly indicating that the researchers were not in control of the exposure allocation (see Methods for KQ4). Eighty-eight of the natural experiment studies took place in community settings (56%) and 49 (31%) were in other institutional settings (e.g., schools or worksites). Nineteen studies (12%) evaluated an intervention or exposure at the level of the individual. Analysis was performed at the individual level in 90 percent of these studies. For example, Project Healthy Schools, a diet and physical activity intervention, was implemented at 23 schools in Michigan, and its success was evaluated by comparing individual changes in body mass index (BMI) and diet among 6th graders before and after the program was implemented.[92] Most studies evaluating community or school-level programs used methods such as multilevel modeling or robust standard errors to account for the hierarchical structure of the data, but 20 studies (13%) did not account for nested data structure in the analysis.

The most common analytic approach in natural experiment studies was cross-sectional comparisons of exposed and unexposed groups (n=55, 35%). For example, Taber and colleagues used regression models to compare dietary intake among high school students in California, one of the first states to regulate the nutrition content of competitive foods in schools, to students in states without competitive food laws.[93] The second most common design was pre/post with the pre-intervention period serving as the control for the post-intervention period (n= 48, 31%). For example, one study evaluated changes in physical activity after construction of a bus line and car-free walking and cycling route in Cambridge using a pre/post analysis embedded in an existing cohort study. The study compared activity levels collected from an annual survey one year before and one year after the construction was complete.[55] Forty-five studies used difference-in-difference approaches (29%) looking at changes before and after the intervention compared to an external control group. This was the third most common study design. This category includes studies such as an evaluation of a new supermarket that opened in a food desert through the Pennsylvania Fresh Food Financing Initiative.[55] Researchers collected BMI and fruit and vegetable intake from residents of intervention and control neighborhoods at one point before and one point after the construction of the supermarket.

For the 48 pre/post studies, the average number of time points pre- and post-intervention was 1 and 1.6, respectively. For the 45 difference-in-difference studies, which used changes in time and across groups, there were an average of 1 and 1.2 time points pre- and post-intervention. Among the studies included in this review, all pre/post studies measured variables at a single time point pre-intervention, and 80 percent had a single measure post-intervention. Difference-in-difference studies also all had a single measure pre-intervention, and 83 percent had only a single post-intervention measure. We use the terms pre/post and difference-in-difference for studies with multiple time points post-intervention rather than interrupted time series due to the small number of time points (maximum 6 points) and the lack of formal interrupted time series methods such as autoregressive integrated moving average.

Description of Methods Used in Experimental Studies

One hundred eighteen studies (40%) included in this review met the criterion for experimental studies, defined as evaluations of researcher-controlled programs, policies, or built environment changes (see Methods for KQ 4). Experimental methods included 74 RCTs (63% of the experimental studies, 25% of all studies), and 44 controlled trials (37% of experimental studies, 15% of all studies) in which the investigator assigned the exposure by means other than randomization (Table 10). Shape Up Somerville is an example of a controlled clinical trial that took place in one intervention and two control communities in Massachusetts. Researchers selected Somerville as the intervention site due to ongoing relationships with that community, so this would not be considered a natural experiment. This community-wide, multi-level diet and physical activity program included a Walk to School Campaign, changes to school breakfast and lunch programs, school and afterschool education programming, enhanced playgrounds for recess, and a restaurant initiative.[94]

Of the experimental studies, the unit of intervention allocation was most often at the organization level (66%) or the community level (23%). Analyses were most often conducted at the individual level (93%).

Description of Methods Used in Other Study Approaches

Twenty studies in this category (7%) did not provide sufficient detail to determine whether the research team was in control of assigning the intervention, whether the intervention was originally intended to be research, or otherwise would be included as either a natural experiment or experiment. Most often, the exposure was at the community (40%) or organizational (45%) level, but the analysis was carried out at the individual level (90% of studies). Thirty-five percent of these studies did not take the hierarchical nature of the data structure into account in the analysis. These studies were most often pre/post (45%) or difference-in–differences (40%) designs.

Table 10. Overview of study design or data collection structure (N=294 studies)

	n	Percent
Natural experiment* studies	156	53
Cross-sectional comparison of exposed and unexposed groups	55	35
Pre/Post	48	31
Difference-in-differences	45	29
Regression Discontinuity	1	1
Interrupted Time Series	4	3
Instrumental Variables	4	3
Other	1	1
Experimental studies	118	40
RCT	74	63
CCT	44	37
Other studies	20	7
Regression model	3	15
Pre/Post	9	45
Difference-in-differences	8	40

*Studies may employ multiple methods and therefore be counted in several categories.

Key Question 5: Risk of Bias

Key Question (KQ) 5: What are the risks of bias in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

Overview

This question aims to evaluate the risks of bias using a standard tool as well as supplemental study design-specific items to identify methodological/analytic advances that would help strengthen efforts to evaluate the effect of future programs, policies, and built environment changes related to obesity prevention and control

Key Findings

- Most natural experiment studies were rated as having a "weak" global rating (i.e., high overall risk of bias), with 63 percent having a weak rating for handling of withdrawals and dropouts, 42 percent having a weak rating for study design, 40 percent having a weak rating for confounding, 26 percent having a weak rating for data collection.
- Among natural experiment studies, regression adjustment was the most common method to control for confounding (73%), followed by direct covariate matching or stratification (12%).

Methods

Data Abstraction

To address KQ 5, we used three complementary approaches recognizing that no risk of bias tool has been specifically designed to assess natural experiment studies, and that all tools have their strengths and limitations. First, to enable comparisons across all study designs (both natural experiment studies and experimental studies), we chose to apply a single risk of bias assessment tool to be used across all studies. Second, we developed additional study design-specific risk of bias questions for the non-experimental designs commonly used in natural experiment studies, such as interrupted time series. Table 11 shows the most commonly encountered types of non-experimental study designs and specific bias concerns we considered relevant to assess. Third, we used an alternative risk of bias assessment tool for a randomly selected sample of the natural experiment studies. The overall intention was to focus on assessing the risk of bias, or internal validity of studies, rather than on applicability or external validity of studies.

To assess risk of bias, our goal was to select a tool that could address many of the risk of bias concerns of natural experiment studies in a single scale. We chose the Effective Public Health Practice Project (EPHPP) tool because it was simple to apply, was interpretable across multiple study designs, and had been developed specifically for population-based programs and policies similar to studies in our systematic review. We considered a number of tools and compared The Risk Of Bias In Non-randomized Studies – of Interventions (ROBINS-I)[95] against the tool from the EPHPP.[96] The EPHPP tool was compared with an earlier version of the ROBINS tool and was shown to have fair inter-rater agreement, a notable challenge for the highly subjective process of risk of bias assessment.[97] In its guidance about using natural experiments, the UK's

Medical Research Council [41, 42] suggested using the Newcastle-Ottawa Scale,[98] a tool developed for observational studies. However, our review included both experimental and observational studies (see Scope of the Review in Methods) and therefore we could not apply the Newcastle-Ottawa Scale across all studies. The EPHPP tool yields individual scores of the domains and an overall classification of risk of bias, and addresses the risk of bias domains common to other tools like ROBINS and the Newcastle-Ottawa Scale.

We trained our risk of bias reviewers in applying the EPHPP tool. Two reviewers independently assessed each study's risk of bias using six domains from the EPHPP tool for all studies:[96] Table 12 displays the domains from the EPHPP, summarizes the included items, and describes the criteria for receiving a "weak rating." Appendix D lists all the items for the EPHPP tool.

Studies received domain-specific ratings as "strong", "moderate" or "weak" according to the EPHPP algorithm [96]. Each study also received a global risk of bias rating: "strong" if none of the domains were rated as weak, "moderate" if only one of the domains was rated as weak, or "weak" if two or more of the domains were rated as weak. For example, to assess selection bias the EPHPP has questions on whether the selected individuals were likely to be representative of the target population, and what percentage of selected individuals agreed to participate. The study would be rated as "weak" on the selection bias domain if: "the selected individuals are not likely to be representative of the target population and there is less than 60 percent participation, or the selected individuals are not described/can't tell and the level of participation is not described/can't tell." Any study, including one with a non-experimental study design, could receive a "strong" global rating if it was not rated as "weak" in any of the domains.

While we found the EPHPP's domains applicable to assessing the risk of bias in natural experiment studies, it was not specifically designed for these types of studies, as no tool exists specific to natural experiment studies. To supplement the EPHPP in addressing bias specific to natural experiment study designs, we additionally assessed the methods to address confounding and types of adjustment in all studies, and developed the design-specific risk of bias questions to assess specific threats to bias for each of the non-experimental designs listed in Table 10. In addition, in a subset (n=20) of randomly selected natural experiment studies, we used the Newcastle-Ottawa Scale for Cohort Studies to assess the risk of bias and compared results to those from the EPHPP tool (Appendix L).[98]

Data Synthesis

We described the risk of bias assessments across all studies and by type of study design. As described in the KQ 5 Methods, we used the EPHPP tool for all 294 studies to rate the risk of bias in the 6 domains of selection bias, study design, confounding, blinding, data collection, and withdrawals and dropouts (Appendix C). The EPHPP also provided a global bias rating based on the results across these 6 domains (Appendix C). We summarize the risk of bias ratings across studies by study design type: natural experiment studies, experimental studies, and other studies.

Table 11. Analytic methods that can be used in non-experimental studies and specific bias concerns

Analytic Method	Definition	Key Assumptions	Specific Bias Concerns
Cross-sectional comparison of exposed and unexposed groups [42]	Compares exposed and unexposed groups at a single point in time Propensity score methods or regression adjustment can be used to adjust for observed confounders within this design.	Adjustment for observed confounders No unmeasured confounding	Confounding
Difference in differences [99, 100]	Compares exposed and unexposed groups before and after the exposure Takes advantage of variation across time and across groups	Unobserved differences between the two groups do not change over time; i.e., in the absence of the exposure, the trend in outcome in the two groups would be identical.	Changes over time (independent of exposure) that differentially affect exposed or unexposed group
Instrumental variable [101, 102]	Involves identifying an "instrument" that influences receipt of the program or policy of actual interest but does not directly influence the outcome; the instrument also needs to be, at least hypothetically, randomized.	Instrument is associated with receipt of the program or policy of interest (testable). Exclusion restriction: no direct effect of the instrument on the outcome; i.e., Instrument associated with outcome only through exposure Instrument randomized (no common cause with outcome), or at least conditionally randomized (conditional on observed factors)	Violation of exclusion restriction Non-randomization of instrument Weak instrument (not strongly predictive of exposure itself)
Interrupted time series[103, 104]	Assesses change over time before and after a policy intervention Design stronger if also includes data on an untreated comparison group (in which case it is an extension of a difference-in-differences design to multiple time points).	Unobserved differences between groups are fixed No other "interruption" at the time of the policy change Groups would have identical changes in trends in absence of intervention.	Group composition changing over time Comparison group not providing accurate estimate of what would have happened in absence of intervention (e.g., if trends over time differ in unobserved ways between comparison and intervention sites) Change in measurement over time

Analytic Method	Definition	Key Assumptions	Specific Bias Concerns
Pre/Post [42]	Compares one group before and after an intervention, with the pre-intervention period serving as the control group for the post-intervention period.	No secular trend in the outcome	Changes over time unrelated to the exposure
Regression discontinuity [105-107]	Uses a cutoff/ rule to assign intervention status; analysis compares those just above the cutoff to those just below the cutoff to estimate effect of the intervention	Smooth model relating the cutoff variable to the outcome in the absence of the intervention Intervention must have been assigned using the cutoff/rule	Unclear demarcation at cutoff Manipulation of cutoff variable near the cutoff Incorrect model specification above or below the cutoff

Table 12. Summary of Effective Public Health Practice Project quality assessment tool

Domain	Summary of Items	Criteria for Weak Rating
Selection bias	Representativeness of sample Participation rate	Sample not likely to be representative of target population; or participation rate less than 60%
Study design	Type of study design Randomization	Not reported or not RCT, CCT, cohort study, case control, or interrupted time series
Confounders	Baseline differences between groups Control for confounding	Less than 60% of identified confounders accounted for in analysis; or confounding not assessed/reported
Blinding	Blinding of outcome assessor Blinding of study participants	Both outcome assessor and study participants are not blinded
Data Collection Methods	Validity of data collection tools Reliability of data collection tools	Data collection tools not shown to be valid; or validity and reliability not described
Withdrawals and dropouts	Count and reasons for dropouts Percent completing study	Follow-up rate of less than 60%; or no report of attrition
Global Bias Rating	Summary of all six domains	Two or more weak ratings

CCT=controlled clinical trial; RCT=randomized controlled trial

Results

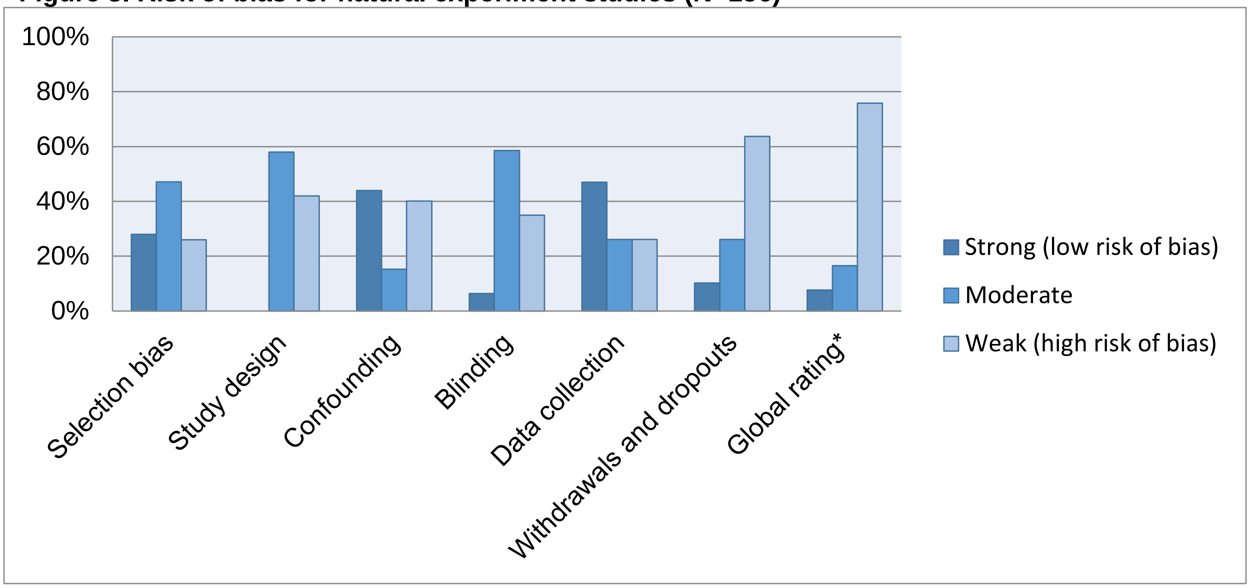
Risk of Bias in Natural Experiment Studies

Figure 8 shows EPHPP risk of bias ratings for the 156 natural experiment studies. The domains most likely to be rated as strong (i.e., low risk of bias) were data collection methods and confounding, but still only a minority of natural experiment studies were rated as strong in those domains: 74 (47%) for data collection, and 69 (44%) for confounding. EPHPP rates studies as "strong" in the domain of confounding if the researchers control for at least 80 percent of identified confounders, or if there were no important differences between exposed and unexposed groups at baseline. For example, one evaluation of the Los Angeles Fast Food Ban used the California Health Interview Survey to compare changes in diet and obesity outcomes among residents of areas affected by the ban compared to residents of areas not affected by the ban.[60] In addition to selecting comparison neighborhoods, researchers controlled for both individual level and neighborhood level confounders: individual gender, age, race, household size and income, marital status and income; as well as neighborhood population density, median income, and racial composition. Studies received a "strong" rating in data collection methods if the data collection tools employed were shown to be both valid and reliable; for example, the use of the Recent Physical Activity Questionnaire to evaluate the impact of a new transit system on physical activity.[83] See Appendix K for individual risk of bias ratings.

EPHPP's selection bias domain covers the likelihood that the study participants are representative of the target population as well as the percentage of individuals who agree to participate. Forty-three natural experiment studies were rated "strong" on selection bias (28%); 98 studies (63%) were rated as "very likely" that the study sample was representative of the target population, but only 40 studies (25%) reported that 80 to 100 percent of selected individuals agreed to participate. Ninety-nine natural experiment studies were rated as "weak" (i.e., high risk of bias) in the domain of withdrawals and dropouts (64%). In 30 percent of natural experiment studies, withdrawals and dropouts were either not reported or not enough information was given for a reviewer to determine how attrition was handled. For example, one evaluation of a new bus line and pedestrian thoroughfare collected data from 1143 commuters at baseline, but was only able to collect limited follow-up data as many participants were lost from each group and for unclear reasons[83].

The EPHPP risk of bias assessment tool rates only randomized controlled trials (RCTs) and controlled clinical trials as “strong” in the study design domain, therefore none of the natural experiments were rated as having “strong” study designs. EPHPP rates studies on blinding of both participants and outcome assessors to intervention status. Although blinding of outcome assessors may be possible in some natural experiment studies, blinding of participants often is not feasible. Thus, it is not surprising that few studies were rated strong in the domain of blinding.

Figure 8. Risk of bias for natural experiment studies (N=156)



*Studies are given a “strong” global rating if there are no domains given a “weak” rating, a “moderate” global rating if there is a single domain with a “weak” rating, and a “weak” global rating if there are two or more domains with a “weak” rating.

Since confounding is a common source of bias in natural experiment studies, we examined the most commonly adjusted for control variables in natural experiment studies (see Table 13). This does not include the criteria on which comparison groups were matched among the studies that used, for example, a matched comparison community. Of the 156 studies, 24 percent controlled for community-level confounders, and 17 percent controlled for school or worksite level confounders. Controlling for individual-level variables such as age, race, gender, and

Table 13. Common categories of control variables accounted for in natural experiment studies (N=156)

Category	Examples	n (%)
Age	Age, age categories, grade	82 (52)
Race/ethnicity	Race, Hispanic ethnicity	63 (40)
Sex or gender		94 (69)
Baseline measure of outcome	BMI or BMI category at baseline, physical activity at baseline	32 (20)
Household socioeconomic status	Income, parental education, food security, eligibility for free lunch, welfare or SNAP recipient	68 (43)
School characteristics	Proportion of students by race, proportion of students eligible for free lunch	27 (17)
Community characteristics	Proportion by race in census tract, population density, density of food and alcohol establishments, area-level employment, education, income, urban or rural	38 (24)

BMI=Body Mass Index; n=number of studies; SNAP=Supplemental Nutrition Assistance Program

household socioeconomic status, was more common. Four studies included a sensitivity analysis to explore robustness of the results to unobserved confounders.

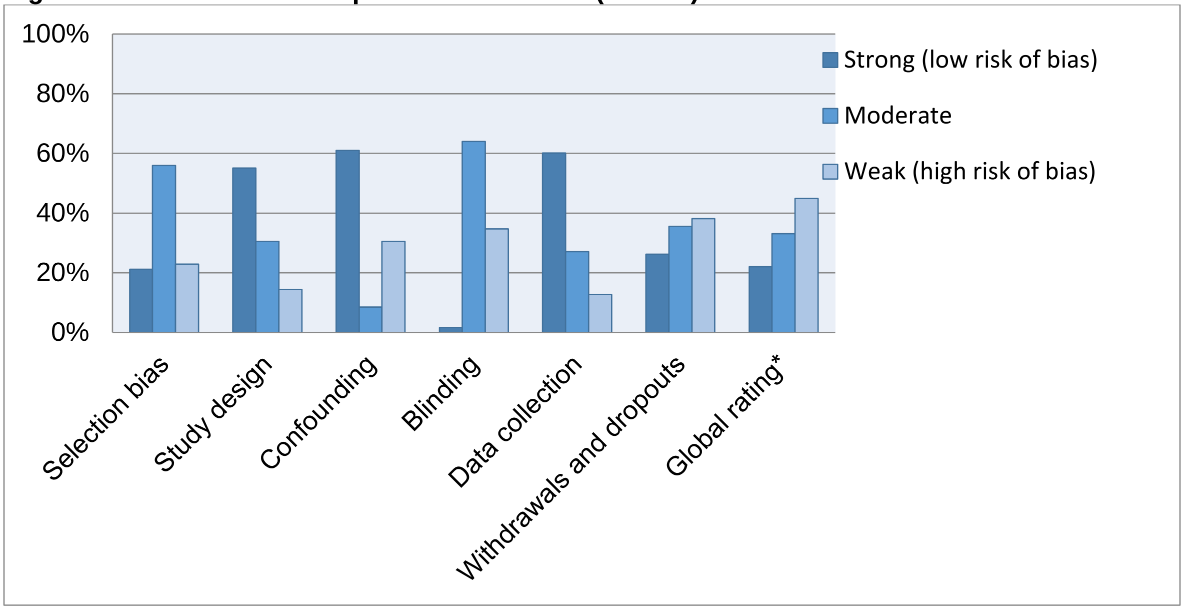
Among the natural experiment studies, the most common method used to minimize the risk of bias associated with confounding was regression adjustment (73%), followed by direct covariate stratification or matching (12%). Propensity score methods were used in 4 studies (3%). One study used synthetic control methods to create a control group and used that group in models that adjusted for confounding.[108] In 2004, the Los Angeles school district began regulating the nutritional content of all food in all its schools. Due to the lack of an appropriate comparison group, the researchers created a synthetic control group, which is a weighted combination of several control districts that more closely resembles the Los Angeles school district prior to 2004, in order to evaluate the policy. Although some studies used multiple methods to control for confounding, such as regression adjustment and matched controls, others used very limited or no methods to control for confounding. A challenge in assessing the success of the confounding control, however, is that 33 percent of studies did not include a “Table 1” with a comparison of key demographic and potentially confounding variables (age, sex, race, etc.) between the exposed and unexposed groups.

Instrumental variable, regression discontinuity, and interrupted time series analyses were rarely seen in the studies included in this review. We reviewed fewer than five of each of these studies and cannot generalize risk of bias in these designs due to the small numbers (see KQ 4).

Risk of Bias in Experimental Studies

As shown in Figure 9, experimental studies rated strongly in the domains of study design, confounding, and data collection methods, meaning that risk of bias in these domains is low. However, most of these studies were rated as moderate or weak in the areas of blinding, selection bias, and handling of withdrawals and dropouts. In 57 percent of RCTs, the study population was rated very likely to be representative of the target population. Studies also received weak ratings in these categories when they failed to provide the information needed to assess these domains. See Appendix K for individual study risk of bias ratings.

Figure 9. Risk of bias for experimental studies (N= 118)

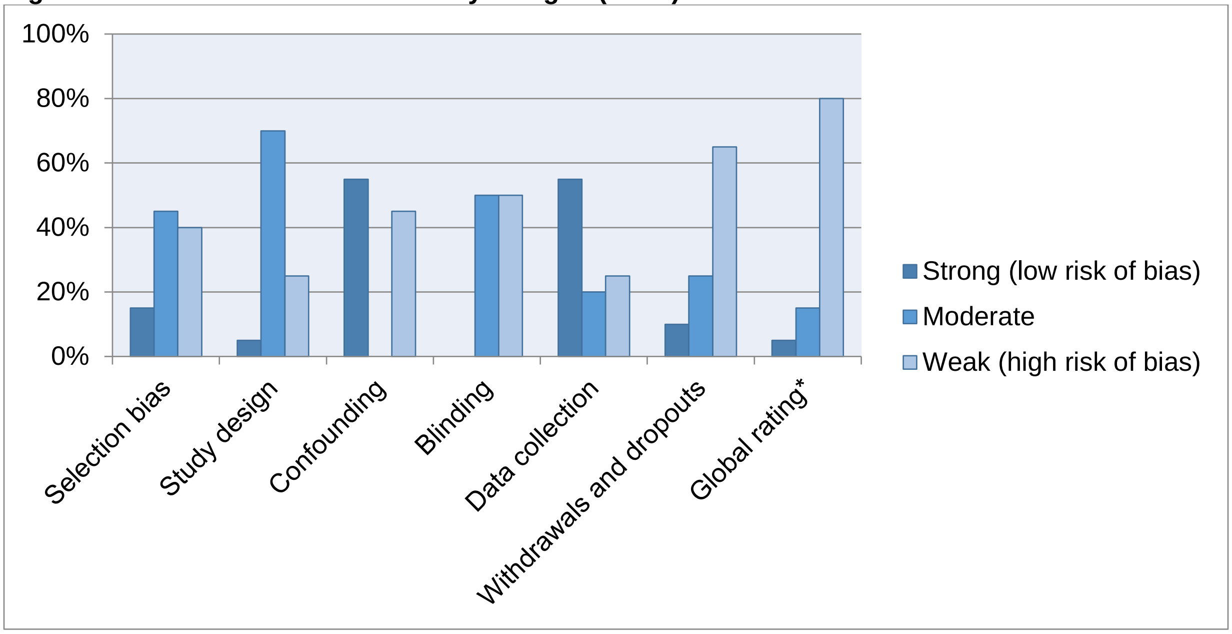


*Studies are given a "strong" global rating if there are no domains given a "weak" rating, a "moderate" global rating if there is a single domain with a "weak" rating, and a "weak" global rating if there are two or more domains with a "weak" rating.

Risk of Bias in Other Study Designs

As shown in Figure 10, the 20 studies (7%) in this category did not provide sufficient detail to determine whether the research team was in control of the intervention, whether the intervention was originally intended to be research, or otherwise would be included as either a natural experiment or experiment. Sixteen of these studies (80%) received "weak" (i.e., high risk of bias) global ratings using the EPHPP tool. The domains where they were most likely to be rated "weak" included blinding (50% rated weak) and withdrawals and dropouts (65% rated weak). Only 45 percent of the studies described how potential confounders and key demographic information differed between exposed and unexposed groups, making assessments of confounding challenging. These studies did control for some individual confounders such as age (50%) and gender (45%), but none controlled for community level confounders and only 15 percent controlled for school or site level confounders.

Figure 10. Risk of bias for other study designs (N=20)



*Studies are given a "strong" global rating if there are no domains given a "weak" rating, a "moderate" global rating if there is a single domain with a "weak" rating, and a "weak" global rating if there are two or more domains with a "weak" rating.

Risk of Bias Assessment Using Another Scale

Because no risk of bias tool has been developed specifically for natural experiment studies, we compared our bias assessment from EPHPP with an assessment from the Newcastle-Ottawa Scale[98] (Appendix L) in a random subsample of 20 natural experiment studies. The domains of the EPHPP and the Newcastle-Ottawa Scale are not directly comparable, and only the EPHPP has a global rating score. The Newcastle-Ottawa scale includes three domains: selection, comparability (of exposed and unexposed groups), and outcome (includes both method of outcome assessment and follow-up rates). As mentioned previously, the EPHPP tool includes the domains of selection bias, study design, confounding, blinding, data collection methods, withdrawals and dropouts, and a global rating. Overall, we showed that fewer natural experiment studies received the highest rating (lowest risk of bias) using the Newcastle-Ottawa Scale, compared with the EPHPP tool. For example, using the Newcastle-Ottawa Scale, only 3 of 20 studies received the highest rating in the "selection" domain, 9 of 20 studies in the "confounding" domain, and one of 20 studies in the "outcomes" domain. Using the EPHPP tool, 5 of 20 received the maximum rating in selection and half received the maximum score in the confounding domain (Appendix L).

Key Question 6: Methodological Advances

Key Question (KQ) 6: What methodological/analytic advances (e.g., data system features, approaches to linking data sources, or analytic methods) would help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control?

Overview

KQ6 provided an opportunity to get feedback from experts in the field of obesity research about suggestions for methodological/analytic advances (e.g., data system features, approaches to linking data sources, or analytic methods) to strengthen efforts to estimate the effect of programs, policies or built environment changes on obesity prevention and control.

Key Finding

- The internal advisors agreed about the importance of 24 methodological/analytic advances that the core research team suggested for strengthening efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control.

Methods

Data Abstraction

To address KQ 6 about the needs for methodological/analytic advances, we followed the following steps to engage our research team, internal advisors, and external experts:

1. We asked each investigator on the research team to suggest answers to KQ, 6 taking into consideration the results for KQ 1-5, and the following specific questions:
    a. What features or types of data sources could help researchers advance methods for conducting studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?
    b. What methodological advances would help to facilitate better or more frequent linkage of population-based data sources for studies, especially natural experiments, in obesity prevention and control?
    c. What methodological advances (e.g., measures and data collection procedures) would help to strengthen the assessment of obesity-related outcomes, including dietary and physical activity behaviors in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?
    d. What study design and analytic approaches would help to strengthen methods and reduce the risk of bias encountered in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?

2. We discussed the suggestions as a team and created a master list of unique items based on the consensus of the team.
3. We developed a form to elicit feedback about the list of methodological/analytic advances that could improve obesity prevention and control natural experiments (See Appendix F for the form).
4. We asked our internal advisors to review the form and provide input on the list. We chose the experts based on their expertise. All of the internal advisors have training and practice in health policy. Two experts have clinical expertise in obesity prevention and control (adults and children). Additionally, the internal advisors provide expertise in: economic decision making; cost-effectiveness; and housing, community planning, and urban development.
5. We obtained additional input from external technical experts about the suggested methodological/analytic advances that are needed by asking them to complete the form as part of their review of the draft of the evidence report.

Data Synthesis

For this report, we prepared a master list of methodological/analytic advances that would help strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control, as developed the study team. At the request of the Pathways to Prevention Workshop planners, we did not prioritize the items on the list.

Results

Our research team developed questions to elicit feedback from internal advisors and external experts about what methodological/analytic advances (e.g., data system features, approaches to linking data sources, or analytic methods) would help to strengthen efforts to estimate the effect of programs, policies or built environment changes on obesity prevention and control. We then developed several recommendations within each of these questions aligned with our KQs: KQs 1 and 2 were fcoused on identifying methodologic or analytic advances that may impact the frequency and better use of data sources in public health studies; KQ 3 was focused on identifying methodologic and analytic advances that would lead to more consistent reporting of obesity-realted outcomes and measures; KQs 4 and 5 were focused on identifying methodologic and analytic advances that would lead to more consistent use of terms in reporting study designs, as well as lead to more time series designs, natural experiment studies, and development and use of validated tools.

Table 14 summarizes these questions and the corresponding recommendations from our research team regarding methodological/analytic advances that could help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control. These recommendations were then independently reviewed by our internal advisors and external experts having varied areas of relevant expertise (see Methods for details on area of expertise). The advisors agreed that 24 of the 26 items were important. The only items that were not endorsed by all advisors were the call for consistent use of a standard format for describing how data were collected and validated (including data quality control processes), and the call for requiring an explanation of how each data source was intended to be used, both addressing KQ1.

Table 14. Analytic and methodologic advances identified by internal and external experts

Key Question(s)	Form Question	Answers
1	What features or types of data sources could help researchers advance methods for conducting studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?	A process that encourages and facilitates dissemination of publicly available information about the existence and location of data sources that include information about obesity-related outcomes.
		A process that encourages and facilitates dissemination of publicly available information about the existence and location of data sources that include information about programs, policies, or built environment changes that could affect obesity prevention and control
		Consistent use of standard terminology in data sources that include obesity-related information, including such concepts as: classification of interventions intended to contribute to obesity prevention and control (e.g., governmental program or policy, non-governmental program or policy, or built environment change); and units of measurement of obesity-related outcomes
		Consistent use of data dictionaries and codebooks that define all elements, and that are readily accessible and searchable
		Consistent use of a standard format for describing how data were collected and validated (including data quality control processes)
		Explanation of how each data source was intended to be used
		Description of the timing of interventions in data sources containing information about programs, policies, or built environment changes that could affect obesity prevention and control
		Inclusion of BMI and other health behavior data in data sources covering small geographic areas
2	What methodological advances would help to facilitate better or more frequent linkage of population-based data sources for studies, especially natural experiments, in obesity prevention and control?	Consistent use of standard procedures for linking health care data from different sources
		Development and use of new methods for linking data on social determinants of health with health care data
		Development of reporting standards by publishers for the description of how data sources are linked when studies report more than one data source in manuscripts
		Adoption of standard policies and procedures for exchanging/sharing data

Key Question(s)	Form Question	Answers
3	What methodological advances (e.g., measures and data collection procedures) would help to strengthen the assessment of obesity-related outcomes, including dietary and physical activity behaviors in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?	Standardized measures and methods for obesity-related outcomes across populations and studies to better facilitate comparisons
		Improving data collection measures for park-based and transportation-based studies to assess changes in individual and population physical activity beyond observing park or transportation use
		Assessment of the validity of intermediate outcomes such as studies of food purchasing behavior correlated to behavioral and health outcomes
		Longer term surveillance of measures to measure the impact of an intervention on changes in obesity measures over time
		Inclusion of BMI and other health behavior data in data sources covering small geographic areas
		Establishing standards for the collection of obesity-related outcomes in adults and children
		Consistent use of validated measures of obesity-related outcomes across studies.
		Consistent use of terminology in describing measures of obesity-related outcomes used in surveys or observational studies
4 and 5	What study design and analytic approaches would help to strengthen methods and reduce the risk of bias encountered in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?	Consistent use of standards for terms and reporting in studies of obesity prevention and control using natural experiment designs, including: study design, testing assumptions, sensitivity analyses, observed (and adjusted for) confounders, and unobserved confounders
		Design-specific reporting standards for observational study methods used in natural experiments related to obesity prevention and control
		Greater use of time-series designs instead of simple pre-post comparisons in studies of obesity prevention and control
		Greater use of stronger natural experiment designs such as instrumental variables and regression discontinuity
		Development and use of validated instruments for measuring the “exposures” in studies of how programs, policies, or built environment changes affect obesity prevention and control
		Development and use of a specific practical and validated tool for assessing the risk of bias in observational studies of how programs, policies, or built environment changes affect obesity prevention and control

BMI=body mass index

Discussion

We conducted a systematic review of studies that evaluate how policies, programs, and built environment changes affect obesity prevention and control outcomes. For Key Question (KQ) 1 and KQ 2, we focused on summarizing and evaluating the data sources and data linkages used in those studies. For KQ 3, we summarized how studies assessed childhood and adult obesity outcomes, dietary and physical activity behaviors, and other co-outcomes (e.g., commuting behavior). For KQ 4 and KQ 5, we evaluated the risks of bias in the experimental and non-experimental studies. For KQ 6, we identified specific methodological/analytic advances that could strengthen efforts to estimate the effectiveness of programs, policies, and built environment changes intended to improve obesity prevention and control.

We identified 294 studies (including 156 natural experiment studies), a majority of which were conducted in the United States. We included a wide range of policies, programs and built environment changes, including 152 studies that evaluated governmental programs or policies at the local, state/regional, or federal levels with 139 unique policy or program evaluations.

For KQs 1 and 2, we reported on 93 studies using a primary or secondary data source that were sharable with other researchers, with a total of 116 unique data sources. Among these, 106 data sources met criteria for being a data system. Data systems represent organized, accessible data sources that go behind just collecting and managing data, but also have some degree of an information technology infrastructure to maintain and operate the system. Of the 106 data systems, 96 were used in natural experiments. One third of the 71 US data systems were linked with a data source other than a primary data source, most commonly using a geographic allocation (e.g., by county or zip code) or at the individual-level.

For KQ 3, we found 112 studies with childhood BMI/weight outcomes (50 were natural experiment studies), 32 studies with adult weight/BMI outcomes (17 were natural experiment studies), 148 studies with dietary behaviors (77 were natural experiment studies) and 152 studies on physical activity (71 were natural experiment studies). Thirty-seven of the studies also reported on commuting behaviors, food environment, physical environment, or food purchasing behaviors. Weight was most commonly directly measured by trained staff. Questionnaires for assessing dietary behaviors included the School Physical Activity and Nutrition and Youth Risk Behavior Survey (YRBS) Questionnaires in children, and the Behavioral Risk Factor Surveillance System (BRFSS) in adults. The most common methods for assessing physical activity were questionnaires and electronic monitoring, e.g., pedometers, for all types of study designs.

For KQs 4 and 5, natural experiment studies most commonly used regression models to compare exposed and unexposed groups at a single time point (35%). The next most common analytic approach was comparing exposed and unexposed groups using difference-in-difference methods (29%), followed by pre/post designs that compared one group before and after an exposure (31%). Fewer studies used instrumental variable, regression discontinuity or interrupted time series approaches with more than 2 time points pre- and post-intervention. Most natural experiment studies were rated as having a “weak” global rating (i.e., high risk of bias) due to handling of withdrawals and dropouts, weak study design and weak handling of confounding.

Findings in Relationship to What Is Already Known

Our systematic review is the first to focus on describing and appraising the methods (data sources, study design, and analytic approaches and risks of bias), used in natural experiment studies of policies, programs, and built environment changes to prevent and control obesity. Our review was broad and comprehensive, and included both U.S. and non-U.S. studies, all types of policy, programmatic and built environment interventions and all study designs. Although our review focused on evaluating the methods, other recent systematic reviews identified many of the same articles but focused on assessing the effectiveness of certain types of policies or programs, such as on food environment policies,[24, 109-111] (e.g., the review by Sisnowski et al. included 36 articles), or built environment changes (e.g., reviews by Ferdinand et al included 169 articles [109] and Mayne et al included 37 articles[36]), as well as specific settings such as school-based programs or policies[112] (included 32 articles). Another 2013 systematic review included 147 studies focused on the effectiveness of childhood obesity prevention.[113] Finally, Gudzune and colleagues' systematic review focused on the prevention of weight gain in the worksite or college settings.[114]

Our systematic review has several significant and original contributions to advance the field of obesity prevention and control, particularly for informing the future design and reporting of natural experiment studies related to obesity prevention and control. Although a few prior studies have described the current state of data sources and data linkages in public health research (e.g., a review of data systems for the field of suicide prevention),[86] no studies have created this list in the field of obesity, which will be useful for future obesity research. Additionally, for obesity measures, a database of measures exists for childhood obesity, called the National Collaborative on Childhood Obesity Research (NCCOR) Measures Registry,[53] but no database exists for adult obesity research. The NCCOR serves to catalog the data sources, but does not assess which measures are used in research or other evaluations, which is a major contribution of our examination of KQ 3. Finally, for KQs 4 and 5, we described study designs and analytic approaches currently being used in natural experiment studies, and determined the extent to which studies were limited by specific types of bias. While there is growing interest in using natural experiments to evaluate obesity policies and programs, a major contribution of our review was to highlight areas for improvement in the approaches, and the need for stronger guidance and standards for evaluators to report their designs and findings to enhance trust in their results.

Applicability

The applicability of our review and the identified studies depended on the diversity of study populations, obesity policies and programs, and outcomes assessed. We summarized applicability in terms of the populations, interventions, comparators, outcomes, timing, setting framework, as well as in terms of each of the KQs.

The populations of the studies included both obese and non-obese children and adults, and these populations were generally applicable to other populations and communities. However, of the 261 studies, the majority were of children, with fewer evaluations of policies and programs in adult populations or community (non-school) settings. Many studies did not report the races and ethnicities of their populations being studies. Of those that reported race and ethnicity, few studies included Native Americans, or targeted a high proportion of Hispanics.

We included interventions that were governmental and non-governmental population-based programs. We identified a wide range of obesity-related policies and programs, including state- (e.g., Arkansas Act 1220 focused on school nutrition and physical activity)[115] and federal-level legislation (e.g., Food Stamp Program).[75, 116-120] These evaluations of policies and programs are applicable and specific to the setting where the policy or program was enacted and implemented.

To enhance applicability of the review, we included studies that reported health outcomes and behaviors important to policymakers, program evaluators, researchers and clinicians, namely weight, dietary behaviors and physical activity. Many studies reported on childhood weight outcomes with fewer studies reporting on adult weight or body mass index. Even more studies reported dietary or physical activity measures. These outcomes are applicable to the population of interest, and are important for assessing the impact of obesity related policies and programs, particularly given the growing epidemic of obesity in both adults and children. Although weight and behavior change may be long-term outcomes, some evaluations of programs and policies have begun to demonstrate significant impact on these outcomes.[19, 56]

The studies' settings were both in the United States and other countries, and set in the workplace, school and diverse communities. We included a total of 106 studies from outside the United States. Few studies reported their setting as within a rural community.

Regarding the applicability of KQ1 results, we showed that the majority of the U.S. data systems were statewide or nationally representative. Data systems with a state-level focus were mainly collected in California, New York, Massachusetts, Minnesota, Pennsylvania, Texas and Alaska. Most of the U.S. data systems had a focus on schools or communities.

For KQ4 and KQ5, we described methods and risks of bias in natural experiment studies, as well as experimental designs, and highlighted the strengths, as well as risks of bias associated with each of them. Although randomized controlled trials (RCTs) are considered the gold standard to reduce risks of bias, RCTs are challenging to implement due to high cost and often randomization of participants or communities to policies or programs is not feasible. To improve the applicability and validity of their evaluations, researchers could consider innovative trial designs that would allow randomization, such as stepped wedge or waitlist control designs. However, few studies used these approaches. The questions in obesity policy research are well suited for natural experiment study designs to increase the internal and external validity of their studies when assessing causal effects.

Limitations of the Systematic Review Process

We noted several limitations to our systematic review process. First, we developed several exclusions, most significantly excluding: studies without a clear comparison or unexposed group or time period; studies without a defined population-based program, policy, or built environment change; and studies without our main outcomes of weight or obesity-related health behavior. Examples of studies that we excluded are those that assessed the associations between perceived or measured home, school, or physical environment and various weight-related outcomes (e.g., Wong et al. 2016[121]) but without a described program, policy, or change in the environment. We sometimes excluded studies that evaluated policies because they did not include one of our main outcomes, such as the study by Chen and colleagues evaluating the effect of menu labeling on change in caloric information awareness,[58] but without a measure of change in dietary intake. We also excluded park and transportation studies that reported observed number of users of the park or form of transportation, instead of the individual–level change in physical activity. For example, a study by Fitzhugh and colleagues assessed the effect of an urban greenway/trail on directly observed physical activity in the general neighborhood and school, but did not have measures of individual behavior change, which we required in this review.[122]

Second, regarding our evaluation of data sources and linkages, we limited our full assessment of data specifications to studies conducted in the United States to enable consistent access and identification of codebooks in English. However, even among these data sources, our ability to fully assess data quality was limited by the low availability of online codebooks and data dictionaries.

Third, although the focus of the review was to improve our understanding of obesity-related natural experiments, the definition of what methods and designs meet a definition of a "natural experiment" continues to evolve. As described in the Methods, we classified "natural experiments" according to the MRC[41] definition as those where "the intervention/control was assigned to participants/communities/schools by factors outside the control of the investigators." In applying this definition, we identified some studies where it was not clear. For example, one study evaluated the Healthy Hawaii initiative and provided trends in percent of population eating fruits and vegetables by year, but it was neither a natural experiment study nor an experimental design.[123] We presented the findings of this review by "natural experiment", experimental designs, and other non-experimental designs, in order to compare within and across study design approaches, and also to avoid being constrained by an evolving, and often subjective, natural experiment definition.

Fourth, we relied on a previously developed risk of bias assessment tool. No well-established risk of bias assessment tool exists specifically for natural experiment studies. To enable comparisons across all study designs (both experimental and non-experimental) included in the review, our goal was to use a single tool. A general tool such as the Effective Public Health Practice Project (EPHPP) is useful for gathering information on risk of bias due to a number of bias concerns, including measurement error and loss to follow-up and withdrawals. However, tools like EPHPP have been criticized for being overly rigorous and failing to take into account feasibility, implementation and future scalability, which are important issues for natural experiment studies. In addition, risk of bias tools, including the EPHPP, are designed to evaluate internal validity and not external validity, while the strength of a natural experiment study is to enhance generalizability and external validity, which these tools may not address. In its guidance, the UK's Medical Research Council (MRC) [41] suggested using a different risk of bias assessment tool for natural experiment studies, the Newcastle-Ottawa Scale,[98], which was developed for cohort studies. We additionally applied the Newcastle-Ottawa Scale for cohort studies[98] to a randomly selected subset of natural experiment studies. The Newcastle-Ottawa Scale has fewer domains and no global score, making it challenging to compare between the two tools. Overall, we showed that the natural experiment studies were similarly rated as "weak" in terms of risk of bias, across both the EPHPP tool and the Newcastle-Ottawa Scale. The EPHPP and our specific study design approach had other limitations, including our inability to detect the degree of risk from type 2 error among smaller RCTs or cluster RCTs with few clusters. An additional challenge was that any non-experimental study involves some untestable assumptions, and thus we could not directly assess bias but, rather, could only assess the likely validity of the assumptions underlying each approach. In addition, few of the studies did formal assessments of the robustness of results to violations of those assumptions.

Limitations of the Current Evidence

We identified several limitations of the current evidence on methods for obesity-related natural experiments and other evaluations of obesity prevention and control policies and programs. First, the current evidence base not does yet take advantage of the plethora of available data sources on obesity. Natural experiment studies used many national health surveys such as National Health and Nutrition Examination Survey [124] and BRFSS.[125] The Patient Centered Outcomes Research Institute (PCORI) has established PCORNet with 13 Clinical Data Research and 20 Patient Powered Research networks to link patient data longitudinally across patient organizations as well as large health systems in the United States.[126] Although the infrastructure is still under development and testing, PCORNet provides an example of how health care data and outcomes could be used to evaluate obesity prevention policies and programs, especially through linkages with other public health data sources. In addition, the Natural Experiments for Translation in Diabetes collaborations provide examples of how health systems are using natural experiment approaches to evaluate diabetes management and prevention approaches, including telephonic health coaching programs, insurance policies involving high deductibles, early diabetes detection in primary care, and national scaling of the Diabetes Prevention Program.[127] Further, to improve the ability of obesity researchers to use and link data sources with spatial attributes, these data should contain consistent spatial units of analysis that can be easily linked together. For example, census data and traffic data may come in with different spatial units, which makes it difficult to link these data together.

As with other obesity prevention and control studies, natural experiments have many of the same challenges in terms of obtaining valid and reliable measures of dietary intake, physical activity and weight status. All obesity prevention studies should aim to find practical ways to obtain high quality, reliable measures and ensure that the assessment of these variables in other data systems be of the highest possible quality. In our review, we identified several different measures for obesity outcomes. For example, for childhood obesity, we described the use of standard measures, such as change in body mass index (BMI) z-score or BMI percentile; however, several studies used other non-standard measures in children, such as absolute BMI change or weight change in children. We identified a need for population-based studies to use objective measures of diet (e.g., 24 hour recalls) and physical activity (e.g., accelerometers), and to expand measures of body composition beyond body mass index. Additionally, we identified very few studies that reported on co-outcomes or unintended consequences associated with policies or programs.

This review provided a unique opportunity to describe the current evidence in terms of study design and analytic approaches, including natural experiment studies and experimental approaches to evaluate policy and program interventions for obesity prevention and control. Although RCTs are the gold standard for clinical efficacy research, they are often impractical and/or costly when testing the effectiveness of policies or programs that are new or have been adapted from other settings. The MRC’s definition of natural experiments involves studies with “unplanned variation in the exposure of interest.”[41] Because experimental studies also have limitations and biases, in our review we chose to include both experimental designs where the exposure of interest was controlled, as well as non-experimental studies with “unplanned variation” in the exposure.

Among the natural experiment studies, we expected to find common non-experimental designs, such as instrumental variables, regression discontinuity, propensity score, and interrupted time series methods. However, we showed that few studies used these study designs that could improve causal inferences. It is possible that use of instrumental variables is limited by difficulties in selecting appropriate instrumental variables with the data typically available to researchers in this field. By far the most common design was cross-sectional regression models. In addition, many studies failed to present a table of covariate balance across groups to enable assessment of risk of bias due to confounding. Among the natural experiment study designs, an evaluation of Arkansas' Act 1220 was rated as having lower risk of bias.[115] They used a comparison group design using a difference in difference approach to assess the effect of Arkansas Act 1220's mandate on BMI screening in public schools on BMI z-score, using the Centers for Disease Control and Prevention (CDC)'s YRBS.[115] This study received a higher EPHPP rating because it used both valid and reliable data collection tools, was rated as being generalizable, and neither participants nor outcome assessors knew the exposure status of the participants. For pre/post studies (i.e., where an exposed group was compared to itself in a prior time period), the average number of time points pre- and post-intervention was 1 and 1.4, respectively. For difference-in-difference studies, which use changes in time and across groups, there were an average of 1 and 1.1 time points pre- and post-intervention. The MRC recommends multiple pre- and post- measures to improve the design of natural experiment studies, especially when a control group is not available as in the pre/post designs.[41] Among the studies included in this review, all pre/post studies measured variables at a single time point pre-intervention, and 86 percent had a single measure post-intervention. Depending on the research question, the type of natural experiment being evaluated, and the stability of the outcome of interest, adding multiple time points should improve study validity, but could have cost/time implications for researchers and funders.

A standard definition of selection bias is "bias in the estimated association or effect of an exposure on an outcome that arises from the procedures used to select individuals into the study or the analysis".[128] When the selection involves conditioning on a factor that is affected by the exposure or a cause of the exposure, and also affected by the outcome or a cause of the outcome, selection bias can arise even in the absence of a causal effect of exposure on outcome, i.e., under the causal null hypothesis. Because such uses of "selection bias" do not imply lack of internal validity, it is more appropriate to use the expressions "lack of generalizability" or "low external validity." To include concerns about external validity, which is particularly relevant to natural experiment studies, we applied the EPHPP's definition of selection bias to natural experiment studies, assessing to what extent the individuals selected to participate in the study are likely to be representative of the target population.[91]

Future Research Needs and Opportunities

We identified a large number of natural experiment and experimental studies assessing the effects of obesity programs and policies on body weight, BMI, diet and physical activity. Our results highlight a need for future research to use better methodological standards to enhance validity and reporting. To improve the use of data systems and create linkages, we suggest that obesity researchers make greater use of the health information technology infrastructure to conduct pragmatic evaluations of obesity-related policies and programs. Since many people do not obtain longitudinal continuity care, communities need ways to collect ongoing health and behavioral information, as well as link with health care systems, community-level, school, and public health data sources to aim for completeness. Several good examples are Michigan's

Project Healthy Schools[129] and Shape Up Somerville (MA).[94] Michigan's Project Healthy Schools represented a collaboration between the University of Michigan and local community organizations, including public schools, to provide an opportunity for long-term (four years reported in the included study[129]) data collection to assess the effect of a wellness program in school. Shape Up Somerville provided another example of longitudinal data collection in one community to assess the long-term effects of a multilevel childhood obesity prevention program, supported by the CDC.[94] In the future, schools and school systems could collect health information, in particular standard weight and height measures, from their students and then link these data with other sources to increase their ability to evaluate policies and programs aimed at obesity prevention. Ongoing data collection could address the need for having "baseline" assessments available for natural experiment researchers.

To enhance validity and trustworthiness of future research, natural experiments in obesity will need to graduate their approaches from simple two-time point pre/post assessments to include approaches that capture individuals at multiple time points and use multiple comparison/control groups that each have their limitations. To improve the selection of and design of valid comparisons groups, researchers could consider approaches such as propensity score matching and regression discontinuity.[44, 103, 130] For example, regression discontinuity methods take advantage of existing rules or cutoff points that determine receipt of the intervention of interest (e.g., individuals above some BMI threshold receive a program; those below that threshold do not). Persons just above or just below the cutoff are assumed to be very similar, so comparing these groups allows for a valid estimate of the effect of the intervention.[130] Propensity score methods are also underused in obesity research; many studies did not even report the similarity of exposed and unexposed groups, making it hard to know whether they were or were not similar on observed confounders. Propensity score methods can help ensure the comparison of groups that are similar on observed confounders and, thus, avoid extrapolation and model dependence. Also, accompanying sensitivity analyses can be used to assess robustness of the results to a potential unobserved confounder.

Key Question 6 highlighted methodologic and analytic advances that could help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control. These advances include consistent use of data dictionaries, reporting standards on linkage methods of data sources, data sources with long-term public health surveillance of obesity and health behavioral outcomes and use of study designs with multiple pre- and post- exposure time points. Because natural experiments are often conducted to evaluate feasibility, implementation barriers, future research is needed to evaluate studies in terms of implementation outcomes, as current risk of bias instruments do not address feasibility or scalability. Finally, there is growing interest in using systems science approaches to tackle complex population health problems like obesity,[131, 132] but we do not currently have risk of bias or other methods to evaluate the quality or risks of bias in for studies that apply these new methodologies.

Finally, our review highlights the need for methodological standards in study design, analyses, and reporting of data system features and data linkages. Despite guidance from the MRC[41] and the PCORI methodology committee,[133] no standards like the Consolidated Standards Of Reporting Trials for trials exist for natural experiment or policy evaluation studies. We recommend standard reporting guidelines to enhance the rigor and consistency of research using natural experiments.

Conclusions

Our systematic review identified a large heterogeneous sample of natural experiment studies and data sources that have been used to estimate the effect of programs, policies, or built environment changes on obesity prevention and control. The studies used a wide variety of outcome measures and analytic methods, often with substantial risk of bias. The findings reinforce the need for methodological and analytic advances that would strengthen efforts to improve obesity prevention and control.

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Appendix A. Acronyms

Table A1. List of acronyms

Acronym	Definition
AHRQ	Agency for Healthcare Research and Quality
APPLE	Alberta Project Promoting Active Living and Healthy Eating in Schools
ATLAS	Active Teen Leaders Avoiding Screen-time
AVHPSP	Annapolis Valley Health Promoting School Project
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CHALK	Choosing Healthy & Active Lifestyles for Kids
CHL	Children's Healthy Living
CI	Confidence interval
CLASS	Classification of Laws Associated with School Students
CNRA	Child Nutrition and WIC Reauthorization Act
CONSORT	Consolidated Standards of Reporting Trials
CPPW	Communities Putting Prevention to Work
CSHP	Coordinated School Health Program
DC	District of Columbia
DPP	Diabetes Prevention Program
EB4K with Play	Energy Balance for Kids with Play
EHR	Electronic health records
EMR	electronic medical records
EPHPP	Effective Public Health Practice Project
HDI	Human Development Index
HEAL-CHI	Healthy Eating Active Living–Community Health Initiative (HEAL-CHI)[136]
Healthy ONES	The Healthy Options for Nutrition Environments in Schools
HEROES	Healthy, Energetic, Ready, Outstanding, Enthusiastic, Schools
HFH	Healthy Foods Hawaii
HFHF	Healthy Foods, Healthy Families

HIPAA	Health Insurance Portability and Accountability Act
HLCK	Healthy Living Cambridge Kids
HSP	Healthy Schools Program
HUD	Department of Housing and Urban Development
ICAPS	Intervention Centered on Adolescents' Physical activity and Sedentary behavior
IDEFICS	The Identification and prevention of Diet and lifestyle-induced health EFfects In Children and infantS
IOM	Institute of Medicine
JAWS	Jog and Walk Stars
KNF	Kids N Fitness
KPS	Kearney Public School
KQ	Key Question
MOTMGC	Men on the Move: Growing Communities
MRC	UK Medical Research Council
MSBE	Michigan State Board of Education
M-SPAN	Middle-School Physical Activity and Nutrition
MTO	Moving to Opportunity
NCCOR	The National Collaborative on Childhood Obesity Research
NCHWTF	North Carolina Health and Wellness Trust Fund
NEXT-D	Natural Experiments for Translation in Diabetes
NHANES	National Health and Nutrition Examination Survey
NIH	National Institutes of Health
NPS	National Park Service
NSCH	National Survey of Children's Health

Acronym	Definition
P2P	Pathways to Prevention Program
PA	Physical activity
PACE	Partnership for an Active Community Environment
PCORI	The Patient Centered Outcomes Research Institute
PCORNet	The National Patient-Centered Clinical Research Network
PICOTS	Populations, Interventions, Comparators, Outcomes, Timing, Setting
POD	Preventing Obesity by Design
RCT	Randomized Controlled Trial
ROBINS-I	The Risk Of Bias In Non-randomized Studies – of Interventions
SNAP	Supplemental Nutrition Assistance Program
SNPI	School Nutrition Policy Initiative
SOPARC	System for observing play and recreation in communities
SOPLAY	System for observing play and leisure activity in youth
SPARK	Sports, Play, and Active Recreation for Kids
SRDR	Systematic Review Data Repository
SRTS	Safe Routes to School
SSB	Sugar sweetened beverages
TEP	Technical expert panel
TFN	Texas Fitness Now
UK	United Kingdom
US	United States
WIC	Women, Infants, and Children
YRBSS	Youth Risk Behavior Surveillance System

Appendix B. Glossary of Key Terms

24-hour dietary recall: 24-hour dietary recall is aimed at capturing a comprehensive and detailed accounting of all foods, beverages, and in some cases, supplements, consumed on a given day. Traditionally, 24-hour recalls have been administered by an interviewer. Multiple-pass methods are used to improve accuracy and may be implemented using computerized systems.[1]

BMI *z*-score: Number of standard deviations away from the population mean body mass index (BMI); in other words, the degree to which an individual's measurement deviates from what is expected for that individual.

Body mass index (BMI): An indirect measure of body fat, calculated as the ratio of a person's body weight in kilograms to the square of a person's height in meters. BMI (kg/m^2) = weight (kilograms) ÷ height (meters)^2 BMI (lb/in^2) = weight (pounds) ÷ height (inches)^2 × 703 In children and youth, BMI is interpreted using growth charts for age and gender and is referred to as BMI-for-age and sex, which is used to assess underweight, overweight, and obesity. According to the Centers for Disease Control and Prevention (CDC), a child with a BMI that is equal to or greater than the 95th percentile is considered to be obese. A child with a BMI that is equal to or between the 85th and 95th percentile is considered to be overweight.[2]

Calorie A calorie is defined as the amount of heat required to change the temperature of one gram of water from 14.5 degrees Celsius to 15.5 degrees Celsius. In this report, "calorie" is used synonymously with "kilocalorie," the unit of measure for energy obtained from food and beverages.

Case control study: A retrospective study design where the investigators gather 'cases' of people who already have the outcome of interest and 'controls' who do not. Both groups are then questioned or their records examined about whether they received the intervention exposure of interest.[3]

Changes in the Built Environment: Built environments are the totality of places built or designed by humans, including buildings, grounds around buildings, layout of communities, transportation infrastructure, and parks and trails.[4]

<u>Note</u>: examples include supermarkets, farmer's markets, as well as infrastructure

Cohort (one group pre + post (before and after): The same group is pretested, given an intervention, and tested immediately after the intervention. The intervention group, by means of the pretest, act as their own control group.[3]

Cohort analytic (two group pre and post): An observational study design where groups are assembled according to whether or not exposure to the intervention has occurred. Exposure to the intervention is not under the control of the investigators. Study groups might be nonequivalent or not comparable on some feature that affects outcome.[3]

Competitive Foods and beverages offered at schools other than meals and foods snacks served through the federally reimbursed school lunch, breakfast, and after-school snack programs. Competitive foods includes food and beverages items sold through à la carte lines, snack bars, student stores, vending machines, and school fundraisers.

Controlled Clinical Trial (CCT): An experimental study design where the method of allocating study subjects to intervention or control groups is open to individuals responsible for recruiting subjects or providing the intervention. The method of allocation is transparent

before assignment, e.g. an open list of random numbers or allocation by date of birth, etc.[3]

Data source: Datasets, including both primary and secondary sources.

Data system: A data system involves the systematic collection of data, such as in a database, as well as the information technology infrastructure to maintain and operate the system.[5]

Electronic health record (EHR): A digital version of a patient's paper chart. EHRs are real-time, patient-centered records that make information available instantly and securely to authorized users. While an EHR does contain the medical and treatment histories of patients, an EHR system is built to go beyond standard clinical data collected in a provider's office and can be inclusive of a broader view of a patient's care.[6]

Environment The external influences on the life of an individual or community.

Food frequency questionnaires (FFQ): Food frequency questionnaires gather information about the frequency with which different foods and beverages are consumed over some period of time, often the last month or year. They may capture total diet or particular aspects of the diet. A questionnaire aimed at capturing total diet can be lengthy, requiring 30-60 minutes to complete.[1]

Food records/diaries: Food records or diaries (referred to as records subsequently, for simplicity) are intended to capture a detailed account of all foods, beverages, and possibly, supplements consumed on one or more days. Records are often kept for a period of one, three, or seven days. The distinction between recalls and records is that with a recall, the respondent reports (i.e., recalls, relying on memory) what was consumed yesterday (or over the past 24 hours) whereas with a record, the respondent keeps track of (i.e., records in real time) what he or she consumes.

Interrupted time series: A time series consists of multiple observations over time. Observations can be on the same units (e.g. individuals over time) or on different but similar units (e.g. student achievement scores for particular grade and school). Interrupted time series analysis requires knowing the specific point in the series when an intervention occurred.[3]

Messaging about nutrition and/or physical activity: Consistent with the 2012 IOM Report that described "Message Environments", policies and programs were classified as having specific messages or information about nutrition and /or physical activity (e.g. posted flyers or informational campaigns), which included social marketing strategies.[7]

Natural experiment: Natural experiment refers to ways of evaluating policy, programmatic and environmental interventions using unplanned variation in exposure to assess the impact on health outcomes. The key features of these definitions are that: (1) the intervention (policy, program, environment change) is not undertaken for the purposes of research; and (2) the variation in exposure and outcomes is analyzed using methods that attempt to make causal inferences. Outside of a randomized controlled trial it is rare for variation in exposure to an intervention to be random, so special care is needed in the design, reporting and interpretation of evidence from natural experimental. Definition adapted from Craig, 2012.[8]

Obesity An excess amount of subcutaneous body fat in proportion to lean body mass. In adults, a BMI of 30 or greater is considered obese. In this report, obesity in children and adolescents refers to age- and sex-specific BMIs that are equal to or greater than the 95th percentile of the CDC BMI growth charts. In most children, these values are known to indicate elevated body fat and to reflect the comorbidities associated with excessive body fatness.

Observation (physical activity): Direct observation is considered to be a gold standard method of physical activity assessment because behavior is directly observed. Observation typically involves the choice of a participant to observe (because it is not possible to observe all participants at the same time), when to watch (because it is not practical to try to observe continuously for extended periods), and how to record the behavior.[9]

Physical activity:

*Moderate***-** On an absolute scale, moderate-intensity physical activity is intensity completed at 3.0 to 5.9 times the intensity of rest. On a scale physical activity that is relative to an individual's personal capacity, moderate intensity physical activity is usually a 5 or 6 on a scale of 0 to 10.

*Vigorous***-** On an absolute scale, vigorous-intensity physical activity is intensity completed at 6.0 or more times the intensity of rest. On a scale physical activity relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0 to 10.

Policy: is broadly defined to include both formal public policies at local, state and federal levels of government, and organizational level policies, such as those implemented by large organizations, worksites or school districts. Examples include, but are not limited to, the development of supermarkets in underserved areas, calorie labeling requirements, taxes on foods and/or beverages, after-school and summer programs, modification of the built (or human-made) environments to encourage walking or cycling for transportation or leisure.[10]

Population-based: Individuals sampled are broadly representative of the targeted, general population, such as the neighborhood or children in a school system. In this review, obesity prevention and control policies and programs broadly target adults and/or children and the communities they live in.

Prevention With regard to obesity,

primary prevention represents avoiding the occurrence of obesity in a population

secondary prevention represents early detection of disease through screening with the purpose of limiting its occurrence

tertiary prevention involves preventing the sequelae of obesity in childhood and adulthood.

Program: Set of activities initiated by governmental or other organizational bodies to enhance obesity prevention and control. Examples might include programs implemented worksites, healthcare organizations, after-school or summer programs, or communities that can be expected to improve obesity related behaviors such as energy intake and activity level. [10]

Randomized controlled trial (RCT): An experimental design where investigators randomly allocate eligible people to an intervention or control group. A rater should describe a study as an RCT if the randomization sequence allows each study participant to have the same chance of receiving each intervention and the investigators could not predict which intervention was next.[3]

Rural: Relating to the country or countryside. In this report populations were designated "rural" by study authors, or not defined. The systematic review study group did not define these populations.

Questionnaires (diet): Brief instruments that enable the collection of basic information about particular foods or beverages or other dietary behaviors. Screeners may query the frequency of intake of certain foods or beverages and thus may be thought of as short food frequency questionnaires, usually without questions regarding portion sizes.[1]

Questionnaires (Physical Activity): include various self-report surveys, such as physical activity questionnaires and diaries, that capture a participant's perception and interpretation of physical activity behavior. These tools also can be defined as subjective measures because they rely on the person's ability to interpret and recall physical activity and are generally categorized by mode of administration: self-administered or interview (most are self-administered).[9]

Suburban: An outlying area adjacent to a city or town. In this report populations were designated "suburban" by study authors, or not defined. The systematic review study group did not define these populations.

Urban: Relating to or a characteristic of a city. In this report populations were designated "urban" by study authors, or not defined. The systematic review study group did not define these populations.

Wearable technology: A category of technology devices that can be worn by a consumer and often include tracking information related to health and fitness.[11]

Appendix B References

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Appendix C. Detailed Search Strategies

Table C1. PubMed search strategy

#	Term/string
1	obesity[mh]
2	obese[tiab]
3	obesity[tiab]
4	overweight[tiab]
5	“over weight”[tiab]
6	BMI[tiab]
7	“body mass index”[tiab]
8	“Body mass index”[mh]
9	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8
10	"Policy"[Mesh]
11	policy[tiab]
12	policies[tiab]
13	law[tiab]
14	Purchasing[tiab]
15	Purchases[tiab]
16	“food labeling”[mh]
17	“calorie information”[tiab]
18	“calorie labeling”[tiab]
19	Environment[tiab]
20	10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19
21	9 AND 20
	Date limited: 2000 to present

Table C2. CINAHL/PsycINFO/EconLit search strategy
Results from 4 November 2016

Search ID#	Search Terms	Search Options
S48	S33 AND S46	**Limiters** - Published Date: 20000101-20161031; Exclude MEDLINE records; Publication Year: 2000-2016; Exclude Dissertations **Search modes** - Boolean/Phrase
S47	S33 AND S46	**Search modes** - Boolean/Phrase
S46	S34 OR S35 OR S36 OR S37 OR S38 OR S39 OR S40 OR S41 OR S42 OR S43 OR S44 OR S45	**Search modes** - Boolean/Phrase
S45	TI environment OR AB environment	**Search modes** - Boolean/Phrase
S44	TI "calorie labeling" OR AB "calorie labeling"	**Search modes** - Boolean/Phrase
S43	TI "caloric information" OR AB "caloric information"	**Search modes** - Boolean/Phrase
S42	TI "calorie information" OR AB "calorie information"	**Search modes** - Boolean/Phrase
S41	TI "food labeling" OR AB "food labeling"	**Search modes** - Boolean/Phrase
S40	TI purchases OR AB purchases	**Search modes** - Boolean/Phrase
S39	TI purchasing OR AB purchasing	**Search modes** - Boolean/Phrase
S38	TI law OR AB law	**Search modes** - Boolean/Phrase
S37	TI policies OR AB policies	**Search modes** - Boolean/Phrase
S36	TI policy OR AB policy	**Search modes** - Boolean/Phrase
S35	(MH "Food Labeling+")	**Search modes** - Boolean/Phrase
S34	(MH "Public Policy+")	**Search modes** - Boolean/Phrase
S33	S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32	**Search modes** - Boolean/Phrase

Search ID#	Search Terms	Search Options
S32	TI BMI OR AB BMI	**Search modes** - Boolean/Phrase
S31	TI "body mass index" OR AB "body mass index"	**Search modes** - Boolean/Phrase
S30	TI "over weight" OR AB "over weight"	**Search modes** - Boolean/Phrase
S29	TI overweight OR AB overweight	**Search modes** - Boolean/Phrase
S28	TI obese OR AB obese	**Search modes** - Boolean/Phrase
S27	TI obesity OR AB obesity	**Search modes** - Boolean/Phrase
S26	(MH "body mass index+")	**Search modes** - Boolean/Phrase

Table C2. CINAHL/PsycINFO/EconLit search strategy (continued)

Search ID#	Search Terms	Search Options
S25	(MH "Obesity+")	**Search modes** - Boolean/Phrase
S24	S9 AND S22	**Limiters** - Published Date: 20000101-20161031; Exclude MEDLINE records; Publication Year: 2000-2016; Exclude Dissertations **Search modes** - Boolean/Phrase
S23	S9 AND S22	**Search modes** - Boolean/Phrase
S22	S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	**Search modes** - Boolean/Phrase
S21	TI environment OR AB environment	**Search modes** - Boolean/Phrase
S20	TI "calorie labeling" OR AB "calorie labeling"	**Search modes** - Boolean/Phrase
S19	TI "caloric information" OR AB "caloric information"	**Search modes** - Boolean/Phrase
S18	TI "calorie information" OR AB "calorie information"	**Search modes** - Boolean/Phrase
S17	TI "food labeling" OR AB "food labeling"	**Search modes** - Boolean/Phrase
S16	TI purchases OR AB purchases	**Search modes** - Boolean/Phrase
S15	TI purchasing OR AB purchasing	**Search modes** - Boolean/Phrase
S14	TI law OR AB law	**Search modes** - Boolean/Phrase
S13	TI policies OR AB policies	**Search modes** - Boolean/Phrase
S12	TI policy OR AB policy	**Search modes** - Boolean/Phrase

Table C2. CINAHL/PsycINFO/EconLit search strategy (continued)

Search ID#	Search Terms	Search Options
S11	(MH "Food Labeling+")	**Search modes** - Boolean/Phrase
S10	(MH "Public Policy+")	**Search modes** - Boolean/Phrase
S9	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8	**Search modes** - Boolean/Phrase
S8	TI BMI OR AB BMI	**Search modes** - Boolean/Phrase
S7	TI "body mass index" OR AB "body mass index"	**Search modes** - Boolean/Phrase
S6	TI "over weight" OR AB "over weight"	**Search modes** - Boolean/Phrase
S5	TI overweight OR AB overweight	**Search modes** - Boolean/Phrase
S4	TI obese OR AB obese	**Search modes** - Boolean/Phrase
S3	TI obesity OR AB obesity	**Search modes** - Boolean/Phrase
S2	(MH "body mass index+")	**Search modes** - Boolean/Phrase
S1	(MH "Obesity+")	**Search modes** - Boolean/Phrase

Table C3. Supplemental search strategy (PubMed)

#	**Term/string**
1	Exercise[mh]
2	exercise[tiab]
3	“physical activity”[tiab]
4	“motor activity”[mh]
5	“motor activity”[tiab]
6	“energy metabolism”[mh]
7	“energy expenditure”[tiab]
8	diet[mh]
9	diet[tiab]
10	dietary[tiab]
11	“energy intake”[mh]
12	“caloric intake”[tiab]
13	calories[tiab]
14	fruit[tiab]
15	vegetable[tiab]
16	“sugar sweetened beverage”[tiab]
17	SSB[tiab]
18	“fast foods”[mh]
19	“fast food”[tiab]
20	“fast foods”[tiab]
21	intake[tiab]
22	consumption[tiab]
23	13 OR 14 OR 15 OR 16 OR 17 OR 18 OR 19 OR 20
24	21 OR 22
25	23 AND 24
26	1 OR 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12
27	26 OR 25
28	"Transportation"[Mesh]

#	**Term/string**
29	transportation[tiab]
30	transit[tiab]
31	recreation[Mesh]
32	recreation[tiab]
33	"Environment Design"[Mesh]
34	"Walking"[Mesh]
35	walk[tiab]
36	walking[tiab]
37	"Bicycling"[Mesh]
38	bike[tiab]
39	bicycling[tiab]
40	biking
41	greening[tiab]
42	28 OR 29 OR 30 OR 31 OR 32 OR 33 OR 34 OR 35 OR 36 OR 37 OR 38 OR 39 OR 40 OR 41
43	27 AND 42
	Limit to systematic reviews AND limit to 2013 through 2017

Appendix D. Abstraction Forms

Figure D1. Abstract screening form

SUBMIT FORM and go to ▼ or Skip to Next

1. Does this title/abstract apply to any of the Key questions?

- No (answer reasons for exclusion)

  Exclude article from review, see PICOTS for details

  - No original data
  - Study of fewer than 100 participants total
  - Does not address a change in the built environment or is not a population-based program or policy designed to act on social, structural, or environmental levels
  - No comparison group, unexposed group, or pre-post comparison
  - Studies in a setting not generalizable to a free-living population or community (e.g., prison, nursing homes)
  - Study only targets a specific clinical sub-population (e.g., sever mental health issues, diabetics) other than obese and overweight populations
  - Not relevant to the Key Questions
  - No abstract (use for only for not applicable titles or articles <1 pages in length; comments, editorial, or letters to the editor)
  - No human data reported
  - Not in English
  - Protocol of a relevant study—no data available
  - Other, please specify

  Clear Response

- Yes
- Unclear (screen article)

5.

- Article may have relevant references--PULL FOR HAND SEARCHING

6. Comment

Figure D2. Article screening form

SUBMIT FORM and go to ▼ or Skip to Next

1. Does this article apply to any of the Key questions?

- (•) No (answer reasons for exclusion)

Exclude article from review, see PICOTS for detials

- ( ) Does not apply to the key questions
- ( ) No outcome of interest (Weight, BMI, change in diet behavior, change in physical activity behavior)
- ( ) Does not address a change in the built environment, or is not a population-base program or policy designed to act on social, structural, or environmental levels.
- ( ) Study measures only a specific micro/macronutrient or dietary health behavior (except for macronutrients of fruit/vegetable, fiber intake or dietary health behaviors of sugar sweetened beverage or fast food intake)
- ( ) No comparison group, unexposed group, pre-post comparison, or regression analysis of the exposure.
- ( ) Study targets a specific clinical subpopulation (e.g., severe mental health issues, diabetes) ONLY. Exception—obese and overweight populations.
- ( ) Study of fewer than 100 participants total
- ( ) Protocol of a relevant study (use only if the protocol is relevant to our key questions)
- ( ) Meeting abstract of a relevant study (use only if the meeting abstract is relevant to our key questions)
- ( ) Not English language
- ( ) No Original data (editorial, perspective, opinion piece)
- ( ) Programs and policies enacted or implemented prior to 2000
- ( ) Single site study (e.g., single school)
- ( ) Policy or program is NOT focused on obesity or nutrition-related structural or environmental changes (e.g. one child China)
- ( ) A school-bsed policy or program that only includes a curriculum change without evidence of a structural or environmental component
- ( ) Study takes place in a country that does not have a very high human development index
- ( ) Other please specify

Clear Response

- ( ) Yes

3. Flag excluded articles

- [ ] Potentially relevant abstract—search for full text article
- [ ] Article not eligible, but may include relevant references
- [ ] Article not eligible--subsequent publications may apply

4. New Question

...

5. Comment

Figure D3. Data source abstraction form

SUBMIT FORM and go to ▼ or Skip to Next

DATA SOURCE INFORMATION

THIS IS A MULTIPLE SUBMISSION FORM
--IF MORE THAN ONE DATA SOURCE/DAT SYSTEM IS DESCRIBED IN THIS STUDY YOU WILL NEED TO FILL IN A FORM FOR EACH.

1. Type of data source
   - ○ Primary-limited to this study [DO NOT ABSTRACT ANY FURTHER INFORMATION]
   - ○ Primary-limited to this study with potential to be shared (e.g., data is in a data repository)
   - ○ Secondary use of an existing data source

   Clear Response

2. Original purpose of data collection
   Answer only if clearly stated

   ...

3. Data collection dates for data source
   enter year
   - ☐ Start date
   - ☐ End date or "Ongoing"
   - ☐ Not reported

4. Data source meta-data
   enter NR if information is not reported
   - ☐ Owner/Custodian (e.g., study authors, city, CDC)
   - ☐ Name
   - ☐ URL/Link
   - ☐ Citation

5. Setting/origin of the data source (if not specifieid for the data source use the study setting)
   - ◉ U.S.

     6.
     - ☐ National
     - ☐ State
     - ☐ City
     - ☐ Region
     - ☐ Other (define)
   - ○ Non-US (specify country, etc.)

   Clear Response

7. Method of data collection for the data source

- ☐ Survey
- ☐ EMR/EHR
- ☐ Claims
- ☐ Wearable devices
- ☐ Other

8. Is this data source linked with another data source?

- ◉ Yes (ID other data source)

  9. Linkage Method(s)

  ...

- ○ No

Clear Response

10. Target population of the data source

- ☐ Sex (M/F/both)
- ☐ Age (range, or other details)
- ☐ Race/ethnicity (define)
- ☐ Pre-intervention BMI (define)
- ☐ Other

11. Does the data source include an exposure of interest OR an outcome of interest?
choose all that apply

- ☑ Includes an exposure of interest

  12.
  - ☐ Program
  - ☐ Policy
  - ☐ Built environment

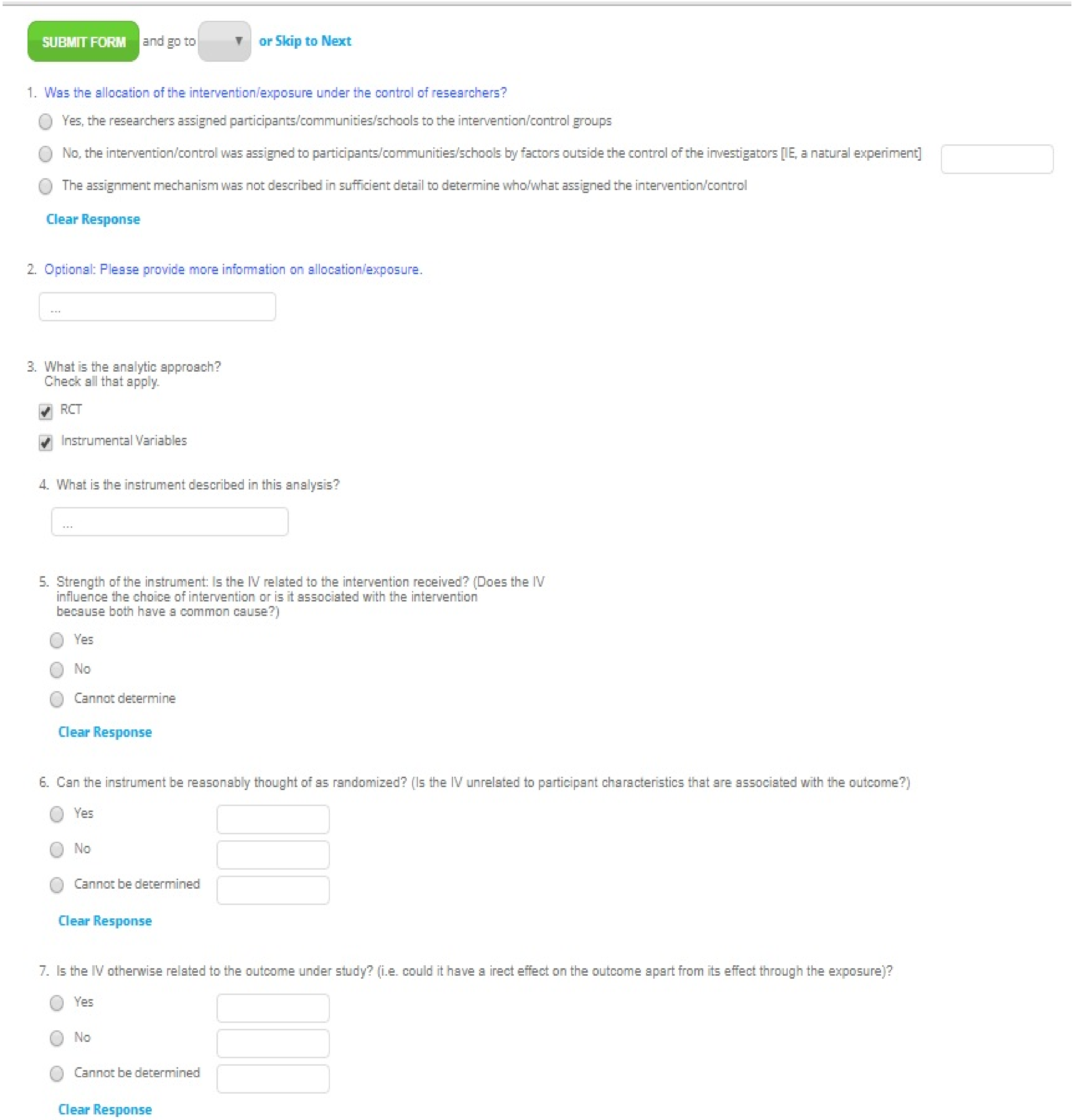
- ☑ Includes an outcome of interest

  13.
  - ☐ Weight or BMI change (adult)
  - ☐ BMI z-score or BMI percentile (child)
  - ☐ Weight percentile or weight percentile change (child)
  - ☐ Change in diet behaviors
  - ☐ Change in physical activity behaviors (adult or child)
  - ☐ Other (including co-outcomes)

- ☐ None

14. Other (any other information about the data source; simply copy and paste the paragraph of interest)

Figure D4. Design specific abstraction form



SUBMIT FORM and go to ▼ or Skip to Next

1. Was the allocation of the intervention/exposure under the control of researchers?
   - Yes, the researchers assigned participants/communities/schools to the intervention/control groups
   - No, the intervention/control was assigned to participants/communities/schools by factors outside the control of the investigators [IE, a natural experiment]
   - The assignment mechanism was not described in sufficient detail to determine who/what assigned the intervention/control

   Clear Response

2. Optional: Please provide more information on allocation/exposure.

   ...

3. What is the analytic approach?
   Check all that apply.
   - [x] RCT
   - [x] Instrumental Variables

4. What is the instrument described in this analysis?

   ...

5. Strength of the instrument: Is the IV related to the intervention received? (Does the IV influence the choice of intervention or is it associated with the intervention because both have a common cause?)
   - Yes
   - No
   - Cannot determine

   Clear Response

6. Can the instrument be reasonably thought of as randomized? (Is the IV unrelated to participant characteristics that are associated with the outcome?)
   - Yes
   - No
   - Cannot be determined

   Clear Response

7. Is the IV otherwise related to the outcome under study? (i.e. could it have a irect effect on the outcome apart from its effect through the exposure)?
   - Yes
   - No
   - Cannot be determined

   Clear Response

8. Are any sensitivity analyses shown to assess robustness of results to the key assumptions?

- Yes
- No
- Cannot be determined

Clear Response

9. Do the authors show covariate balance across levels of the instrument, and/or discuss potential confounding of the IV/outcome relationship?

- Yes
- No
- Cannot be determined

Clear Response

10. Do the authors clearly state the estimand and talk about what is needed to assume the effect holds across the population (i.e., CACE vs. ATE)?

- Yes
- No
- Cannot be determined

Clear Response

☑ Regression Discontinuity

11. Could all observations have received the intervention had the cutoff point been set differently?

- Yes
- No
- Cannot be determined

Clear Response

12. Was the assignment mechanism described?

- Yes
- No
- Cannot be determined

Clear Response

13. Could the assignment variable have been manipulated?

- Yes
- No
- Cannot be determined

Clear Response

14. Was the assignment mechanism followed?

- ○ Yes
- ○ No
- ○ Cannot be determined

Clear Response

15. Was the model specification assessed through model diagnostics (to make sure the data fit well)?

- ○ Yes
- ○ No
- ○ Cannot be determined

Clear Response

16. Were sensitivity analyses shown to assess robustness to the specific functional form used to model the outcome?

- ○ Yes
- ○ No
- ○ Cannot be determined

Clear Response

17. Were sensitivity analyses performed to assess varying bandwidths?

- ○ Yes
- ○ No
- ○ Cannot be determined

Clear Response

☑ Comparison Group Designs (Propensity score methods, regression adjustment, controlled clinical trials, and pre-post/difference in difference designs)

18. Please specify type if comparison group design.

- ○ Propensity score methods
- ○ Regression model
- ◉ Controlled clinical trial

20. How was the intervention allocated?

Pre/post

Difference in difference

Other (please specify)

Clear Response

19. Provide information on timepoints

How many time points were data collected pre-intervention?

How may time points were data collected post-intervention?

21. What method(s) were used to control for confounding?

Regression adjustment

Direct covariate matching or stratification

Propensity score matching

Propensity score weighting (including IPTW)

Propensity score stratification (including full matching)

Other

22. Was overlap in propensity scores/covariate distributions between groups assessed?

Yes

No

Cannot be determined

Clear Response

23. Do the diagnostics indicate that outcome analyses were run on samples comparable on covariates?

Yes

No

Cannot be determined

Clear Response

24. Was sensitivity of results to an unobserved confounder reported?

Yes

No

Cannot be determined

Clear Response

25. List all covariates included in the model

26. Is there clustering in the data that is not accounted for in the data analysis?

- Yes (explain)
- No
- Cannot tell

Clear Response

- [x] Interrupted Time Series

27. How many time points are included pre-intervention?

...

28. How many time points are included post-intervention?

...

29. Was the intervention independent of other changes?

- Yes
- No
- Cannot be determined

Clear Response

30. Was the shape of the intervention effect pre-specified?

- Yes
- No
- Cannot be determined

Clear Response

31. Was the intervention unlikely to affect data collection?

- Yes
- No
- Cannot be determined

Clear Response

32. Was knowledge of the allocated interventions adequately prevented during the study?

- Yes
- No
- Cannot be determined

Clear Response

33. Was model fit assessed?

- Yes
- No
- Cannot be determined

Clear Response

34. Were sensitivity analyses shown, to assess robustness to different model specifications?

- Yes
- No
- Cannot be determined

Clear Response

35. Were effects on "null outcomes" examined?

- Yes
- No
- Cannot be determined

Clear Response

36. If a comparison group was used, was there evidence that the pre-intervention trends were similar in intervention and comparison groups?

- Yes
- No
- Other (please specify)
- Cannot be determined

Clear Response

Clear Response

37. If a comparison group was used, was the comparison group free of intervention during the time period studied?

- Yes
- No
- Other (please specify)
- Cannot be determined

Clear Response

- Other (please specify)

38. Comments

SUBMIT FORM and go to Skip to Next

Figure D5. Study and participant characteristics abstraction form

SUBMIT FORM and go to ▼ or Skip to Next

STUDY CHARACTERISTICS

1. If this study refers to another publication of this program, policy, or built environment change, please paste the references in the box below:

...

2. Study Dates

- [ ] Start Date
- [ ] End Date
- [ ] Dates not reported

3. In what type of community did the study occur (choose all that apply).

- [ ] Urban
- [ ] Suburban
- [ ] Rural
- [ ] Not Described

4. What was the study setting? (choose all that apply)

- [ ] Early childhood education or daycare (e.g., pre-school, head start)
- [x] School (check all that apply)

5.

  - [ ] Elementary (K-5)
  - [ ] Middle (6-8)
  - [ ] High (9-12)
  - [ ] Other (define)

- [ ] University
- [ ] After school or summer school
- [ ] Food assistance program (e.g., WIC, SNAP)
- [ ] Senior center
- [ ] Community center (e.g., job training, youth)
- [ ] Community or neighborhood (e.g., parks, farmers market)
- [ ] Employer or worksite
- [ ] Transportation (e.g., commuters)
- [ ] Other target setting (describe)

6. Are the inclusion/exclusion criteria applied on an individual or site (school, workplace, etc.) level?

- Individual
- Site (describe)
- No criteria specified

Criteria	Include (Specify)	Exclude (specify)
Sex	7. Specify Clear Response	8. Specify Clear Response
Age	9. Specify Clear Response	10. Specify Clear Response
Race/ethnicity	11. Specify Clear Response	12. Specify Clear Response
Other (specify) *Cut and paste additional information form the Methods section of the paper.*	13.	14.

PARTICIPANT CHARACTERISTICS

16. Define Groups

- Group 1 (define_always use group 1 as the unexposed, control, pre-control, or reference)
- Group 2 (define)
- Group 3 (define)
- Group 4 (define)
- Group 5 (define)
- Group 6 (define)
- Other (please describe)

Record Population Sizes

Group	N at Baseline	Time of last follow-up	N at last follow-up
Total *If total N is not reported, report by group below*	17. ...	18. ...	19. ...
1	20. ...	21. ...	22. ...
2	23. ...	24. ...	25. ...
3	26. ...	27. ...	28. ...
4	29. ...	30. ...	31. ...
5	32. ...	33. ...	34. ...
6	35. ...	36. ...	37. ...

Report Baseline Data for the Following Demographics for teh entire study population
if information is only reported by group, enter the range
if this is a pre/post study enter ranges

Demographic	Measure:enter all data	Notes or Comments
38. Sex Male Female **Clear Response**	39. N %	40. ...
Age	41. Mean (SD)	42. ...
43. Age Category *Choose 1* Age category Grade category **Clear Response**	44. Define, % Define, % Define, % Define, % Define, % Define, % Define, % Define, %	45. ...
46. Pre-intervention weight or BMI (adult) *Choose 1: weight takes priority* Weight BMI BMI category **Clear Response**	47. Define, % Define, % Define, % Define, %	48. ...
49. Pre-intervention BMI (children) *Choose 1: z-score takes priority over percentile* BMI z-score BMI percentile **Clear Response**	50. Define, % Define, % Define, % Define, %	51. ...

Race/Ethnicity	52. ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____	53. ...
54. Other ...	55. ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____ ☐ Define, % ____	56. ...

57. Comments

Figure D6. Intervention abstraction form

SUBMIT FORM and go to ▼ or Skip to Next

INTERVENTIONS

1. Is there more than one program, policy, or built environment change discussed in this paper?
Note: if there is more than 1, you will need to fill out information on EACH intervention on this form.
Contact Renee if there are more than 3 discussed.

- ○ Yes (enter number of interventions) [ ]
- ○ No

Clear Response

INTERVENTION 1

Policy/Program/Built Environment Change

2. What is the original target or goal of the program/policy/built environment change (check all that apply)?

- ☐ Physical activity environment (e.g., Increasing opportunities for walking in low resource neighborhoods)
- ☐ Food and beverage environment (e.g. food assistance program)
- ☐ Messaging environment (e.g. nutrition labeling, food marketing)
- ☐ Healthcare environment (e.g. health insurance, health system or healthcare providers)
- ☐ Work environment (e.g., active living & healthy living at work)
- ☐ School and early child care environment (e.g., Reducing availability of SSBs in state-run/subsidized child care settings)
- ☐ Physical and Built environment (e.g. transit, park or other outdoor space)
- ☐ Other (define)

3. Did the study evaluate a policy?

- ○ No
- ◉ Yes

4. What is the name of the policy?

[...]

5. Was this a governmental policy?

- ○ No, non-governmental
- ◉ Yes

Clear Response

Clear Response

6. What level was the governmental policy?

- [x] Federal/national (Specify country)

7.
- [ ] If U.S. provide Bill Name, and #
- [ ] Date of passage (enter date or NR)
- [ ] Date of enactment (enter date or NR)
- [ ] Is the policy still in effect (Y/N/DK)

- [x] State/province/region (Specify state/province/region)

8.
- [ ] If U.S. provide Bill Name, and #
- [ ] Date of passage (enter date or NR)
- [ ] Date of enactment (enter date or NR)
- [ ] Is the policy still in effect (Y/N/DK)

- [x] Local/community (specify locality)

9.
- [ ] Date of passage (enter date or NR)
- [ ] Date of enactment (enter date or NR)
- [ ] Is the policy still in effect (Y/N/DK)

11. Did the study evaluate a program?

- ○ **No**
- ◉ **Yes**

12. What is the name of the program?

...

13. Was this a governmental program?

- ○ **No, non-governmental**
- ◉ **Yes**

14. What level was the governmental program?

- [x] Federal/national (specify country)

15.
- [ ] Program start year (enter date or NR)
- [ ] Program end year (enter date or NR)

- [x] State/province/region (specify state/province/region)

16.
- [ ] Program start year (enter date or NR)
- [ ] Program end year (enter date, NR, or still in effect)

☑ Local/community (specify locality)

17.

☐ Program start year (enter date or NR)

☐ Program end year (enter date, NR, or still in effect)

Clear Response

Clear Response

19. Did the study evaluate a **built environment** or **other change** that is not a result of a program/policy described above??

○ No

◉ Yes

20. What is the name or nature of the built environment or other change?

...

21. What level was the built environment or other change?

☑ Federal/national (specify country)

22.

☐ Built environment or other change start year (enter date or NR)

☐ Built environment or other change end year (enter date or NR)

☑ State/province/region (specify state/province/region)

23.

☐ Built environment or other change start year (enter date or NR)

☐ Built environment or other change end year (enter date, NR, or still in effect)

☑ Local/community (specify locality)

24.

☐ Built environment or other change start year (enter date or NR)

☐ Built environment or other change end year (enter date, NR, or still in effect)

Clear Response

Figure D7. General outcomes abstraction form

SUBMIT FORM and go to ▼ or Skip to Next

MAIN OUTCOMES

1. Were any of the outcomes of interest reported by subgroup?
   Outcomes of interest: Adult weigh and BMI ; Child/adolescent BMI z-score, BMI pecentile, weight , weight percentile; change in physical activity behavior; change in diet behavior.

- (●) Yes

2.

- ☐ Age
- ☐ Race/ethnicity
- ☐ Gender
- ☐ Urban/rural
- ☐ Type 2 diabetes mellitus
- ☐ Elevated cardiovascular risk
- ☐ Other (define)

3. If subgroups are not reported consistently across outcomes note here.

- ( ) No

Clear Response

4. 1. Was the outcome "Body weight or BMI" reported?

- (●) Yes

5. **Is the population adult, children/adolescents (choose all that apply)**

- ☑ **Adult (> 21 years or older)**

6. **Adult weight-related outcomes reported**
   check all that apply

- ☑ **Change in body weight (adult)**

7. How was body weight assessed?

- ☐ self-reported using a questionnaire?(please describe instrument)
- ☐ Electronic medical record
- ☐ other not directly measured data source (please describe)

- [ ] Objective measure: standard weight measurement protocol by research staff
- [ ] Objective measure: other objective measure: please describe

8. What was the direction of the effect?

- ( ) Favorable (weight reduction)
- ( ) No difference
- ( ) Negative (weight increase)

Clear Response

9. Did they report a statistically significant change in body weight?

- ( ) Yes
- ( ) No
- ( ) Not reported

Clear Response

Please described detailed information on ADULT weight change in the next outcome form.

- [x] **Change in BMI (adult)**

10. How was BMI assessed?

- [ ] self-reported using a questionnaire?(please describe instrument)
- [ ] Electronic medical record
- [ ] other not directly measured data source (please describe)
- [ ] Objective measure: standard weight measurement protocol by research staff
- [ ] Objective measure: other objective measure: please describe

11. What was the direction of the effect?

- ( ) Favorable (Lower BMI)
- ( ) No difference
- ( ) Negative (higher BMI)
- ( ) Not reported

Clear Response

12. Did they report a statistically significant change in BMI?

- ( ) Yes
- ( ) No
- ( ) Not reported

Clear Response

13. Describe (very **briefly**, in a short phrase--include numeric data) the main results about change in BMI.

☑ **Children/adolescents (< or = 21 years)**

14. **Child weight-related outcome reported**
check all that apply

☑ **Change in BMI z-score (child)**

16. How was BMI z-score assessed?

- ☐ self-reported using a questionnaire?(please describe instrument)
- ☐ Electronic medical record
- ☐ other not directly measured data source (please describe)
- ☐ Objective measure: standard weight measurement protocol by research staff
- ☐ Objective measure: other objective measure: please describe

17. What was the direction of the effect?

- ○ Favorable (BMI z-score decrease)
- ○ No difference
- ○ Negative (BMI z-score increase)
- ○ Not reported

Clear Response

18. Did they report a statistically significant change in BMI z-score

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

Please described detailed information on CHILD BMI z-score change in the next outcome form.

☑ **Change in BMI percentile (Child)**

19. How was change in BMI percentile assessed?

- [ ] self-reported using a questionnaire?(please describe instrument)
- [ ] Electronic medical record
- [ ] other not directly measured data source (please describe)
- [ ] Objective measure: standard weight measurement protocol by research staff
- [ ] Objective measure: other objective measure: please describe

20. What was the direction of the effect?

- ○ Favorable (BMI percentile decrease)
- ○ No difference
- ○ Negative (BMI percentile increase)

Clear Response

21. Did they report a statistically significant change in BMI percentile

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

22. Describe (very **briefly**, in a short phrase--include numeric data) the main results about change in BMI percentile.

- [x] **Change in weight (child)**

23. How was change in weight assessed?

- [ ] self-reported using a questionnaire?(please describe instrument)
- [ ] Electronic medical record
- [ ] other not directly measured data source (please describe)
- [ ] Objective measure: standard weight measurement protocol by research staff
- [ ] Objective measure: other objective measure: please describe

24. What was the direction of the effect?

- ○ Favorable (weight reduction)
- ○ No difference
- ○ Negative (weight increase)
- ○ Not reported

Clear Response

25. Did they report a statistically significant change in weight

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

26. Describe (very **briefly**, in a short phrase--include numeric data) the main results about change in weight.

☑ **Change in weight percentile (child)**

27. How was change in weight percentile assessed?

- ☐ self-reported using a questionnaire?(please describe instrument)
- ☐ Electronic medical record
- ☐ other not directly measured data source (please describe)
- ☐ Objective measure: standard weight measurement protocol by research staff
- ☐ Objective measure: other objective measure: please describe

28. What was the direction of the effect?

- ○ Favorable (weight percentile decrease)
- ○ No difference
- ○ Negative (weight percentile increase)
- ○ Not reported

Clear Response

29. Did they report a statistically significant change in weight percentile

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

30. Describe (very **briefly**, in a short phrase–include numeric data) the main results about change in weight percentile.

15. If none of the above outcomes apply (i.e., pediatric BMI) enter details here

- ○ No

Clear Response

31. **Was the outcome "change in physical activity" (in adults or children) reported?**
Note: to be eligible, physical activity outcome must specify BOTH activity TYPE (e.g. walking) and QUANTITY (e.g. days)

- ◉ Yes

32. How was PA measured? (**click here for list of standard instruments**) (check all that apply)

- ☐ Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- ☐ Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- ☐ Objective measure: Pedometer or other wearable device to measure physical activity (e.g. step count)
- ☐ Objective measure: other objective measure: please describe

33. What was the direction of the effect?

- Favorable (more physical activity)
- No difference
- Negative (less physical activity)
- Not reported

Clear Response

34. Did they report a statistically significant change in physical activity?

- Yes
- No
- Not reported

Clear Response

35. Describe (very **briefly**, in a short phrase–include numeric data) the main results about physical activity.

- No

Clear Response

36. **Was the outcome "Change in dietary behavior" (adult or children) reported?**

- (●) Yes

37. **What was measured? Check all that apply**

- [x] **Change in total daily caloric intake**

38. How was "change in total daily caloric intake" measured? **(click here for list of standard instruments)** (check all that apply)

- [ ] Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- [ ] Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- [ ] Objective measure (describe)

39. What was the direction of the effect

- Favorable (LESS caloric intake)
- no difference

- Negative (MORE caloric intake)
- Not reported

Clear Response

40. Did they report a statistically significant change in caloric intake?

- Yes
- No
- Not reported

Clear Response

41. Describe (very **briefly**, in a short phrase--include numeric data) the main results about caloric intake

☑ **Change in "fruit and/or vegetable intake**

42. How was "fruit and/or vegetable intake" measured? **(click here for list of standard instruments)** (check all that apply)

- ☐ Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- ☐ Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- ☐ Objective measure (describe)

43. What was the direction of the effect

- Favorable (MORE fruit and/or vegetable intake)
- no difference
- Negative (LESS fruit and/or vegetable intake)
- Not reported

Clear Response

44. Did they report a statistically significant change in fruit and/or vegetable intake?

- Yes
- No
- Not reported

Clear Response

45. Describe (very **briefly**, in a short phrase--include numeric data) the main results about fruit and/or vegetable intake.

☑ **Change in "fiber intake**

46. How was "fiber intake" measured? **(click here for list of standard instruments)** (check all that apply)

- ☐ Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- ☐ Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- ☐ Objective measure (describe)

47. What was the direction of the effect

- ○ Favorable (MORE fiber intake)
- ○ no difference
- ○ Negative (LESS fiber intake)
- ○ Not reported

Clear Response

48. Did they report a statistically significant change in fiber intake?

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

49. Describe (very **briefly**, in a short phrase--include numeric data) the main results about fiber intake

☑ **Change in "sugar sweetened beverage intake" (e.g. soft drinks)? (note – this is not "purchasing of sugar sweetened beverage")**

50. How was "sugar sweetened beverage intake" measured? **(click here for list of standard instruments)** (check all that apply)

- ☐ Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- ☐ Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- ☐ Objective measure (describe)

51. What was the direction of the effect

- ○ Favorable (LESS sugar sweetened beverage intake)
- ○ no difference
- ○ Negative (MORE sugar sweetened beverage intake)
- ○ Not reported

Clear Response

52. Did they report a statistically significant change in sugar sweetened beverage intake?

- ○ Yes
- ○ No
- ○ Not reported

Clear Response

53. Describe (very **briefly**, in a short phrase--include numeric data) the main results about sugar sweetened beverage intake

☑ **Change in "fast food intake" (e.g. number of meals/week eating at McDonald's)**

54. How was "fast food intake" measured? **(click here for list of standard instruments)** (check all that apply)

- ☐ Instrument or questionnaire with VALIDATION reference provided (please describe instrument)
- ☐ Instrument or questionnaire WITHOUT validation reference provided (please describe instrument) but on our list of common and standard measures (LINK) (please describe instrument)
- ☐ Objective measure (describe)

55. What was the direction of the effect

55. What was the direction of the effect

- Favorable (LESS fast food intake intake)
- no difference
- Negative (MORE fast food intake intake)
- Not reported

Clear Response

56. Did they report a statistically significant change in fast food intake intake?

- Yes
- No
- Not reported

Clear Response

57. Describe (very **briefly**, in a short phrase--include numeric data) the main results about fast food intake intake

- No

Clear Response

58. Choose co-outcomes reported
Answer this question ONLY if one of the above outcomes is chosen.

- (selected) Change in food environment (e.g. more farmers markets) Please describe the outcome

59.
- How was it measured? Questionnaire, observed, other
- What was the direction of the effect: Favorable, no difference, Negative
- Did they report a statistically significant effect (Y/N)

- Change in physical activity environment (e.g. more bike lanes). Please describe the outcome
- Change in commuting behavior. Please describe the outcome
- Change in purchasing behavior. Please describe the outcome
- Other outcome, e.g. measures of urban renewal. Please describe the outcome
- Other outcome, e.g. measures of urban renewal. Please describe the outcome

Clear Response

SUBMIT FORM and go to **Skip to Next**

Figure D8. Future research needs abstraction form

SUBMIT FORM and go to ▼ or Skip to Next

GAPS and Future Research Needs

1. Does this paper specifically mention future research needs or gaps?
   This information is typically found near the end of the discussion section or conclusions

   - Yes
   - No

   Clear Response

2. List research needs/gaps
   you can cut and paste directly from the article

3. Identify any research needs or gaps that the authors did not specifically mention, but you feel are apparent after reading this paper.

Figure D9. Risk of bias abstraction form

SELECTION BIAS

1. Are the individuals selected to participate in the study likely to be representative of the target population?

- Very likely
- Somewhat likely
- Not likely
- Can't tell

2. What percentage of selected individuals agreed to participate?

- 80 - 100% agreement
- 60 – 79% agreement
- less than 60% agreement
- Not applicable
- Can't tell

3. Rate this section
   See ratings dictionary below

- Strong
- Moderate
- Weak

Ratings Dictionary (selection bias):
Strong: The selected individuals are very likely to be representative of the target population (Q1) and there is greater than 80% participation (Q2).
Moderate: The selected individuals are very likely or somewhat likely to be representative of the target population (Q1); and there is 60 - 79% participation (Q2). 'Moderate' may also be assigned if participation cannot be determined/can't tell (Q2).
Weak: The selected individuals are not likely to be representative of the target population (Q1) and there is less than 60% participation (Q2); OR the selected individuals are not described/can't tell (Q1) and the level of participation is not described/can't tell (Q2).

STUDY DESIGN

4. Indicate the study design
   see **Study Design Dictionary**

- Randomized controlled trial
- Controlled clinical trial
- Cohort analytic (two group pre + post)
- Case-control
- Cohort (one group pre + post (before and after))
- Cohort, 2 group, post-only assessment
- Interrupted time series
- Cross sectional
- Other (specify)
- Cannot tell

5. Was the study described as randomized? If NO, answer "NA" for questions 6 thru 8.

- Yes
- No

6. If Yes, was the method of randomization described?
   See term **dictionary**

- Yes
- No
- NA

7. If Yes, was the method appropriate?
   See term **dictionary**

- Yes
- No
- NA

8. Rate this section
   See ratings dictionary below

- Strong
- Moderate
- Weak
- NA

Ratings Dictionary (study design):
Strong: will be assigned to thosearticles that described RCTs and CCTs.
Moderate: will be assigned to those that described a cohort analytic study, a case control study, a cohort design, or an interrupted time series.
Weak: will be assigned to those that used any other method or did not state the method used.

CONFOUNDERS

9. Were there important differences between groups prior to the intervention?

- Yes
- No
- Cannot Tell

The following are examples of confounders:
1 Race
2 Sex
3 Marital status/family
4 Age
5 SES (income or class)
6 Education
7 Health status
8 Pre-intervention score on outcome measure

10. If yes, indicate the percentage of relevant confounders that were controlled (either in the design (e.g. stratification, matching) or analysis)?

- 80 – 100% (most)
- 60 – 79% (some)
- Less than 60% (few or none)
- Can't Tell
- NA (use if answer to question 9 is "no")

11. Rate this section
See ratings dictionary below

- Strong
- Moderate
- Weak

Ratings Dictionary (confounders):
Strong: will be assigned to those articles where there are no important differences between groups, OR that controlled for at least 80% of relevant confounders (Q9 and 10).
Moderate: will be given to those studies where there are important differences between groups, and that controlled for 60 – 79% of relevant confounders (Q9 and 10).
Weak: will be given to those studies where there are important differences between groups and that controlled for less than 60% of relevant confounders (Q 9 and 10); OR control of confounders was not described/can't tell (Q9 and 10).

BLINDING

12. Was (were) the outcome assessor(s) aware of the intervention or exposure status of participants?

- Yes
- No
- Cannot tell

13. Were the study participants aware of the research question?

- Yes
- No
- Cannot tell

14. Rate this section
See ratings dictionary below

- Strong
- Moderate
- Weak

Ratings Dictionary (blinding):
Strong: Neither the outcome assessor nor the participant is aware of the participant's intervention status (Q 13 and 14).
Moderate: The outcome assessor OR the paticipants are not aware of the participant's intervention status (Q13 and 14); OR blinding is not described (Q13 and 14).
Weak: The outcome assessor and the participants are aware of the intervention status of participants (Q13 and 14).

...

DATA COLLECTION METHODS

16. Were data collection tools shown to be valid?

- Yes
- No
- Cannot tell

17. Were data collection tools shown to be reliable?

- Yes
- No
- Cannot tell

18. Rate this section
    See ratings dictionary below

- Strong
- Moderate
- Weak

Ratings Dictionary (data collection methods)
Strong: The data collection tools have been shown to be valid and reliable (Q 16 and 17).
Moderate:
The data collection tools have been shown to be valid and the data collection tools have not been shown to be reliable (Q 16 and 17); OR reliability is not described (Q 17).
Weak: The data collection tools have not been shown to be valid or reliable (Q 16 and 17); OR both reliability and validity are not described (Q 16 and 17).

WITHDRAWALS AND DROP-OUTS

19. Were withdrawals and drop-outs reported in terms of numbers and/or reasons per group?

- Yes
- No
- Cannot tell
- Not Applicable (i.e. one time surveys or interviews)

20. Indicate the percentage of participants completing the study. (If the percentage differs by groups, record the lowest).

- 80 -100%
- 60 - 79%
- less than 60%
- Cannot tell
- Not Applicable (i.e. Retrospective case-control)

21. Rate this section
See ratings dictionary below

- Strong
- Moderate
- Weak

Ratings Dictionary (wathdrawals and drop outs):
Strong: will be assigned when the follow-up rate is reported as 80% or greater (Q 19 and 20).
Moderate: will be assigned when the follow-up rate is reported as 60 – 79% (Q19 and 20) OR the rate cannot be determined/can't tell (Q 20)
Weak: will be assigned when a follow-up rate is reported as less than 60% (Q 19 and 20) OR the rate cannot be determined/can't tell (Q 20) OR the answers are not applicable

INTERVENTION INTEGRITY

22. What percentage of participants received the allocated intervention or exposure of interest?

- 80 -100%
- 60 - 79%
- less than 60%
- Cannot tell

23. Was the consistency of the intervention measured?

- Yes
- No
- Cannot tell

24. Is it likely that subjects received an unintended intervention (contamination or co-intervention) that may influence the results?

- Yes
- No
- Cannot tell

ANALYSES

25. Indicate the unit of allocation

- Community
- organization/institution
- practice/office
- individual

26. Indicate the unit of analysis

- Community
- organization/institution
- practice/office
- individual

27. Are the statistical methods appropriate for the study design?

- Yes
- No (e.g. RCT that does not use intention to treat (ITT) analysis; clustering of data ignored; descriptive statistics with no formal statistical testing), please specify
- Cannot tell

28. Is the analysis performed by intervention allocation status (i.e. intention to treat) rather than the actual intervention received?

- Yes
- No
- Cannottell
- NA (for non-trials)

29. Comments

SUBMIT FORM and go to Skip to Next

Appendix E. Data System Classification/Coding Schema

Data System Specs and Meta Info

Data System Definition	
Exists	[Y/N]
Accessible	[Y/N]
Sharable	[Y/N]
Outcome	[Y/N]
Qualifies	[Y/N]
US vs Non-US	
Non-US	[Y/N]
Country	[TXT]
Data System Type	
Primary	[Y/N]
Non-sharable	[Y/N]
Sharable	[Y/N]
Secondary	[Y/N]
Data System Meta	
Database Name	[TXT]
Database Abbreviation	[TXT]
Data Custodian / Owner Name	[TXT]
Data Custodian Abbreviation	[TXT]
Web Links (URL)	
Generic/Dedicated Website	[URL]
Data Dictionary	[URL]
Download (e.g., public use file)	[URL]
Parent System (e.g., national system)	[URL]
Additional Links #1	[URL]
Additional Links #2	[URL]
Additional Links #3	[URL]
Data System Information Availability	
Dedicated Web Page	[Y/N]
Summary of Data System (e.g., description and purpose)	[Y/N]
Some Detailed Information (e.g., data elements)	[Y/N]
Very Detailed Information (e.g., data quality reports)	[Y/N]
Data Accessible (free or for a fee)	[Y/N]
Publicly Available (e.g., public use file with download link)	[Y/N]
Requires Automated Registration (e.g., signing up)	[Y/N]
Requires Manual Confirmation (e.g., email request)	[Y/N]

Data Dictionary (any level)	[Y/N]
Formal Data Dictionary (e.g., XML, PDF)	[Y/N]
Informal Data Dictionary (e.g., survey questions)	[Y/N]
Proxy Data Dictionary (e.g., summary reports)	[Y/N]
Data Use and Functions	
Purpose	[TXT]
Research	[Y/N]
Clinical	[Y/N]
Administrative	[Y/N]
Pub Health	[Y/N]
Other	[TXT]
Geographic Coverage	
Countries	
Country	[TXT]
U.S.-based	[Y/N]
Other (e.g., multi-country)	[TXT]
U.S. Coverage	
Setting	[TXT]
National	[Y/N]
Regional (e.g., east coast)	[Y/N]
State-level	[Y/N]
Area (smaller than state)	[Y/N]
County or City-level	[Y/N]
Zip code or Census Tract	[Y/N]
Smaller than Census Tract (e.g., Block Group)	[Y/N]
Other (e.g., territory)	[Y/N]
U.S. States	
Alabama (AL)	[Y/N]
Alaska (AK)	[Y/N]
Arizona (AZ)	[Y/N]
Arkansas (AR)	[Y/N]
California (CA)	[Y/N]
Colorado (CO)	[Y/N]
Connecticut (CT)	[Y/N]
Delaware (DE)	[Y/N]
Florida (FL)	[Y/N]
Georgia (GA)	[Y/N]
Hawaii (HI)	[Y/N]
Idaho (ID)	[Y/N]
Illinois (IL)	[Y/N]
Indiana (IN)	[Y/N]
Iowa (IA)	[Y/N]
Kansas (KS)	[Y/N]

Kentucky (KY)		[Y/N]
Louisiana (LA)		[Y/N]
Maine (ME)	[Y/N]	
Maryland (MD)		[Y/N]
Massachusetts (MA)	[Y/N]	
Michigan (MI)		[Y/N]
Minnesota (MN)	[Y/N]	
Mississippi (MS)	[Y/N]	
Missouri (MO)		[Y/N]
Montana (MT)		[Y/N]
Nebraska (NE)		[Y/N]
Nevada (NV)	[Y/N]	
New Hampshire (NH)		[Y/N]
New Jersey (NJ)	[Y/N]	
New Mexico (NM)	[Y/N]	
New York (NY)		[Y/N]
North Carolina (NC)	[Y/N]	
North Dakota (ND)	[Y/N]	
Ohio (OH)	[Y/N]	
Oklahoma (OK)		[Y/N]
Oregon (OR)	[Y/N]	
Pennsylvania (PA)	[Y/N]	
Rhode Island (RI)	[Y/N]	
South Carolina (SC)	[Y/N]	
South Dakota (SD)	[Y/N]	
Tennessee (TN)		[Y/N]
Texas (TX)	[Y/N]	
Utah (UT)	[Y/N]	
Vermont (VT)		[Y/N]
Virginia (VA)	[Y/N]	
Washington (WA)	[Y/N]	
West Virginia (WV)	[Y/N]	
Wisconsin (WI)		[Y/N]
Wyoming (WY)		[Y/N]
Other (e.g., islands, territories)		[Y/N]
Demographic Coverage		
Population Denominator		
General Population	[Y/N]	
Community level	[Y/N]	
Schools		[Y/N]
Programs	[Y/N]	
Households	[Y/N]	
Other	[Y/N]	
Age Coverage		
Age Range (text/numerical)	[Y/N]	
Infant	[Y/N]	

Preschool [Y/N]
Elementary School [Y/N]
Middle School [Y/N]
High School [Y/N]
Teen/Adolescent/Youth (not bound to school age) [Y/N]
Adult [Y/N]
Gender
Male [Y/N]
Female [Y/N]
Other Demographics
Socio-economic Status [Y/N]
Ethnicity [Y/N]
Race [Y/N]

Data Granularity

Aggregation Unit
Individual [Y/N]
Aggregated [Y/N]
Demographic [Y/N]
Geographic [Y/N]
Entity
Payer [Y/N]
Provider [Y/N]
Employer [Y/N]
Educational Institute (e.g., school) [Y/N]
Other [TXT]

Outcomes/Variables of Interest

Primary Outcomes [Y/N]
Weight [Y/N]
Height [Y/N]
BMI [Y/N]
Diet [Y/N]
Physical Activity [Y/N]
Secondary [Intermediate] Outcome [Y/N]
Policy [Y/N]
Program [Y/N]
Build Environment [Y/N]
Other Geographical Information [Y/N]

Data System Scalability

Data Linkage
Linked [Y/N]
Linked Data (i.e., external DB names) [TXT]
Linked Method [TXT]
Data Collection Method
Collection Method [TXT]
Survey (self-report) [Y/N]
EHR/EMR (any medical record) [Y/N]

Panel / Longitudinal (cohort)	[Y/N]
Cross-sectional	[Y/N]
Other (objective measure)	[Y/N]
Data Updates	
Ongoing	[Y/N]
Stopped	[Y/N]
Year Started	[YYYY]
Year Stopped	[YYYY]
Data Governance	
Data Access	
Unrestricted	[Y/N]
Public Use File Link	[URL]
Registration Required	[Y/N]
Data Commodity	
Free	[Y/N]
Fee	[Y/N]
Other (e.g., special licensing structure)	[Y/N]
Data Privacy (HIPAA Status)	
Compliant	
Limited	
Protected	

Appendix F. Approach to Identifying Methodological/Analytic Advances That Would Help Strengthen Efforts To Estimate the Effect of Programs, Policies, or Built Environment Changes on Obesity Prevention and Control

Advancing Research Methods for Evaluation of Natural Experiments in Obesity Prevention and Control

Thank you for agreeing to be an advisor for the Johns Hopkins University, Evidence-base Practice Center project, *"Advancing Research Methods for Evaluation of Natural Experiments in Obesity Prevention and Control"*. Part of the project involves identifying methodological and analytic advances that would help to strengthen efforts to estimate the effect of programs, policies, or built environment changes on obesity prevention and control (e.g. data system features, approaches to linking data, and analytic or study design approaches to reduce bias) We would appreciate your input on this portion of the project. For each question listed below, our team has identified potential methodological and analytic advances that could help strengthen efforts to determine the effect of programs, policies, or built environment changes on obesity prevention and control. We ask that you identify the methodological or analytic advances you think would advance the field of research in obesity prevention and control, especially evaluation of natural experiments in which the intervention is not controlled by researchers. After reviewing each list, please check all items that would help to advance the field, and then add anything else you believe would help to advance the field.

Key Question 1: What population-based data sources have been used in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

What features or types of data sources could help researchers advance methods for conducting studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?

Check all that apply.

- ☐ A process that encourages and facilitates dissemination of publicly available information about the existence and location of data sources that include <u>information about obesity-related outcomes.</u>

- ☐ A process that encourages and facilitates dissemination of publicly available information about the existence and location of data sources that include information about <u>programs, policies, or built environment changes</u> that could affect obesity prevention and control

- ☐ Consistent use of standard terminology in data sources that include obesity-related information, including such concepts as: classification of interventions intended to contribute to obesity prevention and control (e.g., governmental program or policy, non-governmental program or policy, or built environment change); and units of measurement of obesity-related outcomes

- ☐ Consistent use of data dictionaries and codebooks that define all elements, and that are are readily accessible and searchable

- ☐ Consistent use of a standard format for describing how data were collected and validated (including data quality control processes)

- ☐ Explanation of how each data source was intended to be used

- ☐ Description of the timing of interventions in data sources containing information about programs, policies, or built environment changes that could affect obesity prevention and control

- ☐ Inclusion of BMI and other health behavior data in data sources covering small geographic areas.

Please add any additional features or types of data sources that could help researcher advance methods for conducting studies on obesity prevention and control.

Key Question 2. What methods have been used to link different population-based data sources?

What methodological advances would help to facilitate better or more frequent linkage of population-based data sources for studies, especially natural experiments, in obesity prevention and control?

Check all that apply.

- ☐ Consistent use of standard procedures for linking health care data from different sources
- ☐ Development and use of new methods for linking data on social determinants of health with health care data
- ☐ Development of reporting standards by publishers for the description of how data sources are linked when studies report more than one data source in manuscripts
- ☐ Adoption of standard policies and procedures for exchanging/sharing data

Please add any additional methodological advances that would help facilitate better or more frequent linkage of population-based data sources.

Key Question 3. What obesity measures, dietary physical behaviors, and other outcomes have been assessed in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control?

What methodological advances (e.g. measures and data collection procedures) would help to strengthen the assessment of obesity-related outcomes, including dietary and physical activity behaviors, in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?

Check all that apply.

- ☐ Standardized measures and methods for obesity-related outcomes across populations and studies to better facilitate comparisons.
- ☐ Improving data collection measures for park-based and transportation-based studies to assess changes in individual and population physical activity beyond observing park or transportation use.
- ☐ Assessment of the validity of intermediate outcomes such as studies of purchasing behavior correlated to behavioral and health outcomes.
- ☐ Longer term surveillance of measures to measure the impact of an intervention on changes in obesity measures over time
- ☐ Inclusion of BMI and other health behavior data in data sources covering small geographic areas.
- ☐ Establishing standards for the collection of obesity-related outcomes in adults and children.
- ☐ Consistent use of validated measures of obesity-related outcomes across studies.
- ☐ Consistent use of terminology in describing measures of obesity-related outcomes used in surveys or observational studies

Please add any additional methodological advances that would help to strengthen the assessment of obesity-related outcomes.

Key Question 4. Which experimental and non-experimental methods have been used in studies of how programs, policies or built environment changes affect or are associated with obesity prevention and control outcomes?

Key Question 5. What are the risks of bias in studies of how programs, policies, or built environment changes affect or are associated with obesity prevention and control outcomes?

What study design and analytic approaches would help to strengthen methods and reduce the risk of bias encountered in studies, especially natural experiments, of how programs, policies or built environment changes affect obesity prevention and control?

Check all that apply.

- ☐ Consistent use of standards for terms and reporting in studies of obesity prevention and control using natural experiment designs, including: study design, testing assumptions, sensitivity analyses, observed (and adjusted for) confounders, and unobserved confounders
- ☐ Design-specific reporting standards for observational study methods used in natural experiments related to obesity prevention and control
- ☐ Greater use of time-series designs instead of simple pre-post comparisons in studies of obesity prevention and control
- ☐ Greater use of stronger natural experiment designs such as instrumental variables and regression discontinuity
- ☐ Development and use of validated instruments for measuring the "exposures" in studies of how programs, policies, or built environment changes affect obesity prevention and control
- ☐ Development and use of a specific practical and validated tool for assessing the risk of bias in observational studies of how programs, policies, or built environment changes affect obesity prevention and control

Please add any additional study design and analytic approaches that would help strengthen methods and reduce the risk of bias encountered in studies on obesity prevention and control.

Appendix G. Included Studies

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Appendix H. Evidence Tables

Evidence Table H1a. Intervention descriptions of included studies that follow a natural experiment method

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Anderson, 2013[1]	Child Nutrition and WIC Reauthorization Act (CNWICRA)	Physical activity environment	School	Child	US
Anthamatten, 2011[2]	Learning Landscape	Physical activity environment	School	Child	US
Azevedo, 2014[3]	Dance mat systems in public schools	Pysical and built environment	School	Child	Non-US
Barnidge, 2013[4]	Healthier Missouri Communities	Food and beverage environment	Community or neighborhood	Adult	US
Barroso, 2009[5]	Texas Senate Bill 42 (SB42)	Physical activity environment	School	Child	US
Bauhoff, 2014[6]	Senate Bill SB 677; Los Angeles Unified School District Nutrition Policy	Food and beverage environment	School	Child	US
Bauman, 2003[7]	‘Push Play’ initiative	Messaging environment	Community or neighborhood	Adult	Non-US
Bere, 2010[8]	Fruits and Vegetables Make the Marks	Food and beverage environment	School	Child	Non-US
Berger-Jenkins, 2014[9]	Choosing Healthy & Active Lifestyles for Kids (CHALK)	Food and beverage environment Physical activity environment	School	Child	US
Bolton, 2017[10]	Health-Promoting Communities: Being Active Eating Well	Physical activity environment School and early child care environment Social marketing environment	Other or multiple (define)	Child	Non-US
Bowling, 2016[11]	Healthy Foods, Healthy Families (HFHF)	Food and beverage environment	Community or neighborhood Food assistance programs	Adult	US
Branas, 2011[12]	Vacant lot greening program	Physical and Built environment Parks and recreation environment	Community or neighborhood	Adult	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Brown, 2008[13]	New urbanist neighborhood (in comparison to traditional suburban neighborhood)	Physical and Built environment Parks and recreation environment	Community or neighborhood	Adult	US
Brown, 2015[14]	Moving Across Places	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
Brown, 2016[15]	Complete streets design	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
Brown, 2016[16]	Moving Across Places	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
Burke, 2014[17]	The HealthMPowers program	Food and beverage environment Physical activity environment	School	Child	US
Buscail, 2016[18]	“For health, I move in my neighborhood!”	Physical activity environment	Community or neighborhood	Adult	Non-US
Caldwell, 2009[19]	Colorado Trust	Food and beverage environment	Community or neighborhood	Both	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Calise, 2013[20]	Residents moving to a new urbanist neighborhood	Physical and Built environment Parks and recreation environment Transportation environment	Community or neighborhood	Adult	US
Camacho-Rivera, 2017[21]	AHOME	Food and beverage environment	Food assistance programs	Adult	US
Capogrossi, 2016[22]	School Breakfast Program (SBP) and National School Lunch program	Food and beverage environment	School	Child	US
Cawley, 2007[23]	YRBSS merged with state policies	Physical activity environment	School	Child	US
Cawley, 2007[24]	YRBSS merged with state policies	Physical activity environment	School	Child	US
Chen, 2015[25]	The Home Appliances Going to the Countryside	Policy changes	Community or neighborhood	Adult	Non-US
Cleland, 2008[26]	Compulsory school physical activity	Physical activity environment	School	Adult	Non-US
Coffield, 2011[27]	Child Nutrition and WIC Reauthorization Act (CNRA)	Policy changes	School	Child	US
Cohen, 2012[28]	Fitness Zone	Physical activity environment Parks and recreation environment	Community or neighborhood	Both	US
Cohen, 2014[29]	Creating Healthy, Active and Nurturing Growing-up Environments (CHANGE) study: serve healthier school breakfast and lunch	Food and beverage environment	School	Child	US
Coyle, 2009[30]	Mississippi Fresh Fruit and Vegetable Program (MFVP)	Food and beverage environment	School	Child	US
Cradock, 2011[31]	Boston Public Schools Snack and Beverage Policy	Food and beverage environment	School	Child	US
Cradock, 2014[32]	Boston Active School Day Policy	Physical activity environment	School	Child	US
Cullen, 2006[33]	National School-lunch program and local school-level food policy changes	Food and beverage environment	School	Child	US
Cullen, 2008[34]	Texas Public School Nutrition Policy	Food and beverage environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Cummins, 2005[35]	Impact of a super store on a community's food intake	Food and beverage environment	Community or neighborhood	Adult	Non-US
Cummins, 2008[36]	New food retail development on a deprived area	Physical and Built environment	Community or neighborhood	Both	Non-US
Cummins, 2014[37]	Pennsylvania Fresh Food Financing Initiative	Physical and Built environment	Community or neighborhood	Adult	US
Datar, 2016[38]	Competitive foods and beverages policies in public schools in multple states: NY, WA, NC, GA, TX, KY, TN, LA, GA, OK, KS	Food and beverage environment	School (include summer school and after care)	Child	US
De Cocker, 2007[39]	10,000 Steps Ghent--to increas PA	Messaging environment	Community or neighborhood	Adult	Non-US
de Visser, 2016[40]	Project Healthy Schools in two Cities in Michigan	Food and beverage environment Physical activity environment Messaging environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Dill, 2014[41]	installation of new bicycle boulevards.	Physical and Built environment Transportation environment	Community or neighborhood	Both	US
Dubowitz, 2015[42]	Healthy Food Financing Initiative	Physical and Built environment Food and beverage environment	Community or neighborhood	Adult	US
Elbel, 2015[43]	New York City's Food Retail Expansion to Support Health (FRESH)	Food and beverage environment	Community or neighborhood	Adult	US
Elbel, 2017[44]	FRESH: opening a 17,000 square foot supermarket receiving FRESH program incentives	Physical and Built environment, Food and beverage environment,	Community or neighborhood	Adult	US
Falbe, 2016[45]	Excise tax on SSB	Food and beverage environment	Community or neighborhood	Adult	US
Fitzpatrick, 2017[46]	Food practices and policies within schools and neighborhoods	Food and beverage environment	School (include summer school and after care)	Child	Non-US
Flego, 2014[47]	Jamie's Ministry of Food	Food and beverage environment	Community or neighborhood	Adult	Non-US
Fogarty, 2007[48]	National Schools Fruit Scheme (NSFS)	Food and beverage environment	School	Child	Non-US
Fox, 2009[49]	National School Lunch Program	Food and beverage environment	School	Child	US
Frongillo, 2017[50]	Healthy Communities Study (HCS)	Other	Community or Neighborhood	Child	US
Fuller, 2013[51]	BIcycle-taXI: a public bicycle share program	Physical activity environment Transportation environment	Community or neighborhood	Adult	Non-US
Fung, 2013[52]	The Food and Nutrition Policy for Nova Scotia Public Schools	Food and beverage environment	School	Child	Non-US
Gee, 2015[53]	Act 1220 (Arkansas): BMI screening	Policy changes	School	Child	US
Gibson, 2006[54]	Food Stamp program	Food and beverage environment	Food assistance programs	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Giles-Corti, 2013[55]	RESIDential Environmental Project (RESIDE)	Physical and Built environment Parks and recreation environment Transportation environment	Community or neighborhood	Adult	Non-US
Gleason, 2009[56]	School meals	Food and beverage environment	School (include summer school and after care)	Child	US
Goldsby, 2016[57]	Railroad Park	Physical and Built environment Parks and recreation environment	Community or neighborhood	Child	US
Goodman, 2014[58]	a traffic-free bridge was built over Cardiff Bay; Kenilworth, a traffic-free bridge was built over a busy trunk road; and Southampton, an informal riverside footpath was turned into a boardwalk	Physical and Built environment Transportation environment	Community or neighborhood	Adult	Non-US
Goodman, 2016[59]	Bikeability- cycle training in schools	Physical activity environment	Transportation environment	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Gorely, 2011[60]	GreatFun2Run	Messaging environment	School	Child	Non-US
Gorham, 2015[61]	Fresh to You Markets	Food and beverage environment	Community or neighborhood	Both	US
Harding, 2017[62]	The Mālaekahana Bike Path	Physical and Built environment	Community or neighborhood	Adult	US
Heelan, 2015[63]	Kearney Public School (KPS) District; population dose study	Food and beverage environment Physical activity environment	School	Child	US
Hennessy, 2014[64]	Multiple state laws for 50 states and DC	Policy changes	School	Child	US
Herrick, 2012[65]	Sports, Play, and Active Recreation for Kids (SPARK)	Physical activity environment	School	Child	US
Hilmers, 2014[66]	The Supplemental Nutrition Assistance Program (SNAP)	Food and beverage environment	Community or neighborhood Food assistance program	Adult	US
Hobin, 2014[67]	Mandatory province-wide PE policy	Physical activity environment	School	Child	Non-US
Hobin, 2017[68]	Province PE policy on MVPA (moderate to vigorous physical activity)	Physical and Built environment	School (include summer school and after care)	Child	Non-US
Hoelscher, 2016[69]	Fuel Up to Play 60 (FUTP60)	Food and beverage environment	School	Child	Non-US
Hoelscher, 2016[70]	2005 Safe Routes to School (SRTS) initiative	Physical activity environment	School	Child	US
Howlett, 2016[71]	SNAP (Food stamp program)	Food and beverage environment	Food assistance programs	Child	US
Hu, 2016[72]	Reducing Health inequalities : an action report and Tackling Health Inequalities: a program of Action	Policy changes	Community or neighborhood	Adult	Non-US
Hughes, 2012[73]	The School Fruit and Vegetable Scheme (SFVS)	Food and beverage environment	School	Child	Non-US
Hunter, 2016[74]	COMPASS: Changes to PA policies, recreational programming, use of public health units (i.e., a government health agency that carries out community health programs), and environment/equipment	Physical activity environment, School and early child care environment,	School (include summer school and after care)	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Jennings, 2012[75]	Mobile Food Store (MFS)	Food and beverage environment	Community or neighborhood	Adult	Non-US
Jia, 2017[76]	Childhood Obesity Study in China Megacities (COCM)	Food and beverage environment	School (include summer school and after care)	Child	Non-US
Johnson, 2017[77]	One Body One Life (OBOL) healthy lifestyle programme	Physical activity environment	Community or neighborhood	Adult	Non-US
Just, 2014[78]	Food purchases by debit-card	Food and beverage environment	School	Child	Non-US
Kern, 2014[79]	Communities Putting Prevention to Work (CPPW)	Food and beverage environment Physical activity environment	School	Child	US
Keyte, 2012[80]	National Healthy Schools Progamme	Food and beverage environment	School	Child	Non-US
Kim, 2012[81]	Changing food offerings at school tuck shops	Food and beverage environment	School	Child	Non-US
Kim, 2012[82]	Physical education state policies	Policy changes	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
King, 2014[83]	HEROES (Healthy, Energetic, Ready, Outstanding, Enthusiastic, Schools) Initiative	Food and beverage environment	School	Child	US
Kubik, 2005[84]	Schoolwide food policies and practices	Food and beverage environment	School	Child	US
Lachapelle, 2009[85]	Mean distance walked per day for transportation purposes	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
LaRowe, 2016[86]	The Active Early program	Physical activity environment	School	Child	US
Leung, 2013[87]	Supplemental Nutrition Assistance Program (SNAP), formerly the Food Stamp Program	Food and beverage environment	Food assistance programs	Child	US
Liao, 2015[88]	Reach 2010	Food and beverage environment	Community or neighborhood	Adult	US
Ling, 2014[89]	Comprehensive school-based intervention on healthy behavior	Food and beverage environment	School	Child	US
Liu, 2016[90]	WIC and SNAP	Food and beverage environment	Food assistance programs	Child	US
MacDonald, 2010[91]	Light-rail transit use	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
Maddock, 2006[92]	Coordinated School Health Program (CSHP)	Physical activity environment Messaging environment	School	Child	US
Madsen, 2011[93]	Let's Go!	Messaging environment	School	Child	US
Madsen, 2015[94]	Healthy Schools Program (HSP)	Food and beverage environment Physical activity environment	School	Child	US
Malakellis, 2017[95]	The Australian Capital Territory (ACT)	Food and beverage environment, Physical activity environment,	School (include summer school and after care)	Child	Non-US
Masse, 2014[96]	Healthier nutrition guidelines	Food and beverage environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Miewald, 2012[97]	Food Box Program (Fraser Region Harvest Box Program)	Food and beverage environment	Community or neighborhood	Adult	Non-US
Miller, 2015[98]	Light rail transit use	Physical activity environment Transportation environment	Community or neighborhood	Adult	US
Molitor, 2015[99]	Supplemental Nutrition Assistance Program–Education (SNAP-ED)	Food and beverage environment	Food assistance programs	Both	US
Morton, 2016[100]	SPEEDY	Physical activity environment	School (include summer school and after care)	Child	Non-US
Mullally, 2010[101]	Prince Edward Island school nutrition policy	Food and beverage environment	School	Child	Non-US
Mumford, 2011[102]	mixed-use redevelopment community in metropolitan Atlanta (Atlantic Station) that promotes walking and physical activity	Physical and Built environment Parks and recreation environment Transportation environment	Community or neighborhood	Adult	US
Nanney, 2014[103]	The School Obesity-related Policy Evaluation study (ScOPE)	Policy changes	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Nanney, 2016[104]	School-specific policies/program	Food and beverage environment Physical activity environment	School	Child	US
Neelon, 2015[105]	Mebane on the Move Intervention	Physical and Built environment	Community or neighborhood	Child	US
Nehme, 2017[106]	Workplace showers	Physical and Built environment	Employer or workplace	Adult	US
Nguyen, 2015[107]	Supplemental Nutrition Assistance Program (SNAP)	Food and beverage environment	Food assistance programs	Adult	US
Oh, 2015[108]	Analysis of CLASS and NSCH	Physical activity environment	School	Child	US
Olsho, 2015[109]	Health Bucks: Farmers' market incentive program	Food and beverage environment	Food assistance programs	Adult	US
Panter, 2016[110]	The Cambridge Guided Busway	Physical and Built environment Parks and recreation environment Transportation environment	Community or neighborhood	Adult	Non-US
Parsons, 2014[111]	Anchorage School District's School Wellness Policy	Policy changes	School	Child	US
Peterson, 2015[112]	Healthy Choice	Food and beverage environment Physical activity environment	School	Child	US
Powell, 2009[113]	State-level grocery story and vending machine soda taxes	Food and beverage environment	School	Child	US
Quig, 2012[114]	playground upgrade program	Physical and Built environment	Community or neighborhood	Child	US
Reger-Nash, 2005[115]	Wheeling Walks	Physical activity environment	Community or neighborhood	Adult	US
Reger-Nash, 2008[116]	A social marketing intervention promoted walking	Messaging environment	Community or neighborhood	Adult	US
Restrepo, 2016[117]	Calorie Labeling Laws in New York City jurisdictions	Messaging environment	Community or neighborhood	Adult	US
Ridgers, 2007[118]	Sporting Playgrounds' Initiative: playground redesign intervention across time on children's recess physical activity levels	Physical and Built environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Ridgers, 2007[119]	Sporting Playgrounds' Initiative	Physical activity environment	School	Child	Non-US
Riis, 2012[120]	results of different school nutrition policies	Policy changes	School	Child	US
Ritchie, 2016[121]	Breakfast service policy	Food and beverage environment	School	Child	US
Robles, 2017[122]	Electronic Benefit Transfer (EBT) at farmers markets	Food and beverage environment	Community or neighborhood	Adult	US
Rushakoff, 2017[123]	Healthy2Go: received training and technical assistance to increase availability and awareness of healthy foods	Food and beverage environment	Community or neighborhood	Child	US
Sabia, 2016[124]	state high school physical education requirements	Physical activity environment	School	Child	US
Sadler, 2013[125]	an independent grocery store (Witherbee's Market) at the center of the Carriage Town neighborhood	Physical and Built environment	Community or neighborhood	Adult	US
Sanchez-Vaznaugh, 2010[126]	California Childhood Obesity Prevention Act: Obesity Prevention Motion; Obesity Prevention Motion	Food and beverage environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Schanzenbach, 2005[127]	National School Lunch Program	Food and beverage environment	School	Child	US
Schwartz, 2016[128]	Michigan State Board of Education (MSBE) nutrition policy	Physical and Built environment	School	Child	US
Sekhobo, 2014[129]	WIC enrolled children	Physical and Built environment	Community or neighborhood	Child	US
Slater, 2014[130]	Joint Use Policies	Policy changes	School	Child	US
Spence, 2013[131]	Introduction of food and nutrient-based standards	Food and beverage environment	School	Child	Non-US
Stephens, 2014[132]	Regulations governing minimum PA standards in child care centers	Physical activity environment	School	Child	US
Stratton, 2005[133]	multicolor school playground markings	Physical activity environment	School	Child	Non-US
Sturm, 2010[134]	State Soda Tax	Food and beverage environment	School	Child	US
Sturm, 2015[135]	Los Angeles Fast Food ban	Food and beverage environment	Community or neighborhood	Adult	US
Taber, 2011[136]	Policy Changes Targeting Junk Food in School vending machines	Food and beverage environment	School	Child	US
Taber, 2012[137]	Laws governing competitive food nutrition content	Physical activity environment	School	Child	Non-US
Taber, 2012[138]	All Sugar Sweetened Beverage Ban and the only soda ban	Food and beverage environment	School	Child	US
Taber, 2013[139]	State competitive food laws and state physical education laws	Food and beverage environment Physical activity environment	School	Child	US
Tak, 2007[140]	Schoolgruiten project	Food and beverage environment	School	Child	Non-US
Tak, 2009[141]	Schoolgruiten Project, a Dutch primary school-based intervention providing free fruit and vegetables (F&V).	Food and beverage environment	School	Child	Non-US
Tester, 2016[142]	WIC	Food and beverage environment	Food assistance programs	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Toussaint, 2017[143]	The Northwest Iowa Food and Fitness Initiative: Regional Safe Routes to School Programming (see www.saferoutestoschools.org), Walking School Buses, and bike rodeos	Physical and Built environment, Food and beverage environment, Physical activity environment	Community or neighborhood	Child	US
Utter, 2016[144]	School gardens	Food and beverage environment	School (include summer school and after care)	Child	Non-US
Vadiveloo, 2011[145]	Calorie-labeling policy	Messaging environment	Community or neighborhood	Adult	US
Veugelers, 2005[146]	Annapolis Valley Health Promoting School Project (AVHPSP)	Food and beverage environment	School	Child	Non-US
von Hippel, 2015[147]	Texas Fitness Now (TFN)	Physical activity environment	School	Child	US
Webb, 2012[148]	English longitudinal study of ageing	Physical and Built environment Transportation environment	Community or neighborhood	Adult	Non-US
Webb, 2016[149]	Free bus transportation for older people	Physical activity environment Transportation environment	Community or neighborhood	Adult	Non-US
Wells, 2005[150]	National School Fruit Scheme (NSFS)	Food and beverage environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
West, 2011[151]	Building new greenway	Physical and Built environment Parks and recreation environment	Community or neighborhood	Adult	US
Whetstone, 2012[152]	North Carolina Health and Wellness Trust Fund (NCHWTF)	Food and beverage environment Physical activity environment	School	Child	US
Woodward-Lopez, 2010[153]	Senate Bill 12 (SB 12), California	Food and beverage environment	School	Child	US
Wrigley, 2003[154]	Food Deserts in British Cities project (Seacroft project)	Food and beverage environment	Community or neighborhood	Adult	Non-US
Zhu, 2013[155]	LEED for Neighborhood Development (LEED-ND)	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US
Zhu, 2014[156]	Moving to a walkable community	Physical and Built environment Transportation environment	Community or neighborhood	Adult	US

BMI=Body Mass Index; No.=number; PE=physical education; SNAP= Supplemental Nutrition Assistance Program; SSB=sugar sweetened beverage; US=United States; WIC=Women, Infants, and Children program; YRBSS=Youth Risk Behavior Surveillance System

Evidence Table H1b. Intervention descriptions of included studies that follow an experimental method

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Alaimo, 2013[157]	Michigan State Board of Education (MSBE) nutrition policy	Food and beverage environment Messaging environment	School	Child	US
Anderson, 2001[158]	Michigan Farmers' Market Nutrition Program	Food and beverage environment	Community or neighborhood	Adult	US
Angelopoulos, 2009[159]	The CHILDREN study	Food and beverage environment Physical activity environment	School	Child	Non-US
Ask, 2010[160]	Free School lunch	Food and beverage environment	School	Child	Non-US
Audrey, 2015[161]	Walk to Work	Physical and Built environment Physical activity environment Transportation environment	Employer or workplace	Adult	Non-US
Ayala, 2013[162]	Fruit and vegetable promotion in stores with staff training and installing new equipment	Physical and Built environment Messaging environment	Community or neighborhood	Adult	US
Backman, 2011[163]	Fresh fruit availability at worksites	Food and beverage environment	Employer or workplace	Adult	US
Baker, 2016[164]	Men on the Move: Growing Communities (MOTMGC)	Food and beverage environment	Community or neighborhood	Adult	US
Bastian, 2015[165]	APPLE	Physical activity environment	School	Child	US
Bere, 2005[166]	School Fruit Programme	Food and beverage environment	School	Child	Non-US
Bere, 2006[167]	Norwegian School Fruit Programme (no cost to parents) AND Fruit and Vegetables Make the Marks (FVMM) educational programme (Combined)	Food and beverage environment	School	Both	Non-US
Bere, 2006[168]	Fruits and Vegetables Make the Marks intervention	Food and beverage environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Bere, 2007[169]	Fruits and Vegetables Make the Marks (FVMM)	Food and beverage environment	School	Child	Non-US
Beresford, 2010[170]	The 5 a Day intervention: newsletters and promotions to encourage healthy eating	Messaging environment	Employer or workplace	Adult	US
Blum, 2008[171]	Reduced availability of sugar sweetened beverage and diet soda in a la carte and vending programs in Maine public high schools.	Food and beverage environment	School	Child	US
Bonsergent, 2013[172]	The PRomotion de l'ALImentation et de l'ActivitéPhysique (PRALIMAP) trial	Food and beverage environment Physical activity environment	School	Child	Non-US
Bonvin, 2013[173]	"Youp'là Boug"	Physical activity environment	School	Child	Non-US
Busch, 2015[174]	Utrecht Healthy School	Food and beverage environment	School	Child	Non-US
Caballero, 2003[175]	Pathways Program (food protion focused on providing lower fat foods)	Food and beverage environment Physical activity environment	School	Child	US
Chomitz, 2010[176]	Healthy Living Cambridge Kids (KLCK)	Food and beverage environment Physical activity environment	School Community or neighborhood	Child	US
Cochrane, 2012[177]	NHS Health Check program + additional lifestyle support vs. NHS health check alone	Healthcare environment Physical activity environment	Primary care centers	Adult	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Coleman, 2012[178]	The Healthy Options for Nutrition Environments in Schools (Healthy ONES)	Food and beverage environment	School	Child	US
Cortinez-O'Ryan, 2017[179]	"Juega en tu Barrio" (Play in your Neighborhood)	Physical activity environment	Community or neighborhood	Child	Non-US
Crespo, 2012[180]	Community Health Advisor	Food and beverage environment Physical activity environment	School	Child	US
Day, 2008[181]	Action Schools! BC - Healthy Eating, a school-based fruit and vegetable (FV) intervention	Food and beverage environment	School	Child	Non-US
De Coen, 2012[182]	Prevention of Overweight among pre-school and school children (POP) using the Healthy food framework	Food and beverage environment	School	Child	Non-US
de Greeff, 2016[183]	Fit en Vaardig op school	Physical activity environment	School (include summer school and after care)	Child	Non-US
De Henauw, 2015[184]	The Identification and prevention of Dietary- and lifestyle-induced health EFfects In Children and infantS (IDEFICS)	Food and beverage environment Physical activity environment	School Community or neighborhood	Child	Non-US
de Meij, 2011[185]	JUMP-in	Physical activity environment Physical and built environment	School	Child	Non-US
Dunton, 2015[186]	Physical activity intervention	Physical activity environment	School	Child	US
Dzewaltowski, 2009[187]	The Healthy Youth Places	Food and beverage environment Physical activity environment Physical and built environment	School	Both	US
Eagle, 2013[188]	Project Healthy Schools	Food and beverage environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Economos, 2007[189]	Shape-Up Somerville	Food and beverage environment Physical activity environment	Community or neighborhood	Child	US
Elinder, 2012[190]	Stockholm County Implementation Programme in school (SCIP-school)	Food and beverage environment Physical activity environment	School	Child	Non-US
Eriksen, 2003[191]	Fruit and vegetable subscription	Food and beverage environment	School	Child	Non-US
Ermetici, 2016[192]	The Italian EAT project	Food and beverage environment Messaging environment	School	Child	Non-US
Esquivel, 2016[193]	Children's Healthy Living Program for Remote Underserved Minority Populations in the Pacific Region (CHL)	Policy change	School	Child	US
Evans, 2013[194]	Project Tomato: environment of the school promotes the eating of fruit and vegetables	Food and beverage environment	School	Child	Non-US
Fairclough, 2016[195]	Born to Move	Physical activity environment	School (include summer school and after care)	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Farley, 2007[196]	Opening access to schoolyard outside of regular operation hours	Physical and Built environment	Community or neighborhood	Child	US
Farmer, 2017[197]	Cluster randomized intervention called PLAY	Physical activity environment	School (include summer school and after care)	Child	Non-US
Finch, 2014[198]	Multi-level intervention to influence children's' PA behaviors	Physical activity environment	School	Child	US
Foster, 2008[199]	School Nutrition Policy Initiative (SNPI)	Food and beverage environment	School	Child	US
French, 2010[200]	Route H	Food and beverage environment Physical activity environment	Employer or workplace	Adult	US
Fu, 2016[201]	SPARK (Sports, Play and Active Recreation for Kids)	Physical activity environment	School (include summer school and after care)	Child	US
Gatto, 2017[202]	LA Sprouts: gardening, nutrition and cooking intervention	Food and beverage environment	School (include summer school and after care)	Child	US
Geaney, 2016[203]	Food Choice at Work	Food and beverage environment	Employer or workplace	Adult	Non-US
Gittelsohn, 2010[204]	The Healthy Foods Hawaii (HFH)	Physical and Built environment Food and beverage environment	Community or neighborhood	Adult	US
Gittelsohn, 2013[205]	Navajo Healthy Stores (NHS) program	Physical and Built environment Food and beverage environment	Community or neighborhood	Adult	US
Goetzel, 2010[206]	Health promotion messaging and counseling	Messaging environment	Employer or workplace	Adult	US
Gustat, 2012[207]	Partnership for an Active Community Environment (PACE) and city of New Orleans	Physical and Built environment Parks and recreation environment	Community or neighborhood	Adult	US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Haerens, 2006[208]	Physical Activity and Healthy Food Intervention	Food and beverage environment Physical activity environment	School	Child	US
Haerens, 2007[209]	A School-based intervention program on healthy food	Food and beverage environment	School	Child	Non-US
Hardy, 2010[210]	Munch and Move	Food and beverage environment Physical activity environment	School	Child	US
He, 2009[211]	the Northern Fruit and Vegetable Pilot Programme (NFVPP)	Food and beverage environment	School	Child	Non-US
Hendy, 2011[212]	Kid's Choice Program	Physical activity environment	School	Child	US
Hoefkens, 2011[213]	Posting point-of-purchase nutrition-information	Messaging environment	University	Adult	Non-US
Hollis, 2016[214]	Physical Activity 4 Everyone	Physical activity environment	School	Child	US
Huberty, 2011[215]	Ready for Recess	Physical activity environment	School	Child	US
Jago, 2011[216]	The HEALTHY Intervention	Physical activity environment	School	Child	US
Janssen, 2015[217]	PLAYgrounds	Physical activity environment	School	Child	Non-US
Jones, 2015[218]	Increase implementation of healthy eating and PA policies in child-care services	Physical activity environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Jordan, 2008[219]	Gold Medal Schools program	Other	School	Child	US
Jurg, 2006[220]	JUMP-in	Physical activity environment	School	Child	US
Kain, 2004[221]	'Healthy School' initiative	Food and beverage environment Physical activity environment	School	Child	Non-US
Kamada, 2013[222]	The COMMUNICATE (COMMUNIty-wide Campaign To promote Exercise)	Messaging environment	Community or neighborhood	Adult	US
Kastorini, 2016[223]	Diatrofi	Food and beverage environment	School	Child	Non-US
Kloek, 2006[224]	Working on Healthy Neighborhoods	Physical activity environment Food and beverage environment Messaging environment	Community or neighborhood	Adult	Non-US
LaCaille, 2016[225]	Go!	Food and beverage environment Physical activity environment	Employer or workplace	Adult	US
Lemon, 2010[226]	Step Ahead trial	Food and beverage environment Physical activity environment Messaging environment	Employer or workplace	Adult	US
Lemon, 2014[227]	Multi-level weight-gain prevention	Food and beverage environment Food and beverage environment	Employer or workplace	Adult	US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Lent, 2014[228]	Healthy Store Intervention	Physical and Built environment Food and beverage environment	School	Child	US
Linde, 2012[229]	HealthWorks	Food and beverage environment Messaging environment	Employer or workplace	Adult	US
Llargues, 2011[230]	The Avall study: educational material on healthy food and necessary equipment to facilitate educational games on healthy foods	Food and beverage environment	School	Child	Non-US
Lorentzen, 2009[231]	The "Romsås in Motion" study: labeled walking paths, street lighting, gritting of walking paths in winter	Physical and Built environment Physical activity environment Messaging environment	Community or neighborhood	Adult	Non-US
Lubans, 2016[232]	ATLAS	Physical activity environment Messaging environment	School	Child	US
Ludwig, 2011[233]	HUD assignment for urban housing.	Physical and Built environment	Community or neighborhood	Adult	US
Lv, 2014[234]	Community Interventions for Health: build walking trails, bike service system	Messaging environment Work environment Physical and Built environment	Community or neighborhood	Adult	US
Madsen, 2013[235]	America SCORES	Physical activity environment	School	Child	US
Madsen, 2015[236]	Energy Balance for Kids with Play (EB4K with Play)	Food and beverage environment Physical activity environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Mead, 2013[237]	Healthy Foods North	Physical and Built environment Food and beverage environment	Community or neighborhood	Adult	Non-US
Morrill, 2016[238]	Food Dudes	Food and beverage environment	School	Child	US
Murphy, 2011[239]	Welsh Assembly Government's Primary School Free Breakfast Initiative (PSFBI)	Food and beverage environment	School	Child	Non-US
Naylor, 2006[240]	Action Schools	Physical activity environment	School	Child	Non-US
Naylor, 2008[241]	Action Schools BC	Physical activity environment	School	Child	Non-US
Neumark-Sztainer, 2010[242]	New Moves intervention	Physical activity environment	School	Child	US
Nicklas, 2017[243]	Head Start: classroom videotaped (DVD) puppet shows.	Social marketing environment	School (include summer school and after care)	Child	US
Ortega, 2016[244]	Proyecto Mercado FRESCO	Food and beverage environment	Community or neighborhood	Adult	US
Pate, 2005[245]	Lifestyle Education for Activity Program	Physical activity environment	School	Child	US
Pbert, 2016[246]	Lookin' Good Feelin' Good: School nurse intervention and after-school exercise program	Physical activity environment	School	Child	US
Perry, 2004[247]	The Cafeteria Power Plus Intervention	Food and beverage environment	School	Child	US
Ploeg, 2014[248]	Sporting Playgrounds' Initiative: The Alberta Project Promoting Active Living and Healthy Eating in Schools (APPLE Schools)	Physical activity environment	School	Child	Non-US
Pope, 2016[249]	Project CHOICE (Center for Healthy Options and Community Empowerment)- community-based participatory research study	Food and beverage environment	School (include summer school and after care)	Child	US
Ransley, 2007[250]	School fruit and vegetable scheme (SFVS)	Food and beverage environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Reilly, 2006[251]	Movement and Activity Glasgow Intervention in Children (MAGIC)	Physical activity environment	School	Child	Non-US
Reynolds, 2000[252]	High 5	Food and beverage environment	School	Child	US
Ridgers, 2010[253]	"National 10 million sporting playground initiative"	Physical activity environment	School	Child	Non-US
Rush, 2014[254]	Project Energize	Food and beverage environment Physical activity environment	School	Child	Non-US
Sallis, 2003[255]	Middle-School Physical Activity and Nutrition (M-SPAN)	Food and beverage environment	School	Child	US
Sharma, 2016[256]	Brighter Bites	Food and beverage environment	School	Child	Non-US
Shive, 2006[257]	Energize Your Life!	Food and beverage environment Messaging environment	University	Adult	US
Sigmund, 2012[258]	"Healthy Schools" Project (PA program component)	Physical activity environment	School	Child	Non-US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Simon, 2008[259]	'Intervention Centered on Adolescents' Physical activity and Sedentary behavior' (ICAPS)	Physical activity environment	School	Child	US
Steenhuis, 2004[260]	Changing food availability in Dutch cafeterias	Food and beverage environment	Employer or workplace	Adult	Non-US
Story, 2012[261]	Bright Start	Food and beverage environment Physical activity environment	School	Child	US
Tarp, 2016[262]	The Learning, Cognition & Motion (LCoMotion) study	Physical activity environment	School (include summer school and after care)	Child	US
Te Velde, 2008[263]	Pro Children	Food and beverage environment	School	Child	US
Van Cauwenberghe 2012[264]	Lowering recess playground density	Physical and Built environment	School	Adult	Non-US
Waters, 2017[265]	Fun 'n healthy in Moreland!: Healthy lunch options, healthy snacks, fruit breaks, upgraded taps, school water policy/water bottles, schools breakfast, apple slinky machines, fruit deliveries, cooking gardens	Food and beverage environment Physical activity environment School and early child care environment	School (include summer school and after care)	Child	Non-US
Wells, 2014[266]	School garden	Physical and built environment	School	Child	US
Wendel, 2016[267]	Standing desks in classrooms	Physical activity environment	School	Child	US
Whitt-Glover, 2011[268]	Instant Recess	Physical activity environment	School	Child	US
Williamson, 2012[269]	Environmental Modifications (EMs)	Physical activity environment	School	Child	US
Wilson, 2015[270]	Positive Action for Today's Health	Physical and Built environment Messaging environment	Community or neighborhood	Adult	US
Wright, 2012[271]	Competitive Food Laws (varies by state) in 40 States	Food and beverage environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program policy or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Wright, 2013[272]	Kids N Fitness	Physical activity environment	School	Child	US
Yildirim, 2014[273]	Transform-Us! (T-Us)	Physical activity environment	School	Child	Non-US
Zhou, 2014[274]	PA policy changes; PA curriculum	Food and beverage environment Physical activity environment	School	Child	Non-US

ATLAS= Active Teen Leaders Avoiding Screen-time; HUD=US Department of Housing and Urban Development; NHS=National Health Services; No.=number; PA=physical activity; US=United States

Evidence Table H1c. Intervention descriptions of included studies that follow other study design methods

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Ashfield-Watt 2007[275]	Uk Department of health funded pilot community based intervention to improve fruit and vegetable intakes in five economically deprived areas in England	Food and beverage environment	Community or neighborhood	Adult	Non-US
Blake, 2013[276]	The workplace wellness programme	Food and beverage environment	Employer or workplace	Adult	Non-US
Brownson 2004[277]	Bootheel Walking Promotion Project (creation of walking trails)	Physical activity environment	Community or neighborhood	Adult	US
Brownson, 2005[278]	Multilevel community intervention	Physical activity environment	Community or neighborhood	Adult	US
Brusseau, 2016[279]	Comprehensive School Physical Activity Program (CSPAP)	Physical activity environment	School (include summer school and after care)	Child	US
Cheadle, 2012[280]	Healthy Eating Active Living–Community Health Initiative (HEAL-CHI)	Physical and Built environment Physical activity environment	School	Child	US
De Cocker, 2011[281]	10 000 steps Ghent: walking circuits in parks, street signs in parking lots	Physical and Built environment Messaging environment	Community or neighborhood	Adult	Non-US
de Silva-Sanigorski, 2011[282]	Water Jet installation in schools	Messaging environment	School	Child	US
Geaney, 2010[283]	Structured catering initiative	Food and beverage environment	Employer or workplace	Child	Non-US
Gebel, 2011[284]	Wheeling Walks: mass media campaign influence on walking differently	Messaging environment	Community or neighborhood	Adult	US
Heelan, 2009[285]	Walking school Bus	Physical activity environment	School	Child	US
Huberty, 2013[286]	Movin' Afterschool	Physical activity environment	School	Child	US
Magarey, 2013[287]	Eat Well Be Active (EWBA) Community Programs	Physical activity environment	School	Child	Non-US
Naul, 2012[288]	Healthy Children in Sound Communities (HCSC)/gkgk project	Physical activity environment	School	Child	Non-US
Rogers, 2013[289]	Romp & Chomp	Messaging environment	School	Child	US

Author, year	Intervention name/description if not named	Goal of the program, policy, or built environment change	Target of intervention	Adult/Child/Both	US or Non-US
Taber, 2002[290]	State laws regarding the nutrition content of competitive foods sold in high schools	Food and beverage environment	School	Child	US
Tomlin, 2012[291]	Action Schools! BC	Physical activity environment	School	Child	Non-US
Vasquez, 2016[292]	Community-Supported Agriculture (CSA)	Food and beverage environment	Employer or workplace	Adult	US
Weaver, 2017[293]	Partnerships for Active Children in Elementary Schools (PACES)	Physical activity environment	School (include summer school and after care)	Child	US
Whaley, 2010[294]	Supplemental Nutrition Program for Women, Infants, and Children (PHFE-WIC)	Food and beverage environment Physical activity environment	Food assistance programs	Child	US

No.=number; US=United States

Evidence Table H2a. Study and participant characteristics of included studies that follow a natural experiment method

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Anderson, 2013[1]	2003 to 2007	83253	NA	40464 (48.3-48.7)	Grades:9-12	NR
Anthamatten, 2011[2]	2005 to 2006	3688	12 months	NR	NR	African American, 2- 65 Hispanic, 32-92 Anglo, 2- 7 Asian, 1-3
Azevedo, 2014[3]	2010 to 2012	497	12 months	NR	11.2	NR
Barnidge, 2013[4]	2011	NR	1 month	40 (28.4)	NR	Black (Non-Hispanic), 34.8 White (Non-Hispanic), 54.6 Other (including multiple race), 5.7
Barroso, 2009[5]	2006 to 2008	3327	24-36 months	NR	NR	NR
Bauhoff, 2014[6]	2001 to 2006	35899	24 months	NR	12-15	African American, 6-11 Hispanic, 39-72 White, 10-40
Bauman, 2003[7]	1999 to 2002	665	3 years	(45.9- 50.2)	NR	NR
Bere, 2010[8]	2001 to 2008	2887	NA	(48-50)	10-12	NR
Berger-Jenkins, 2014[9]	2008 to 2010	796	2 years	(51.7)	8.98	Hispanic, 60.5 Black (Non-Hispanic), 24.6 White (Non-Hispanic),12.6 Other, 2.3

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Bolton, 2017[10]	2008 to 2010	3648	2 years	NR	5	NR
Bowling, 2016[11]	2013 to 2013	425	17 weeks	24 (5.2)	34.5	Asian, 8.9 Black, 7.9 Cape Verdean, 0.7 Hispanic, 46.2 Multi-Ethnic, 4.8 White, 30.1 Other, 3.1
Branas, 2011[12]	1999 to 2008	NR	NR	NR	36.42-36.98 (Median)	NR
Brown, 2008[13]	2003	453	2 months	(27.9- 63.5)	37.18-46.84	NR
Brown, 2015[14]	2012 to 2013	537	NR	NR	37.8-43.9	Hispanic, 25
Brown, 2016[15]	NR	NR	NR	NR	≥18	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Brown, 2016[16]	2012 to 2013	910	12 months	NR	NR	NR
Burke, 2014[17]	2011 to 2013	23347	7 months	NR	10 - 17	White, 18-51 Black, 26-61 Hispanic, 1-14 Asian/Pacific Islander, 1-18 Two or more races, 2- 5
Buscail, 2016[18]	2013 to 2015	199	24 months	(35.7-41.8)	38.1 - 40.6	NR
Caldwell, 2009[19]	4 to 16 weeks	266	NR	53	All ages	White, 79.7 Not White, 6.4 Hispanic, 7.5 Not Hispanic, 83.8
Calise, 2013[20]	2009	424	3 months	NR	20-39	White (Non-Hispanic), 88.6
Camacho-Rivera, 2017[21]	2011 to 2012	362	NA	NR	44.8-47.4	NR
Capogrossi, 2016[22]	1998 to 2007	5910	NR	(43(55)	NR	Black, 7-33 Hispanic, 17-26
Cawley, 2007[23]	1999 to 2003	36833	36 months	17987	Grades: High school	NR
Cawley, 2007[24]	1999 to 2003	44164	NA	(50)	14-18	White, 64
Chen, 2015[25]	2004 to 2009	18769	3 years	7032	45.4 - 47.46	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Cleland, 2008[26]	2004 to 2006	5170	20 years	NR	31.0 (2.6)	NR
Coffield, 2011[27]	2007 to 2009	40713	2 years	NR	15 - 19	White, 84 Non-White, 16
Cohen, 2012[28]	2008 to 2010	NR	NR	(45.6)	All ages	White (Non-Hispanic), 2.1 Black (Non-Hispanic), 8.5 Asian/Other, 0.8 Hispanic, 74.1
Cohen, 2014[29]	2007 to 2009	1230	NR	(41-47)	8.6	NR
Coyle, 2009[30]	2004 to 2005	NR	12 months	NR	NR	NR
Cradock, 2011[31]	2004 to 2006	2091	24 months	(45 (53)	NR	White, 11-72 Black, 16-43

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*[†]	Race/Ethnicity, %*[‡]
Cradock, 2014[32]	2011 to 2011	455	3 months	187 (48)	10.2 (0.8)	White, Non-Hispanic, 2 Black (Non-Hispanic), 59 Hispanic, 31 Asian, 7 Other, 2
Cullen, 2006[33]	2001 to 2002	2790	2 years	NR	NR	Hispanic, 61 White, 34 African American, 3 Asian other, 2
Cullen, 2008[34]	2001 to 2006	2671	3 years	NR	NR	NR
Cummins, 2005[35]	NR	412	NA	118 (28.6)	≥16	NR
Cummins, 2008[36]	2001	NR	1 year	118 (28.6)	NR	NR
Cummins, 2014[37]	2006 to 2010	1440	48 months	134 (20)	54 (14.8)	Black, 84 White, 9 Hispanic, 2 Other, 4

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Datar, 2016[38]	2013 to 2015	894	18 months	NR	13.17	White (non-Hispanic), 40.6 Black (non-Hispanic), 20.4 Hispanic, 24.8 Other (including multiple race), 14.2
De Cocker, 2007[39]	2005 to 2006	1682	1 year	(47.2-47.5)	25-75	NR
de Visser, 2016[40]	2013 to 2014	2510	6 weeks	(48.5-51.1)	11-12	White, 34.8-58.7 Black, 13.7-44.4 Hispanic, 4.4 Asian, 15.1-0.7
Dill, 2014[41]	2010 to 2013	490	5 days	NR	40.8-43.1	NR
Dubowitz, 2015[42]	2011 to 2014	1372	36 months	(25)	53.3	African American, 95.2 Other, 4.8

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Elbel, 2015[43]	2011 to 2012	850	12 months	NR	NR	Black (Non-Hispanic), 21.9-46 Hispanic, 47.5-70.7 Other (including multiple race), 3.3-8.0
Elbel, 2017[44]	2011 to 2014	3998	3 years	(36)	NR	Hispanic, 50 Black (non-Hispanic), 43 Other (including multiple race), 7.7
Falbe, 2016[45]	2014 to 2015	990	12 months	(40-54)	39-46 (15-17)	African American, 31-34 Hispanic, 20-38 White, 16-32 Other, 13-17
Fitzpatrick, 2017[46]	2005 to 2011	431	2 years	(54)	8-10	NR
Flego, 2014[47]	2011 to 2013	1960	2 years	NR	NR	NR
Fogarty, 2007[48]	2003 to 2005	29050	NA	NR	4-6	NR
Fox, 2009[49]	NR	2228	NR		8.8 – 15.95	White, 50-59 Black, 14-21 Hispanic, 20-24 Other, 6-7

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Frongillo, 2017[50]	2013 to 2015	NR	1 year	NR	9.28	Black (non-Hispanic), 20.6 Hispanic, 39.8 Other (including multiple race), 39.6
Fuller, 2013[51]	2009 to 2010	NR	NA	(47.3-48.1)	47.8-49.4	NR
Fung, 2013[52]	2003 to 2011	10723	2 years	(47.9-49)	Grade: 5	NR
Gee, 2015[53]	2003 to 2009	1081	NA	536 (50.6-52.5)	15.8 - 17.6	White, 61.0-72.1 Black, 21.6-29.9 Other, 3.5-6.6 Hispanic, 1.3-4.5
Gibson, 2006[54]	1979 to NR	14859	NA	(0)	7.8	NR
Giles-Corti, 2013[55]	NR	NR	48 months	(38.6-47.7)	37.2-40.7	NR
Gleason, 2009[56]	2004 to 2005	2314	NR	NR	Grades: 1-12	NR
Goldsby, 2016[57]	2009 to 2012	1443	36 months	634 (44)	10.3 Median	Black, 77 White, 22 Other, 1 Hispanic, 14 Non-Hispanic, 86

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Goodman, 2014[58]	2010 to 2011	3516	2 years	634 (43.3)	NR	White (Non-Hispanic), 96.9
Goodman, 2016[59]	2010 to 2012	3336	2 years	1667 (50)	10-11	Asian/Pacific Islander, 9 Black (non-Hispanic), 1 White (non-Hispanic), 86 Other 1 Mixed, 3
Gorely, 2011[60]	NR	589	10 months	NR	7-11	NR
Gorham, 2015[61]	NR	960	5 months	(8.5)	≥18	Hispanic, 59.2
Harding, 2017[62]	NR	NR	NR	NR	NR	NR
Heelan, 2015[63]	2006 to 2012	2234	72 months	NR	Grades: Kindergarten - 5	Caucasian, 85
Hennessy, 2014[64]	2005 to 2008	16271	NA	(46.8) healthy weight (53.9) overweight/ obese	12.5-12.7	White (Non-Hispanic), 63.6-46.7 Black (Non-Hispanic), 13.6-21.1 Hispanic, 14.9-25.1 Other, 8-7.2
Herrick, 2012[65]	2009 to 2009	100	5 months	(45)	10.4 (0.5) – 10.3 (0.6); Control - Intervention	African American 2 Asian 53 Hispanic 31 White 3 Other 11

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Hilmers, 2014[66]	2006 to 2007	661	NA	(0)	33.89 (8.95) – 35.17 (9.12)	Hispanic, 100
Hobin, 2014[67]	2008 to 2011	477	36 months	204 (45.6)	15.2 (0.818)	NR
Hobin, 2017[68]	2007 to 2013	837	NR	NR	Grades: 9-12	NR
Hoelscher, 2016[69]	2009 to 2010	32482	Spring 2010	(49.6 (50.0)	12.33 (1.05) – 12.9 (1.14)	African American, 16.8-17.2 Hispanic, 28.6-28.1 White other, 54.7-54.7
Hoelscher, 2016[70]	2009 to 2012	78 schools	3 years	(50.5-53.8)	NR	Hispanic 50-70.6 White, 19.8-28.2 Black or African American, 6.6-7.2 Other, 3.0-18.0
Howlett, 2016[71]	2000 to 2011	NR	NR	NR	2-4	NR
Hu, 2016[72]	1990 to 2010	260054	NAs (1990-2000 and 2000-2010 combined)	(46-49)	16-79	NR
Hughes, 2012[73]	2007	2709	1 month	NR	NR	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Hunter, 2016[74]	2013 to 2015	19854	2 years	(46.4)	15.01-15.07	White (non-Hispanic), (73.7)
Jennings, 2012[75]	2009 to 2010	322	12 months	(18.8)	NR	NR
Jia, 2017[76]	2015	1648	NR	738	11.6	NR
Johnson, 2017[77]	2011 to 2012	586	12 weeks	113 (19%)	NR	White (non-Hispanic), 64 Asian/Pacific Islander, 18 Black (non-Hispanic), 6 Other (including multiple race), 9
Just, 2014[78]	NR	725	NA	NR	12.64 – 12.8	White 42-51 Black 15-25 Asian 8
Kern, 2014[79]	2004 to 2012	NR	96 months	NR	NR	NR
Keyte, 2012[80]	2007	511	NA	(50.2-52.5)	Grades: 3-4	NR
Kim, 2012[81]	NR	2057	4-10 weeks	877 (42.6)	NR	NR
Kim, 2012[82]	2002 to 2007	25251	4 years	(50)	13.9-14	White, 59.5-63.1 African American, 16.2-16.9 Hispanic, 12.7-15.4 Other, 7.3-8.1
King, 2014[83]	2008 to 2012	3385	18 months	(51.6)	10.6	White, 86.3
Kubik, 2005[84]	2000 to 2000	3588	NA	(51)	14.2	White, 70

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Lachapelle, 2009[85]	NR	4156	NA	48-50	36.6-42.9	White (Non-Hispanic), 67.6-71
LaRowe, 2016[86]	NR	327	12 months	NR	22.9	White Caucasian 73.3 African American 8.9 Hispanic 7.6 American Indian 8.0 Multiple Race Ethnicities 2.1
Leung, 2013[87]	1999 to 2008	5193	NA	(46.7-50.9)	10.4-12	White (Non-Hispanic), 37.9 - 48.8 African American, 17.7 -31.2 Hispanic, 24.9 -26 Other or multiple ethnicities, 6-7.5
Liao, 2015[88]	2001 to 2006	NR	NR	(40-48.4)	≥18	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Ling, 2014[89]	2011	1508	4 months	814 (54.5)	8.3	NR
Liu, 2016[90]	2014 to 2014	3248	NA	1677 (47)	2.30-2.47	Hispanic, 86.3 White, 4 Black, 6.5 Asian/Pacific Islander, 2.3 Other, 27
MacDonald, 2010[91]	2006 to 2008	801	24 months	NR	NR	NR
Maddock, 2006[92]	2000 to 2004	NR	5 years	NR	NR	NR
Madsen, 2011[93]	2001 to 2008	1148000	7 years	NR	NR	African American, 68.9 American Indian Alaskan Native, 5.7 Asian Pacific Islander Filipino, 84.3 Hispanic, 289.8 White (Non-Hispanic), 238.1 Other, 63.3

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Madsen, 2015[94]	NR	NR		(51)	NR	Hispanic, 55-56 African American, 8 Asian, 17 White (Non-Hispanic), 13-14
Malakellis, 2017[95]	2012 to 2014	1557	2 years	NR	12-16	NR
Masse, 2014[96]	2007 to 2008	11385	NA	(41.8)	14.9	NR
Miewald, 2012[97]	2008	192	8 months	(18-22)	NR	NR
Miller, 2015[98]	2012 to 2013	939	1 year	(49)	≥18	Hispanic, 25
Molitor, 2015[99]	2011	1273	NA	(37.2-55.8)	5.5-49.4	Hispanic, 58.8-90.6 White (Non-Hispanic), 1.12-20.4 Asian/Pacific Islander, 2.5-12.7 Black (Non-Hispanic), 2.0-7.5 Other (including multiple race), 1.2-4.4
Morton, 2016[100]	2007 to 2011	2064	4 years	47.7	10.24	White (non-Hispanic), 97 Other (including multiple race), 3 ,
Mullally, 2010[101]	2001 to 2007	971	5 years	(48.4-50.1)	Grades: 5-6	NR
Mumford, 2011[102]	2008 to 2009	101	NR	NR	NR	White (Non-Hispanic), 47 Black (Non-Hispanic), 33

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Nanney, 2014[103]	2002 to 2006	136549	4 years	NR	NR	NR
Nanney, 2016[104]	2006 to 2013	7237	6 years	NR	NR	Minority, 9.7-14.4
Neelon, 2015[105]	2011 to 2012	104	1 year		7.8-8.3	White (Non-Hispanic), 76.6-85 Black (Non-Hispanic), 12.5-18.8 Hispanic, 6.3 Other, 2.5-4.7
Nehme, 2017[106]	2014	295	9 months	115 (39.8)	NR	White (non-Hispanic), 65.3 Hispanic, 21.7 Black (non-Hispanic), 7.2 Asian/Pacific Islander, 3.6 American Indian/Alaska Native, 1.4
Nguyen, 2015[107]	2003 to 2008	17891	NA	(49)	NR	White, 72 Black, 11 Hispanic, 12 Other, 5
Oh, 2015[108]	2005 to 2007	1895	NA	(51.7)	12.6	White (Non-Hispanic), 32.1 Black (Non-Hispanic), 27.6 Hispanic, 31.3 Non-Hispanic other, 7.6

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Olsho, 2015[109]	2010	2287	NR	NR	NR	NR
Panter, 2016[110]	2011 to 2012	1143	12 months	360 (31.5)	NR	NR
Parsons, 2014[111]	1999 to 2010	6682	60 months	(51.2	2-19	Caucasian, 50.2 Minority, 49.8
Peterson, 2015[112]	2004 to 2009	NR	NR	(49.4)	12.8	White (Non-Hispanic), 70.3 Asian, 3.6 Black (Non-Hispanic), 7.4 Hispanic, 8.5 American Indian Alaskan, 1.3 missing ethnicity
Powell, 2009[113]	1997 to 2006	153673		(48.06)	15.06	White, 69.94 African American, 10.26 Hispanic, 10.10 Other race, 9.69
Quig, 2012[114]	2007 to 2008	184	1 year	72 (46)	7.6	NR
Reger-Nash, 2005[115]	2001 to 2002	1472	12 months	NR	NR	White (Non-Hispanic), 93-96

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Reger-Nash, 2008[116]	2003 to 2005	1834	8 week	NR	40-65	White (Non-Hispanic), 92-97
Restrepo, 2016[117]	2004 to 2012	74	8 years	(41)	53.245	Black, 12 Hispanic, 10
Ridgers, 2007[118]	2003 to 2004	470	6 months	(49.3)	7.9-8.4	NR
Ridgers, 2007[119]	2003 to 2004	297	6 weeks	150	7.8- 8.3	NR
Riis, 2012[120]	2003 to 2007	NR		NR	10-17	NR
Ritchie, 2016[121]	2011 to 2012	3944	NR	49.3	9.75	Hispanic 49.2 White (Non-Hispanic) 12.5 Non-Hispanic 9.1 Asian 8.5 American Indian Alaskan native 1.4 Native Hawaiian Pacific Islander 1.7 Other 16.7

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Robles, 2017[122]	2012	NR	NA	(36.6-52.3)	NR	White (non-Hispanic), 5.1-16.3 Black (non-Hispanic), 41.3-62.1 Hispanic, 25.9-29.4 Asian/Pacific Islander, 2.3-7.3 Other, 4.7-5.7
Rushakoff, 2017[123]	2013 to 2014	287	18 months	NR	NR	White (non-Hispanic), 96 Black (non-Hispanic), 2 Hispanic, 2
Sabia, 2016[124]	1999 to 2011	NR	NA	(49)	14-18	White, 59.6 Black, 13.7 Hispanic, 9.9 Asian, 3.7 Other, 13.1
Sadler, 2013[125]	2009 to 2011	186	2 years	(45)	55	Black (Non-Hispanic), 61
Sanchez-Vaznaugh, 2010[126]	2001 to 2008	567756	8 years	48350 – 293645 (50.7-51.0)	Grades: 5 and 7	White, 8.4-38.2 Hispanic, 47.6-77.8 Black, 5.5-10.0 Asian, 2.7-7.4 Filipino, 1.1-1.3

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Schanzenbach, 2005[127]	NR	NR		NR	67.8 - 67.9 months	White, 100
Schwartz, 2016[128]	NR	60 months	1,065,562	(50.1-50.2)	Grades: Kindergarten-8	Asian, 12.0-14.6 Black, 33.2-36.5 Hispanic, 37.3-38.9 White, 13.3-14.2
Sekhobo, 2014[129]	NR	NR	72 months	NR	NR	NR
Slater, 2014[130]	2009 to 2011	Sample varies	NA	(48)	Grades: 8, 10, and 12	White (Non-Hispanic), 59 Black (Non-Hispanic), 13 Hispanic, 15
Spence, 2013[131]	2003 to 2009	407	5 years	198-322	4 - 7	NR
Stephens, 2014[132]	2009 to 2010	1352		NR	3.39	NR
Stratton, 2005[133]	NR	120	5 months	51	NR	NR
Sturm, 2010[134]	1998 to 2004	7414	NA	(50.2)	134.4 months	Black (Non-Hispanic), 14.2 Hispanic, 17.5 Asian/Pacific Islander, 2.3
Sturm, 2015[135]	2007 to 2012	12058	48 months	NR)	NR	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Taber, 2011[136]	2007 to 2007	90730	NA	(50.7	All ages	White, 62 Black, 18 Hispanic, 15 Other, 5
Taber, 2012[137]	2004 to 2007	8870	36 months	NR	Grades: 5-8	White (Non-Hispanic), 58.9 Black (Non-Hispanic), 11.9 Hispanic, 18.5 Other Non-Hispanic, 10.7
Taber, 2012[138]	2004 to 2007	9170	3 years	NR	NR	White, Non-Hispanic, 44.8-70.7 Black (Non-Hispanic), 11.8-12.2 Hispanic, 7.3-33.0 Other, Non-Hispanic, 6.7-13.1
Taber, 2013[139]	2004 to 2007	5510	3 years	NR	Grade: 8	White, Non-Hispanic, 62.0 Black (Non-Hispanic), 10.4 Hispanic, 17.4 Other, Non-Hispanic, 10.2
Tak, 2007[140]	NR	500	NR	(45.9-50.9)	Grade: 4	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Tak, 2009[141]	2003 to 2005	1328	2 years	346 (42.8(46.6)	9.9-10.1	NR
Tester, 2016[142]	2003 to 2012	1197	108 months	(48.3-56.2)	2.91-3.07	White (Non-Hispanic), 30.4-51.3 Hispanic, 21.8-39.9 Black (Non-Hispanic), 21-22.4 Other/mixed, 5.9-7.3
Toussaint, 2017[143]	2015 to 2016	7137	1 year	3678 (51.53)	4 -12	Hispanic, 4.08 American Indian/Alaska Native, 0.21 Asian/Pacific Islander, 0.53 Black (non-Hispanic), 41.08 Asian/Pacific Islander, 0.10 White, 91.45 Multiracial, 2.55
Utter, 2016[144]	2012	8500	1 year	40-60%	Grades: 9-13	NR
Vadiveloo, 2011[145]	2008 to 2008	1170	NR	(34.9-41)	37.7- 40.4	White, 4.9-9.9 Black, 57.0-81.5 Hispanic, 9.3-25.5 Asian Hawaiian Pacific Islander, 1.2-2.3 Other, 0.6-5.9

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Veugelers, 2005[146]	2003 to NR	5200	NA	NR	Grade: 5	NR
von Hippel, 2015[147]	2008 to 2012	772559		(50)	NR	Asian, 3 Black, 13 Hispanic, 44 Native Am, 0.4 White, 40
Webb, 2012[148]	2004 to 2008	8773	4 years	(44.7)	All ages	NR
Webb, 2016[149]	2012 to 2013	4650	NA	2091	NR	NR
Wells, 2005[150]	2003 to NR	1492	NA	NR	4-8	White British background 56.5-81.1
West, 2011[151]	2007 to 2008	368	1 year	(47.6)	NR	White (Non-Hispanic), 90.2 Black (Non-Hispanic), 6.1 Hispanic, 3.7
Whetstone, 2012[152]	NR	2487	20 months	552 (48.3)	9.5	Caucasian, 64.7 African-American, 35.3 Hispanic origin, 2.6
Woodward-Lopez, 2010[153]	2005 to 2008	3527	24 months	NR	NR	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Wrigley, 2003[154]	2000 to 2001	1009	1 year	(15.9-21.6)		NR
Zhu, 2013[155]	2013 to NR	NR	NR	NR (33)	NR	NR
Zhu, 2014[156]	2013 to 2014	449	NA	(50.8)	37.2	White, 61.1

N=sample size; NA=not applicable; No.=number; NR=not reported

*The range of study participant characteristics are given when the mean of the total participant sample is not reported by the study.

† Reported as mean age in years unless otherwise stated.

‡Given the heterogeneity in race/ethnicity categories reported, these categories were extracted from the studies as is.

Evidence Table H2b. Study and participant characteristics of included studies that follow an experimental method

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Alaimo, 2013[157]	2007 to 2010	1777	2 years	510 (40.6)	12.3-12.4	White, 49.2 African American, 23.0 Hispanic, 15.8 Native American, 4.8 Asian and other, 8.0
Anderson, 2001[158]	NR	564	NR	(0)	NR	Black (Non-Hispanic), 43.3 White (Non-Hispanic), 49. Other (including multiple race), 7.3
Angelopoulos, 2009[159]	2004 to 2006	646	12 month	137(42.7)-141(45.8)	10.25 – 10.29	Greek, 88.0-90.3 Immigrants, 9.7-12.0
Ask, 2010[160]	2007 to 2007	156	4 months	74	Grade: 9	NR
Audrey, 2015[161]	2012 to 2013	187	12 months	98 (52.4)	37.8	White British, 77 White Other, 10.2 Mixed Ethnic Group, 1.1 Asian or Asian British, 2.1 Chinese, 0.5 Not disclosed missing, 9.1
Ayala, 2013[162]	NR	179	13 weeks	NR	32	Hispanic, 100
Backman, 2011[163]	2005	528	3 months	(41.5)	33	Hispanic, 97

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Baker, 2016[164]	2008 to 2013	794	60 months	(34.5-37.3)	38.8-41.7	African-American, 100
Bastian, 2015[165]	2009 to 2011	454	NR	(49-52.8)	NR	NR
Bere, 2005[166]	2001 to 2002	922	9 months	397	NR	NR
Bere, 2006[167]	2001 to 2003	577	2 years	NR	11.3-13.0	NR
Bere, 2006[168]	2001 to 2003	450	2 years	169	11.3-13.0	NR
Bere, 2007[169]	2002 to 2005	3315	36 months	984 (51)	11.8	NR
Beresford, 2010[170]	2001 to 2006	NR	4.4 years	(76.1-86.1)	41.2-42.2	White (Non-Hispanic), 9.6-19.7
Blum, 2008[171]	2004 to 2005	581	9 month	NR	15.8	White, 97.8
Bonsergent, 2013[172]	2006 to 2011	5354	2 years	(47.1)	15.8	NR
Bonvin, 2013[173]	2009 to 2010	648	1 year	335 (51)	3.3	NR
Busch, 2015[174]	2011 to 2013	1716	24 months	NR	NR	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Caballero, 2003[175]	NR	1704	3 years	NR	Grades: 3-5	NR
Chomitz, 2010[176]	2004 to 2007	3561	3 years	963 (51.8)	7.7	Asian, 10.2 Black, 37.3 Hispanic, 14 White, 37.1 Other, 1.7
Cochrane, 2012[177]	2009 to 2010	601	12 months	(86.4-90.1)	63.3 - 63.9	White, 95.8-97.0
Coleman, 2012[178]	2008 to 2010	579	2 years	(43)	8.9	Hispanic, 52 African American, 19 Non-Hispanic White, 19 Asian Pacific Islander, 7 Native American, 0.3 Unknown, 2.7
Cortinez-O'Ryan, 2017[179]	2014	100	12 weeks	NR	4-17	NR
Crespo, 2012[180]	2003 to 2004	808	3 years	NR	5.9- 33	NR
Day, 2008[181]	2006 to 2006	527	12 weeks	240 (43-51)	9.9-10.1	NR
De Coen, 2012[182]	2008 to 2010	1589	2 years	(50)	4.95	NR
de Greeff, 2016[183]	NR	388	2 years	80-81(41-45)	Grades: 2-3	Dutch,100

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
De Henauw, 2015[184]	2007 to 2010	16228	2 years	NR	6.016	NR
de Meij, 2011[185]	2006 to 2008	2848	20 months	1435 (50.4)	8.6	Dutch, 18.5 -10.2 Moroccan, 31.6 - 30.0 Turkish, 14.3 - 23.3 Surinam, 15.9-11.3 Western, Other: 6.5 - 8.1 Non-western other: 13.2 -17.2
Dunton, 2015[186]	NR	130	4 months	50 (41.4-47.3)	10.1-10.3	Black, 7.5-3.8 Asian, 1.9 Hispanic Latino, 52.8-73.1 White, 32.1- 15.4 Other, 5.7-5.8

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Dzewaltowski, 2009[187]	NR	NR	2 years	(45-46)	NR	White (Non-Hispanic), 81.07-87.35
Eagle, 2013[188]	NR	NR	10 weeks	(49)	NR	White (Non-Hispanic), 54.2 Black (Non-Hispanic), 27.3 Asian/Pacific Islander, 5.1 Hispanic, 2.9 Other (including multiple race), 7.2
Economos, 2007[189]	2002 to 2005	1696	1 year	NR	7.34 - 7.92	White: 37.8-5.7 Black: 6.9-25.1 Hispanic: 11.8-22.8
Elinder, 2012[190]	2009 to 2011	813	24 months	NR	6-16	Non-Swedish background, 7- 50
Eriksen, 2003[191]	2000	1493	5 weeks	(45-49)	6-10	NR
Ermetici, 2016[192]	2009 to 2011	487	2 years	(50-52)	12.5	NR
Esquivel, 2016[193]	2013 to 2014	349	1 year	(54)	2-5	Asian, 9 Multiracial, 62 Native Hawaiian and Pacific Islander, 23 White, 6
Evans, 2013[194]	2006 to 2008	1031	20 month	(48.1-51.4)	7	White (Non-Hispanic), 92.1-93.5
Fairclough, 2016[195]	2015	139	2 months	NR	10.7 (median)	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Farley, 2007[196]	2003 to 2005	710	2 years	(50.5)	Grades: 2-8	Black (Non-Hispanic), 90-99
Farmer, 2017[197]	2010 to 2013	902	1 year	NR	7.9-8.0	Asian/Pacific Islander, 34.0-38.0 White (non-Hispanic), 46.1-52.0 Other (including multiple race), 13.3-15.7
Finch, 2014[198]	2010	348	6 months	(56-60)	3-5	Aboriginal, 2.9-4.6
Foster, 2008[199]	NR	1349	2 years	(45-48)	11.2 – 11.13	Black, 44.33 - 46.83 Asian,17.09- 27.67 Hispanic, 5.83 -22.43 Other, 5.47-5.50 White, 10.68-14.17
French, 2010[200]	2005 to 2007	1063	18 months	(79)	47	White, 63
Fu, 2016[201]	NR	174	9 weeks	82	12.06	NR
Gatto, 2017[202]	2011 to 2013	375	12 weeks	153	9.3	Hispanic,89

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Geaney, 2016[203]	NR	850	7-9 months	393 (76)	18-65	NR
Gittelsohn, 2010[204]	2006 to 2007	234	9-11 months	(5)	9.8 - 41.7	Native Hawaiian or PI, 64.0
Gittelsohn, 2013[205]	NR	276	15-20 months	NR	45.8–48.2	NR
Goetzel, 2010[206]	2007 to 2008	5124	2 years	(73)	44.6-44.8	White (Non-Hispanic), 77.1-79.1
Gustat, 2012[207]	2006 to 2009	499	2 years	(34.7-45.3)	41.6– 47	African American, 85.7-100
Haerens, 2006[208]	2003 to 2005	NR	2 years	NR	NR	NR
Haerens, 2007[209]	2003 to 2004	2840	9 months	(63.4)	13.1	NR
Hardy, 2010[210]	2008 to 2008	430	6 months	(49.4-50.3)	4.4	NR
He, 2009[211]	2006	1586	21 weeks	576 (45.1)	11.6	NR
Hendy, 2011[212]	NR	457	3 months	211	NR	NR
Hoefkens, 2011[213]	2008 to 2009	380	7 months	(59)	21 to 22	NR
Hollis, 2016[214]	2011	1150	24 months	244-299 (48-49)	NR	Aboriginal and Torres Strait Islander: 8.4-8.8
Huberty, 2011[215]	2009 to 2010	262	8 months	(46)	Grades: 1-6	White (Non-Hispanic), 4 Black (Non-Hispanic), 28 Hispanic, 29 Asian/Pacific Islander, 4 Other, 1

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Jago, 2011[216]	2006 to 2009	6573	3 years	(47.6)	11.2 - 11.3	59, Hispanic 19.8, black 21.3, white
Janssen, 2015[217]	2009 to 2010	2280	10 months	(55.4-56)	8.6 – 8.7	Western, 8.1-8.6 Non-Western, 91-2
Jones, 2015[218]	2012 to 2014	128	12 months	NR	3-5	NR
Jordan, 2008[219]	2005 to 2006	767	1 year	(51-52)	9.0	White, 85.8-86.7 Hispanic, 7.0-7.6 American Indian Alaska Native, 0.4-0.7 Native Hawaiian Pacific Islander, 0.4-2.8 Asian, 0.7 African American, 0.0-2.1 Other, 2.5-2.8
Jurg, 2006[220]	2002 to 2003	502	10 months	245	Grades: 4-6	Foreign origin, 94-71

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Kain, 2004[221]	2002	3577	6 months	(52.0-53.5)	10.6	NR
Kamada, 2013[222]	2009 to 2010	6000	1 year	2050 (46.2-47.3)	40-79	NR
Kastorini, 2016[223]	2012 to 2013	3941	12 months	(48.1)	3-18	NR
Kloek, 2006[224]	2000 to 2002	2781	2 years	(47)	39-45	NR
LaCaille, 2016[225]	2010 to 2011	526	12 months	NR	43	White (non-Hispanic),92.5
Lemon, 2010[226]	2005 to 2008	806	24 months	(19)	≥18	Asian Other, 1.4 Hispanic, 5.3 Non-Hispanic black, 4.7 Non-Hispanic white, 88.8
Lemon, 2014[227]	2010 to 2012	841	24 months	258 (33)	≥21	White, 95.9 Non-white, 4.1
Lent, 2014[228]	2008 to 2010	767	2 years	(42.2-44.6)	10.97 - 10.99	Black, 54 White, 11.6 Hispanic, 22.9 Asian, 10.8

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Linde, 2012[229]	2005 to 2009	1672	24 months	654 (39.3)	All ages	Non-Hispanic white, 86.8 Non-Hispanic black, 4.3 Other, Non-Hispanic, 4.4 Multiracial, Non-Hispanic, 4.4 Hispanic, 2.2 Undefined/refused-answer, 1.0
Llargues, 2011[230]	2006 to 2008	598	2 years	NR	6.03	NR
Lorentzen, 2009[231]	2000 to 2003	1181	3 year	NR	49.1-49.4	NR
Lubans, 2016[232]	2012 to 2014	361	18 months	(100)	12.7	Australian, 77.2 European, 14.8 African, 1.9 Asian, 1.9 Middle eastern, 0.6
Ludwig, 2011[233]	2008 to 2010	4498	48 months	NR	All ages	Black, 65-66.1 Other nonwhite, 26.8-28.1 White, 6.9-8.5 Hispanic, 30.3-33

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Lv, 2014[234]	2008 to 2011	2016	2 years	(44.6-49.5)	51.7-44.1	Asian/Pacific Islander, 100
Madsen, 2013[235]	2009 to 2010	156	1 year	(60)	9.8	African American, 12 Asian, 32 Latino, 42 White, 0 Other, 14
Madsen, 2015[236]	2011 to 2013	1140	2 years	(42.3-53.1)	Grades: 3-5	White, 5.9- 6.3 Black, 9.2-12.9 Latino, 45.1-54.9 Mixed, 13.9- 14.6 Other, 15.5- 21.9
Mead, 2013[237]	2007 to 2009	494	12 months	68	42.4	NR
Morrill, 2016[238]	2011 to 2012	NR	4.5 months	(51)	Grades 1-5	White (Non-Hispanic), 91 Hispanic, 8 Black (Non-Hispanic), 1 American Indian/Alaska Native, 8 Asian/Pacific Islander, 1
Murphy, 2011[239]	2004 to 2005	4350	12 months	NR	9-11	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Naylor, 2006[240]	2003 to 2004	441	16 months	NR	11.22	Asian, 52 Caucasian, 30
Naylor, 2008[241]	2003 to 2004	515	18 months	(50.7)	10.1 - 10.3	NR
Neumark-Sztainer, 2010[242]	2007 to 2009	356	9 months	(0)	15.8	Black, 28.4 White, 24.4 Asian, 23.0 Hispanic, 14.3 Mixed, Other, 7.3 American Indian, 2.5
Nicklas, 2017[243]	2014	253	4 weeks	125(49.4)	4.43	Black (non-Hispanic), 34.39 Hispanic, 65.61
Ortega, 2016[244]	NR	795	24 months	(22)	44.4	Mexican heritage, 85-89
Pate, 2005[245]	1998 to 2000	2744	2 years	(0)	13.6	African-American, 46.8-50.7
Pbert, 2016[246]	2012 to 2013	126	8 months	(57-58.6)	16.3 - 16.5	White, 63-63.2 Black, 15.8-24.1 Other, 0-7.4 Hispanic, 24.1-38.6

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Perry, 2004[247]	2000 to 2002	1668	12 months	(51)	NR	White, 90
Ploeg, 2014[248]	2009 to 2011	652	2 years	(50.5)	10.9	NR
Pope, 2016[249]	2005 to 2007	222	2 years	(43)	Grades: Kindergarten-8	Black (non-Hispanic),100
Ransley, 2007[250]	2004	4595	7 months	(49-51)	72.1 – 72.4 months	NR
Reilly, 2006[251]	2002 to 2003	545	12 months	NR	NR	NR
Reynolds, 2000[252]	1994 to 1995	1698	12 months	NR	NR	NR
Ridgers, 2010[253]	2003 to 2004	434	12 months	NR	7.9 - 8.4	NR
Rush, 2014[254]	2004 to 2011	6629	24 months	3215 (48.5)	7.58 - 10.69	European, 53.7-65.4 Maori, 26.6-36.6 Pacific, 5.1-6.3 Other, 2.5-3.8
Sallis, 2003[255]	1997 to 1999	24	12 months	(51)	NR	nonwhite, 44.5
Sharma, 2016[256]	2013 to 2015	1348	16 weeks	(11-48.1)	6.15-34.3	Hispanic, 71.2 Black, 23.6 White, 3.5 Other, 1.

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Shive, 2006[257]	2002	835	10 weeks	(23.1-35)	24.0 - 32.2	White, 64.6-82.4 Black, 0-2.6 Latino, 5.0-13.9 Asian PI, 2.9-9.0 American Indian, 3.3-4.8 Other, 4.1-6.7
Sigmund, 2012[258]	2006 to 2008	176	2 years	NR	NR	NR
Simon, 2008[259]	2002 to 2006	954	4 years	(47.4-52.6)	11.6 – 11.7	NR
Steenhuis, 2004[260]	NR	5425	6 months	(62)	18-64	NR
Story, 2012[261]	2005 to 2007	454	2 years	232 (51)	5.78-5.84	Oglala Sioux tribe(Lakota people), 99.3
Tarp, 2016[262]	2013 to 2014	705	20 weeks	309	12.7-13.1	NR
Te Velde, 2008[263]	2003 to 2005	2106	3 years	333-365 (45.7-49.4)	10.7 – 10.8	NR
Van Cauwenberghe 2012[264]	2011	128	1 month	69	5.1	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Waters, 2017[265]	2004 to 2009	3222	4-5 years	NR	NR	NR
Wells, 2014[266]	2011 to 2013	285	2 years	(43.6)	9.3	White (Non-Hispanic), 51.5 Black (Non-Hispanic), 30 Hispanic, 8.8 Asian/Pacific Islander, 9.7
Wendel, 2016[267]	2011 to 2013	193	24 months	96 (49.7)	8.8	White, 74.6 Hispanic, 7.8 Black, 7.3 Other, 10.4
Whitt-Glover, 2011[268]	2009	4599	1 year	(51.2)	NR	Hispanic, 29.5 Black, 31.4 White, 32.6
Williamson, 2012[269]	2006 to 2009	2060	3 years	854 (41.5)	NR	White (Non-Hispanic), 31.6 Black (Non-Hispanic), 68.4
Wilson, 2015[270]	2008 to 2010	434	24 months	(38)	51.12	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Wright, 2012[271]	2009 to 2012	305	12 months	(38-42)	4-8.3	Black or African American, 1-4 Hispanic Latino, 92-96 Mexican Mexican American, 100-95
Wright, 2013[272]	2008 to 2010	251	12 months	50-51 (38-42)	8.3 – 9	Black, 1-4 Other, 4-1 Hispanic Latino, 95-96
Yildirim, 2014[273]	2010 to 2010	599	5-9 months	(43)	8.2 (0.4)	NR
Zhou, 2014[274]	2010 to 2011	387	12 months	191 (53.5)	4.5	NR

N=sample size; NA=not applicable; No.=number; NR=not reported

*The range of study participant characteristics are given when the mean of the total participant sample is not reported by the study.

† Reported as mean age in years unless otherwise stated.

‡Given the heterogeneity in race/ethnicity categories reported, these categories were extracted from the studies as is.

Evidence Table H2c. Study and participant characteristics of included studies that follow other study design methods

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Ashfield-Watt 2007[275]	2000 to 2002	1284	1 year	NR	49-69	White (non-Hispanic), 95 Other, 4
Blake, 2013[276]	2006 to 2011	1452	5 year	297-264 (20.45-23.61)	41.06 - 41.65	NR
Brownson 2004[277]	2000 to 2002	NR	NR	303 (23.4-25.9)	NR	White (non-Hispanic), 64.3-69.7 Black (non-Hispanic), 29.1-33.8 Other (including multiple race), 1.1-1.9 missing/unknown, 0.2
Brownson, 2005[278]	2003 to 2004	2470	12 months	153-207 (20.3-26.6)	NR	White (non-Hispanic), 94.2-94.9) Black (non-Hispanic), 1.6-1.9) Other (including multiple race), 3.3-3.5
Brusseau, 2016[279]	2014 to 2015	1460	12 weeks	730	8.4	NR
Cheadle, 2012[280]	2007 to 2010	3396	48 months	NR	NR	NR
De Cocker, 2011[281]	2005 to 2009	886	4 years	(48.6-53.4)	54.9-56.4	NR
de Silva-Sanigorski, 2011[282]	2004 to 2008	35157	48 months	(50.1-52)	2.07 - 3.65	NR
Geaney, 2010[283]	NR	100	NA	(20 t0 26)	18-44	NR
Gebel, 2011[284]	2001 to 2002	1472	3 months	NR	50-65	NR
Heelan, 2009[285]	NR	NR	2 years	NR	8-8.5	NR
Huberty, 2013[286]	2010 to 2011	490	12 months	(43)	8.7	White, 76
Magarey, 2013[287]	2006 to 2009	1732	3 years	604 (50.5)	11.8	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Naul, 2012[288]	2009 to 2010	744	13 months	291	6.96 - 7.24	NR
Rogers, 2013[289]	2007 to 2011	800	3 years	(33)	11.3	NR
Taber, 2002[290]	2009 to 2010	680	NA	(44.2-50.8)	15.0-15.2	White (non-Hispanic), 11.7-43.5 Black (non-Hispanic), 1.0-33.8 Hispanic, 14.7-76.6 Non-Hispanic other, 8.1-10.8
Tomlin, 2012[291]	2007 to 2008	148	12 months	77	NR	NR

Author, year	Study dates	Total N at baseline	Maximum followup	Male sex, n (%)*	Age or grade*†	Race/Ethnicity, %*‡
Vasquez, 2016[292]	2008 to 2010	935	NR	45 (13.9)	44	NR
Weaver, 2017[293]	2014 to 2016	229	2 years	(50-58.4)	6.7-8.0	White (non-Hispanic), 21.4-63.0) Black (non-Hispanic), 18.5-64.3 Other (including multiple race), 12.4-18.5
Whaley, 2010[294]	2007 to 2009	812	2 years	(49-52)	NR	NR

N=sample size; NA=not applicable; No.=number; NR=not reported

*The range of study participant characteristics are given when the mean of the total participant sample is not reported by the study.

† Reported as mean age in years unless otherwise stated.

‡Given the heterogeneity in race/ethnicity categories reported, these categories were extracted from the studies as is.

Evidence Table H3. Child BMI percentile measures

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI Percentile Measure*
Natural Experiment Studies					
Anderson, 2013[1]	School	US/Federal	Child	NR	NR
Barroso, 2009[5]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Coffield, 2011[27]	School	US/Federal	Child	Measured by trained staff	Self-reported height and weight were taken from the child's first state-issued drivers license obtained between the ages 15 and 19 years.
Datar, 2016[38]	School	Local	Child	Measured by trained staff	Height and weight measurements were also collected by the study staff during visits to the original 12 installations
Datar, 2016[38]	School	Local	Child	Self-reported	Both child and parent reports of the child's height (in feet and inches) and weight (pounds) were obtained for all children via the child and parent surveys
Fox, 2009[49]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Fung, 2013[52]	School	Other country	Child	Measured by trained staff	Standard Measure
Gleason, 2009[56]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Heelan, 2015[63]	School	Local	Child	Measured by trained staff	Standard Measure
Hennessy, 2014[64]	School	State/Regional	Child	Self-reported	parent-reported child height and weight
Herrick, 2012[65]	After school or summer school	Non-Governmental	Child	Measured by trained staff	Standard Measure
Kern, 2014[79]	School	Local	Child	NR	NR
Kim, 2012[82]	School	State/Regional	Child	Self-reported	NSCH survey
Madsen, 2011[93]	School	State/Regional	Child	Other	BMI data retrieved from FITNESSGRAM collected data
Madsen, 2015[94]	School	Non-Governmental	Child	Other	Student-level fitness data from Fitnessgram assessment
Nanney, 2014[103]	School	State/Regional	Child	Self-reported	Minnesota Student Survey (MSS)
Nanney, 2016[104]	School	Local	Child	Self-reported	Questionnaire

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI Percentile Measure*
Oh, 2015[108]	Community or neighborhood , School	US/Federal	Child	Self-reported	parent-reported weight and height of child in NSCH
Parsons, 2014[111]	School	Local	Child	Measured by trained staff	School nurses collected
Peterson, 2015[112]	After school or summer school, School	State/Regional	Child	Measured by trained staff	Standard Measure
Sanchez-Vaznaugh, 2010[126]	School	Local	Child	Other	Fitnessgram test
Schwartz, 2016[128]	School	Local	Child	Measured by trained staff	standard weight and height measurement by physical education teacher
Sekhobo, 2014[129]	Early childhood education	Local	Child	Measured by trained staff	measured by trained WIC staff
Sturm, 2010[134]	School	US/Federal	Child	Measured by trained staff	height and weight were measure by study staff of the Early Childhood Longitudinal Study—Kindergarten Cohort
Taber, 2011[136]	School	State/ Regional	Child	Measured by trained staff	Standard Measure
Taber, 2012[137]	School	Other country	Child	Measured by trained staff	Standard Measure
von Hippel, 2015[147]	School	US/Federal	Child	Other	FitnessGram assessment

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI Percentile Measure
Experimental Studies					
Bonvin, 2013[173]	Early childhood education or daycare	Other country	Child	Measured by trained staff	Standard Measure
Coleman, 2012[178]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Crespo, 2012[180]	Community or neighborhood , School	Local	Child	Self-reported	Calculated percentile from self-report (via parents)
Dzewaltowski, 2009[187]	School	Local	Child	Measured by trained staff	Standard Measure
Foster, 2008[199]	School	Local	Child	Measured by trained staff	Standard Measure
Gatto, 2017[202]	School	Local	Child	Other	Height was measured with a free-standing stadiometer (Seca, Birmingham, UK) and weight and percent body fat via bioelectrical impedance (Tanita TBF 300A, Arlington Heights, IL, USA).
Hendy, 2011[212]	School	Local	Child	Measured by trained staff	Standard Measure
Jago, 2011[216]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Jago, 2011[216]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Kastorini, 2016[223]	School	Other country	Child	Self-reported	self-reported weight and height
Lent, 2014[228]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Madsen, 2013[235]	After school or summer school	Non-Governmental	Child	E.H.R.	E.H.R.
Pope, 2016[249]	School	Local	Child	Measured by trained staff	health screenings IN PHYS ED
Pate, 2005[245]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Reilly, 2006[251]	Early childhood education or daycare	Other country	Child	Measured by trained staff	Standard Measure
Story, 2012[261]	School	State/Regional	Child	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI Percentile Measure
Wendel, 2016[267]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Other Study Designs					
de Silva-Sanigorski, 2011[282]	Early childhood education or daycare	Non-Governmental	Child	Measured by trained staff	Standard Measure
Heelan, 2009[285]	School	State/Regional	Child	Measured by trained staff	BMI percentile
Naul, 2012[288]	School	Other country	Child	Measured by trained staff	Standard Measure

BMI=Body Mass Index; E.H.R.=electronic health record; No.=Number; NR=not reported; US=United States

***** Standard measure" refers to the standardized method for calculating BMI, BMI-z score, and BMI-percentile as stated by the Centers for Disease Control and Prevention (CDC).[295, 296]

Evidence Table H4. Child BMI-z score measures

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI-z Measure*
Natural Experiment Studies					
Bauhoff, 2014[6]	School	State/ Regional	Child	Other	Fitnesgram Physical fitness test- measured height and weight.
Benjamin Neelon, 2015[105]	School	Local	Child	Measured by trained staff	Standard Measure
Bolton, 2017[10]	School	Other country	Child	Measured by trained staff	Standard Measure
Burke, 2014[17]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Capogrossi, 2016[22]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Eagle, 2013[188]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Datar, 2016[38]	School	Local	Child	Measured by trained staff	Height and weight measurements were also collected by the study staff during visits to the original 12 installations
Datar, 2016[38]	School	Local	Child	Self-reported	Both child and parent reports of the child's height (in feet and inches) and weight (pounds) were obtained for all children via the child and parent surveys
Farmer, 2017[197]	School	Other country	Child	Measured by trained staff	Standard Measure
Fitzpatrick, 2017[46]	School	Other country	Child	Measured by trained staff	Standard Measure
Fox, 2009[49]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Gee, 2015[53]	School , Other	State/Regional	Child	Self-reported	Youth Risk Behavior Survey
Gleason, 2009[56]	School	US/Federal	Child	Measured by trained staff	Standard Measure
Goldsby, 2016[57]	Community or neighborhood	Local	Child	E.H.R.	E.H.R.
Herrick, 2012[65]	After school or summer school	Non-Governmental	Child	Measured by trained staff	Standard Measure
Kim, 2012[82]	School	State/Regional	Child	Self-reported	NSCH survey

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI-z Measure*
Leung, 2013[87]	Food assistance program	US/Federal	Child	Other	NHANES
Madsen, 2011[93]	School	State/Regional	Child	Other	BMI data retrieved from FITNESSGRAM collected data
Madsen, 2015[94]	School	Non-Governmental	Child	Other	Student-level fitness data from Fitnessgram assessment
Malakellis, 2017[95]	School	Other country	Child	Measured by trained staff	Standard Measure
Sanchez-Vaznaugh, 2010[126]	School	Local	Child	Other	Fitnessgram test
Schwartz, 2016[128]	School	Local	Child	Measured by trained staff	standard weight and height measurement by physical education teacher
Whetstone, 2012[152]	Community or neighborhood, faith-based, School	State/Regional	Child	Measured by trained staff	Standard Measure
Experimental Studies					
Angelopoulos, 2009[159]	School	Other country	Child	Measured by trained staff	Standard Measure
Bonsergent, 2013[172]	School	Other country	Child	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI-z Measure
Experimental Studies (continued)					
Chomitz, 2010[176]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Coleman, 2012[178]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Crespo, 2012[180]	Community or neighborhood, School	Local	Child	Self-reported	Calculated z-score from self-report (via parents)
De Coen, 2012[182]	School	Other country	Child	Other	BMI z-score
de Greeff, 2016[183]	School	Other country	Child	Measured by trained staff	Standard Measure
De Henauw, 2015[184]	Early childhood education or daycare School	Non-Governmental	Child	Self-reported	IDEFICS questionnaire
Economos, 2007[189]	Community or neighborhood	Non-Governmental	Child	Measured by trained staff	Standard Measure
Ermetici, 2016[192]	School , E.H.R.	Other country	Child	Measured by trained staff	Standard Measure
Esquivel, 2016[193]	Early childhood education or daycare	State/Regional	Child	Measured by trained staff	Standard Measure
Fairclough, 2016[195]	School	Other country	Child	Measured by trained staff	Standard Measure
Foster, 2008[199]	School	Local	Child	Measured by trained staff	Standard Measure
Gatto, 2017[202]	School	Local	Child	Other	Height was measured with a free-standing stadiometer (Seca, Birmingham, UK) and weight and percent body fat via bioelectrical impedance (Tanita TBF 300A, Arlington Heights, IL, USA). BMI-z determined according to CDC cut points

Author, year	**Setting**	**Level**	**Adult/Child**	**Measure type**	**Child BMI-z Measure**
Gorely, 2011[60]	School	Other country	Child	Measured by trained staff	BMI z-score
Haerens, 2006[208]	School	Local	Child	Measured by trained staff	Standard Measure
Hollis, 2016[214]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Jago, 2011[216]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Jordan, 2008[219]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Kain, 2004[221]	School	Other country	Child	Measured by trained staff	Standard Measure
Lent, 2014[228]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Lubans, 2016[232]	School	Local	Child	Measured by trained staff	Standard Measure
Madsen, 2015[236]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Pbert, 2016[246]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/Child	Measure type	Child BMI-z Measure
Experimental Studies (continued)					
Pope, 2016[249]	School	State/Regional	Child	Measured by trained staff	Tanita TBF-310GS
Simon, 2008[259]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Story, 2012[261]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Waters, 2017[265]	School	Other country	Child	Measured by trained staff	Standard Measure
Williamson, 2012[269]	School	State/Regional	Child	Measured by trained staff	Standard Measure
Wright, 2012[271]	School	State/ Regional	Child	Measured by trained staff	Standard Measure
Wright, 2013[272]	After school or summer school, School	Non-Governmental	Child	Measured by trained staff	Standard Measure
Zhou, 2014[274]	Early childhood education or daycare	Other country	Child	Other	body composition analyzer (InBody J20, BIO-SPACE, Seoul, Korea)
Other Study Designs					
de Silva-Sanigorski, 2011[282]	Early childhood education or daycare	Non-Governmental	Child	Measured by trained staff	Standard Measure
Magarey, 2013[287]	School	Other country	Child	Measured by trained staff	Standard Measure
Tomlin, 2012[291]	School	Other country	Child	Measured by trained staff	Standard Measure

BMI-z=Body Mass Index-Z score; E.H.R.=electronic health record; IDEFICS= Identification and prevention of dietary-and lifestyle-induced health effects In children and infants ; NHANES=National Health and Nutrition Examination Survey; No.=Number; NR=not reported; NSCH=National Survey of Children’s Health; US=United States

***** Standard measure" refers to the standardized method for calculating BMI, BMI-z score, and BMI-percentile as stated by the Centers for Disease Control and Prevention (CDC).[295, 296]

Evidence Table H5. Child change in weight measures

Author, year	Setting	Level	Adult/child	Measure type	Child Weight Change Measure*
Natural Experiment Studies					
Capogrossi, 2016[22]	Food assistance program , School	US/Federal	Child	Measured by trained staff	Standard Measure
Frongillo, 2017[50]	Community or neighborhood	Local	Child	Measured by trained staff	BMI and waist circumference
Hobin, 2017[68]	School	Other country	Child	Measured by trained staff	Reports as overweight and obese
Jia, 2017[76]	School	Other country	Child	Measured by trained staff	BMI and Weight status (Obese/overweight)- defined based on International Obesity Task Force-recommended age- and sex-specific cutoffs corresponding to BMI = 25 kg m− 2 at age 18 years
Toussaint, 2017[143]	School	State/Regional	Child	Measured by trained staff	BMI: Standard Measure
Utter, 2016[144]	School	Other country	Child	Measured by trained staff	BMI
Veugelers, 2005[146]	School	Other country	Child	Measured by trained staff	weight and height taken
Experimental Studies					
Ask, 2010[160]	School	Other country	Child	Measured by trained staff	Standard Measure
Bonsergent, 2013[172]	School	Other country	Child	Measured by trained staff	Standard Measure
Bonvin, 2013[173]	Early childhood education or daycare	Other country	Child	Measured by trained staff	Standard Measure
Caballero, 2003[175]	School	State/Regional	Child	Measured by trained staff	Standard measure
Cortinez-O'Ryan, 2017[179]	Community or neighborhood	Other country	Child	Measured by trained staff	BMI of child captured at baseline but not reported at follow up
Farley, 2007[196]	Community or neighborhood	Local	Child	Other	measured height, weight, and an estimate of body fat using bioelectrical impedance analysis
Hollis, 2016[214]	School	Non-Governmental	Child	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/child	Measure type	Child Weight Change Measure*
Tarp, 2016[262]	School	Other country	Child	Measured by trained staff	BMI only: Body mass was measured to one decimal using an electronic scale (Tanita BWB-800, Tokyo, Japan)
Zhou, 2014[274]	Early childhood education or daycare	Other country	Child	Other	body composition analyzer (InBody J20, BIO-SPACE, Seoul, Korea)

Author, year	Setting	Level	Adult/child	Measure type	Child Weight Change Measure
Other Study Designs					
Brusseau, 2016[279]	School	State/Regional	Child	Measured by trained staff	Body mass index (BMI) was calculated using standard procedures taking a student's weight in kilograms divided by the square or his or her height in meters.

BMI=Body Mass Index; No..=Number

***** Standard measure" refers to the standardized method for calculating BMI, BMI-z score, and BMI-percentile as stated by the Centers for Disease Control and Prevention (CDC).[295, 296]

Evidence Table H6. Child other weight outcomes

Author, year	Setting	Level	Adult/child	Measure type
Natural Experiment Studies				
Gibson, 2006[54]	Food assistance program	US/Federal	Child	BMI
Kubik, 2005[84]	School	State/Regional	Child	BMI
Powell, 2009[113]	Community or neighborhood, School	State/Regional	Child	BMI
Schanzenbach, 2005[127]	School	US/Federal	Child	BMI
Experimental Studies				
de Meij, 2011[185]	After school or summer school, School	Other country	Child	BMI
Ploeg, 2014[248]	School	Other country	Child	Probability of obesity
Rush, 2014[254]	School	Local	Child	BMI
Ridgers, 2010[253]	School	Other country	Child	BMI

BMI=Body Mass Index; No..=Number; US=United States

Evidence Table H7. Adult BMI score measures

Author, year	Setting	Level	Adult/child	Measure type	Adult BMI Measure*
Natural Experiment Studies					
Bolton, 2017[10]	Employer or worksite	Other country	Adult	Measured by trained staff	Standard Measure
Brown, 2008[13]	Community or neighborhood	Local	Adult	Self-reported	Self-reported weight and height of head of household
Brown, 2015[14]	Transportation	Local	Adult	Measured by trained staff	"clinically measured"
Brown, 2016[15]	Transportation, Community or neighborhood	Local	Adult	Self-reported	BMI
Camacho-Rivera, 2017[21]	Community or neighborhood	State/Regional	Adult	Measured by trained staff	Standard Measure
Chen, 2015[25]	Home	Other country	Adult	Measured by trained staff	Standard Measure
Cleland, 2008[26]	School	Other country	Adult	Self-reported	Questionnaire (at baseline) and International Physical Activity Questionnaire (IPAQ-L) for follow up, Other objective measure: BMI derived from measured weight and height (method not described)
Cummins, 2014[37]	Community or neighborhood	Local	Adult	Self-reported	self reported weight and height
Dubowitz, 2015[42]	Community or neighborhood	Non-Governmental	Adult	Self-reported	Standard Measure
Hu, 2016[72]	Reducing health inequities	Other country	Adult	Self-reported	measured or self -reported
MacDonald, 2010[91]	Transportation	Local	Adult	Self-reported	BMI was calculated in kg/m^2 using self-reported height and weight
Restrepo, 2016[117]	Community or neighborhood	State/Regional	Adult	Self-reported	self-reported data - from BRFSS

Author, year	Setting	Level	Adult/child	Measure type	Adult BMI Measure*
Sadler, 2013[125]	Community or neighborhood	Local	Adult	Self-reported	Behavioral Risk Factor Surveillance System (BRFSS)
Sturm, 2015[135]	Community or neighborhood	Local	Adult	Self-reported	self reported weight and height
Webb 2016[149]	Transportation	Other country	Adult	Measured by trained staff	Standard Measure
Webb, 2012[148]	Transportation	Other country	Adult	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/child	Measure type	Adult BMI Measure
Experimental Studies					
Baker, 2016[164]	Community or neighborhood	Non-Governmental	Adult	Self-reported	Self-reported
Cochrane, 2012[177]	Primary care centers	Other country	Adult	Measured by trained staff	Standard Measure
Crespo, 2012[180]	Community or neighborhood, School	Local	Adult	Self-reported	BMI
French, 2010[200]	Employer or worksite	Local	Adult	Measured by trained staff	Standard Measure
Geaney, 2016[203]	Employer or worksite	Other country	Adult	Self-reported	Standard Measure
Gittelsohn, 2013[205]	Community or neighborhood	State/Regional	Adult	Self-reported	Self reported height and weight accepted from participants that refused trained data collector measurements, Standard Measure
Goetzel, 2010[206]	Employer or worksite	Non-Governmental	Adult	Self-reported	Biometric data were collected using standardized protocols and instruments developed by Dow Health Services
LaCaille, 2016[225]	Employer or worksite	State/Regional	Adult	Measured by trained staff	Standard Measure
Lemon, 2010[226]	Employer or worksite	State/Regional	Adult	Measured by trained staff	Standard Measure
Lemon, 2014[227]	Employer or worksite, School	Non-Governmental	Adult	Self-reported	Standard Measure
Linde, 2012[229]	Employer or worksite	Non-Governmental	Adult	Measured by trained staff	Standard Measure

Author, year	Setting	Level	Adult/child	Measure type	Adult BMI Measure
Ludwig, 2011[233]	Community or neighborhood	Local	Adult	Measured by trained staff	Measured by trained staff
Mead, 2013[237]	Community or neighborhood	Other country	Adult	Measured by trained staff	Standard Measure
Other Study Designs					
Blake, 2013[276]	Employer or worksite	Other country	Adult	Self-reported	Self Measured
Vasquez, 2016[292]	Employer or worksite	State/Regional	Adult	Other	modified version of the Household Food Inventory checklist, which was based on the previously validated Block Food Frequency Questionnaire

BMI=Body Mass Index; BRFSS= Behavioral Risk Factor Surveillance System

***** Standard measure" refers to the standardized method for calculating BMI, BMI-z score, and BMI-percentile as stated by the Centers for Disease Control and Prevention (CDC).[295, 296]

Evidence Table H8. Adult change in weight measures

Author, year	Setting	Level	Adult/child	Measure type	Adult Weight Change Measure*
Natural Experiment					
Goodman, 2014[58]	Community or neighborhood	Other country	Adult	Self-reported	Self-reported
Experimental					
Cochrane, 2012[177]	Primary care centers	Other country	Adult	Measured by trained staff	Standard Weight Measure
French, 2010[200]	Employer or worksite	Local	Adult	Measured by trained staff	Standard Weight Measure
Geaney, 2016[203]	Employer or worksite	Other country	Adult	Measured by trained staff	Standard Weight Measure
LaCaille, 2016[225]	Employer or worksite	Employer or worksite	Adult	Measured by trained staff	Standard Weight Measure
Lemon, 2014[227]	Employer or worksite, School	Non-Governmental	Adult	Measured by trained staff	Standard Weight Measure

BMI=Body Mass Index; BRFSS= Behavioral Risk Factor Surveillance System; No..=Number; US=United States

***** Standard measure" refers to the standardized method for calculating BMI, BMI-z score, and BMI-percentile as stated by the Centers for Disease Control and Prevention (CDC).[295, 296]

Evidence Table H9. Total calorie intake measures

Author, year	Setting	Level	Adult/Child	Measure type	Diet Calorie Intake Measure
Natural Experiment					
Chen, 2015[25]	Home	Other country	Adult	24-hour recall	self reported 24hr recall
Cullen, 2006[33]	School	Local/Other country	Child	record/log	Anonymous food record entered into Nutrition Data System (version 4.2), Objective measure: Electronic data from POS purchase machine
Dubowitz, 2015[42]	Community or neighborhood	Non-Governmental	Adult	24-hour recall	Automated self administered 24-Hour Dietary Recall (ASA24)
Fung, 2013[52]	School	Other country	Child	Food Frequency Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ) adapted for Canadian settings
Hilmers, 2014[66]	Community or neighborhood , Food assistance program	US/Federal	Adult	record/log	24-hour dietary food record
Leung, 2013[87]	Food assistance program	US/Federal	Child	24-hour recall	NHANES
Ritchie, 2016[121]	School	Local	Child	24-hour recall	24-hour dietary-assisted recall and a 24-hour recall interview
Spence, 2013[131]	School	Other country	Child	record/log	Food Assessment in Schools Tool (FAST)
Taber, 2002[290]	School	State/Regional	Child	24-recall	National Youth Physical Activity and Nutrition Study (NYPANS)
Experimental					
Caballero, 2003[175]	School	State/Regional	Child	Other	Observation
Cochrane, 2012[177]	Primary care centers	Other country	Adult	Other	Primary Prevention Toolkit
Foster, 2008[199]	School	Local	Child	Questionnaire	Youth/Adolescent Questionnaire

Author, year	Setting	Level	Adult/Child	Measure type	Diet Calorie Intake Measure
Geaney, 2016[203]	Employer or worksite	Other country	Adult	24-hour recall	UK 3-step dietary recall (no mention of it being validated)
Gittelsohn, 2010[204]	Community or neighborhood	Non-Governmental	Adult	NR	NR
Pbert, 2016[246]	School	Non-Governmental	Child	NR	NR
Ransley, 2007[250]	School	Other country	Child	record/log	child and diet evaluation tool (CADET)
Sharma, 2016[256]	Food assistance program , School	Other country	Child	Food Frequency Questionnaire	Block Kids Food validated food frequency questionnaire

NHANES=National Health and Nutrition Examination Survey; No.=Number; NR=not reported; US=United States

Evidence Table H10. Change in fast food intake measures

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fast Food Intake Measure
Natural Experiment					
Bauhoff, 2014[6]	School	State/ Regional	Child	Questionnaire	The California Healthy Kids Survey (CHKS)
Camacho-Rivera, 2017[21]	Community or neighborhood	State/ Regional	Adult	Other questionnaire	Not described
Fung, 2013[52]	School	Other country	Child	Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ) adapted for Canadian settings
Gleason, 2009[56]	School	US/Federal	Child	Record/log	Not specific, only reports school breakfast and lunch- Not sure we want his data
Jia, 2017[76]	School	Other country	Child	Other questionnaire	Self reported weekly frequency of fast food and street food consumption.
King, 2014[83]	School	Local	Child	24-hour recall	Student Health Assessment Questionnaire/ 24-hour recall
Molitor, 2015[99]	Home	US/Federal	Both	Food frequency questionnaire	2011–2012 CHIS
Sturm, 2015[135]	Community or neighborhood	Local	Adult	Other questionnaire	Telephone interview
Utter, 2016[144]	School	Other country	Child	Other questionnaire	Self-report
Vadiveloo, 2011[145]	Fast food chains	Local	Adult	Questionnaire	Street-intercept survey
Experimental					
French, 2010[200]	Employer or worksite	Local	Adult	Food Frequency Questionnaire	self-report food frequency questionnaire (adapted from Thompson et al., 2002; Thompson et al., 1998)
Pbert, 2016[246]	School	Non-Governmental	Child	24-hour recall	24-hour dietary recall interview22 using the Interactive Nutrition Data System (NDS, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).
Sharma, 2016[256]	Food assistance program , School	Other country	Child	Questionnaire	Self-reported questionnaire (Ding etal, 2012)
Story, 2012[261]	School	State/Regional	Child	Questionnaire	In-person survey completed by parents

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fast Food Intake Measure
Wright, 2012[271]	School	State/ Regional	Child	Questionnaire	The Child and Adolescent Trial for Cardiovascular Health After-School Student Questionnaire (ASSQ)
Other study designs					
de Silva-Sanigorski, 2011[282]	Early childhood education or daycare	Non-Governmental	Child	Questionnaire	Eating and Physical Activity Questionnaire (EPAQ)

CHIS=California Health Interview Survey; No.=Number; US=United States

Evidence Table H11. Change in fruit and vegetable consumption measures

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Natural Experiment Studies					
Barnidge, 2013[4]	Community or neighborhood	Local	Adult	Food frequency questionnaire	BRFSS
Bauhoff, 2014[6]	School	State/ Regional	Child	Questionnaire	The California Healthy Kids Survey (CHKS)
Bere, 2010[8]	School	Other country	Child	Food frequency questionnaire	measured fruit and vegetable intake and frequency
Berger-Jenkins, 2014[9]	School	Non-Governmental	Child	Questionnaire	survey
Bolton, 2017[10]	Employer or worksite, School	Other country	Both	Other questionnaire	Victorian Population Health Survey
Bolton, 2017[10]	Employer or worksite, School	Other country	Child	Other questionnaire	Victorian state government Local Level Child Health and Wellbeing Survey
Bowling, 2016[11]	Community or neighborhood , Food assistance program	State/Regional	Adult	Questionnaire	Internally designed survey with comparison to 2013 CDC State Indicator Report on Fruits and Vegetables
Caldwell, 2009[19]	Community or neighborhood	State/Regional	Both	Other questionnaire	YRBS to assess F&V consumption
Coyle, 2009[30]	School	State/Regional	Child	24-recall	24-hour dietary recall interview
Cullen, 2006[33]	School	Local	Child	record/log	Anonymous food record entered into Nutrition Data System (version 4.2), Electronic data from POS purchase machine
Cullen, 2008[34]	School	State/Regional	Child	Record/log	Anoynymous record immediately after lunch
Cummins, 2005[35]	Community or neighborhood	Other country	Adult	Other questionnaire	How many portions per day: fruit portion = mdium sized item; vegetabel = 3 heaping tablespoons or a medium salad bowl
Cummins, 2008[36]	Community or neighborhood	Other country	Both	Record/log	Self-reported in survey

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Cummins, 2014[37]	Community or neighborhood	Local	Adult	Food Frequency Questionnaire	Block Food Frequency Questionnaire
Datar, 2016[38]	School	Local	Child	Food frequency questionnaire	Beverage and Snack Questionnaire
de Visser, 2016[40]	School	Non-Governmental	Child	Questionnaire	School Physical Activity and Nutrition (SPAN) survey
Dubowitz, 2015[42]	Community or neighborhood	Non-Governmental	Adult	24-hour recall	Automated self administered 24-Hour Dietary Recall (ASA24)

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Eagle, 2013[188]	School	State/Regional	Child	Food frequency questionnaire	School-Based Nutrition Monitoring Questionnaire
Elbel, 2015[43]	Community or neighborhood	Local	Adult	24-recall	24-hour dietary recall survey
Elbel, 2015[43]	Community or neighborhood	Local	Adult	Other questionnaire	Eating and Physical Activity Questionnaire (EPAQ)
Elbel, 2017[44]	Community or neighborhood	Local	Adult	24-recall	Dietary recall conducted by staff phone interview with participant
Elbel, 2017[44]	Community or neighborhood	Local	Adult	Food frequency questionnaire	Eating and Physical Activity Questionnaire
FFung, 2013[52]	School	Other country	Child	Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ) adapted for Canadian settings
Flego, 2014[47]	Community or neighborhood	Other country	Adult	Food frequency questionnaire	Queensland Self-Reported Health Status Survey
Dubowitz, 2015[42]	Community or neighborhood	Local	Adult	24-recall	Automated SelfAdministered 24-h recall
Dubowitz, 2015[42]	Community or neighborhood	Local	Adult	24-recall	Healthy Eating Index (HEI) 2010 scores
Dubowitz, 2015[42]	Community or neighborhood	Local	Child	Other questionnaire	Parent survey
Fogarty, 2007[48]	School	Other country	Child	Other questionnaire	Times per week fruit was consumed; how much fruit consumed per day on average
Gee, 2015[53]	School	State/Regional	Child	Questionnaire	Centers for Disease Control and Prevention. Youth Risk Behavior Survey (YRBS). Washington, D.C.
Gleason, 2009[56]	School	US/Federal	Adult	Other questionnaire	Dietary Quality Index (DQI) self report for dietary behaviour measures intake of fish, red meat and meat products, starchy foods, fibre, sugary foods, fatty foods, alcohol, and fruit and vegetables.

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Gorham, 2015[61]	Community or neighborhood	Local	Both	Other questionnaire	survey: cups of F&V per day
Hilmers, 2014[66]	Community or neighborhood, Food assistance program	US/Federal	Adult	record/log	24-hour dietary food record
Hoelscher, 2016[69]	School	Other country	Child	Questionnaire	School Physical Activity and Nutrition (SPAN) questionnaire. Self Administered survey of demographics, foods eaten in prior day, physical activity, attitutudes about wellness and the PUTP60 program, and participation/awareness of program
Hughes, 2012[73]	School	Other country	Child	Food frequency questionnaire	CADET

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Jennings, 2012[75]	Community or neighborhood	Other country	Adult	Food frequency questionnaire	East of England Lifestyle Survey
Johnson, 2017[77]	Community or neighborhood	Other country	Adult	Food frequency questionnaire	portions on a ‘typical day’ and Health Survey for England requests the number of portions eaten in the last 24 h
Just, 2014[78]	School	Other country	Child	24-hour recall	24-h dietary recall, but authors only considered food consumed during lunch at the school cafeteria
Keyte, 2012[80]	School	Other country	Child	Other questionnaire	Servings of fruit-vegetable per day
King, 2014[83]	School	Local	Child	24-hour recall	Student Health Assessment Questionnaire/ 24-hour recall
Leung, 2013[87]	Food assistance program	US/Federal	Child	Questionnaire	NHANES
Liao, 2015[88]	Community or neighborhood	US/Federal	Adult	Other questionnaire	REACH Risk Factor Survey compared to BRFSS
Ling, 2014[89]	Community or neighborhood , School	Other country	Child	Questionnaire	School Physical Activity and Nutrition (SPAN) questionnaire
Liu, 2016[90]	Food assistance program	US/Federal	Child	Other questionnaire	Telephone survey
Maddock, 2006[92]	Community or neighborhood, School	State/Regional	Child	Questionnaire	self-report
Malakellis, 2017[95]	School	Other country	Child	Other questionnaire	ABAKQ
Miewald 2012[97]	Community or neighborhood	Other country	Adult	Other questionnaire	Behavioral Risk Factor Surveillance System (BRFSS)
Molitor, 2015[99]	Home	US/Federal	Both	Food frequency questionnaire	2011–2012 CHIS

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Mullally, 2010[101]	School	Other country	Child	Questionnaire	Eating Behaviour Study questionnaire
Nanney, 2014[103]	School	State/Regional	Child	Questionnaire	Instrument with validation
Nanney, 2016[104]	School	Local	Child	Questionnaire	Questionnaire
Olsho, 2015[109]	Community or neighborhood	Local	Adult	Food frequency questionnaire	The New York City Community Health Survey (CHS)
Olsho, 2015[109]	Community or neighborhood	Local	Adult	Other questionnaire	Phone interviews

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Olsho, 2015[109]	Community or neighborhood	Local	Adult	Other questionnaire	Surveys by trained interviewers at farmers market
Peterson, 2015[112]	After school or summer school, School	State/Regional	Child	Questionnaire	use of risk behavior survey-daily intake
Restrepo, 2016[117]	Community or neighborhood	State/Regional	Adult	Questionnaire	self reported
Ritchie, 2016[121]	School	Local	Child	24-hour recall	24-hour dietary-assisted recall and a 24-hour recall interview
Robles, 2017[122]	Community or neighborhood	Local	Adult	Food frequency questionnaire	National Institute of Health's Eating at America's Table Quick Food Scan
Rushakoff, 2017[123]	Community or neighborhood	Local	Child	Other questionnaire	Primary study questionnaire: frequency of consuming leafy greens two or more times a day
Sadler, 2013[125]	Community or neighborhood	Local	Adult	Food frequency questionnaire	Behavioral Risk Factor Surveillance System (BRFSS)
Sturm, 2015[135]	Community or neighborhood	Local	Adult	Other questionnaire	Telephone interview
Tak, 2007[140]	School	Other country	Child	Other questionnaire	Fruit intake--unspecified
Tak, 2009[141]	School	Other country	Child	Food frequency questionnaire	similar to the validated questionnaire of the Pro Children Study
Tester, 2016[142]	Early childhood education	US/Federal	Child	24-hour recall	24-hour diet recall
Utter, 2016[144]	School	Other country	Child	Other questionnaire	Self-report
Veugelers, 2005[146]	School	Other country	Child	Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ)

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Wells, 2005[150]	School	Other country	Child	Questionnaire	Questionnaire was developed, which included a 24 h food tick list, food frequency questions, food attitude questions, questions about the NSFS and personal data (Food tick list adapted from FAST)
Whetstone, 2012[152]	Community or neighborhood , faith-based, School ,	State/Regional	Child	Questionnaire	Physical Activity and Nutrition (PAN) Monitoring Tool
Woodward-Lopez, 2010[153]	School	State/ Regional	Child	Questionnaire	survey
Wrigley, 2003[154]	Community or neighborhood	Other country	Adult	Other questionnaire	National Diet and Nutrition Survey (NDNS)
Wrigley, 2003[154]	Community or neighborhood	Other country	Adult	Record/log	Food consumption diary

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Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Experimental Studies					
Alaimo, 2013[157]	School	State/Regional	Child	Food Frequency Questionnaire	Block Kids Food Frequency Questionnaires
Anderson, 2001[158]	Community or neighborhood	Local	Adult	Food frequency questionnaire	Modified version of BRFSS
Angelopoulos, 2009[159]	School	Other country	Child	NR	NR
Ayala, 2013[162]	Community or neighborhood	Local	Adult	Food frequency questionnaire	National Cancer Institute (NCI) Fruit and Vegetable All-Day Screener
Backman, 2011[163]	Employer or worksite	Local	Adult	Food frequency questionnaire	National Cancer Institute’s By-Meal Fruit and Vegetable Screener,
Baker, 2016[164]	Community or neighborhood	Non-Governmental	Adult	Other	Transtheoretical Model
Bere, 2005[166]	School	Other country	Child	24-recall	24-hour dietary recall
Bere, 2006[167]	School	Other country	Both	Food frequency questionnaire	Food frequency questionnaire
Bere, 2006[167]	School	Other country	Child	24-recall	Written 24-hour F&V recall
Bere, 2006[168]	After school or summer school	Other country	Child	24-recall	24-hour fruit and vegetable recall
Bere, 2007[169]	School	Other country	Child	24-hour recall	Self reported 24 hr recall and Food Frequency Questionnaire (with references cited for validity and reliability)
Beresford, 2010[170]	Employer or worksite	Non-Governmental	Adult	Other questionnaire	The questionnaire consisted of 46 questions pertaining to individual dietary behaviors, stages of change, taste preferences and perceptions, barriers to eating fruits and vegetables, autonomy in meal preparation, and social support

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Cohen, 2014[29]	School	Non-Governmental	Child	Food frequency questionnaire	2007 Block Food Screener
Crespo, 2012[180]	Community or neighborhood , School	Local	Child	Food frequency questionnaire	daily sevings of F&V
Day, 2008[181]	School	Other country	Child	24-recall	hand-counting, using Canadian Nutrient File serving sizes,10 from a validated 24-Hour Food Recall questionnaire
Day, 2008[181]	School	Other country	Child	Food frequency questionnaire	a Food Frequency Questionnaire (Food Frequency Questionnaire) adapted from the Eating at America's Table Study Quick Food Scan
De Coen, 2012[182]	School	Other country	Child	Other	F&V consumption
De Henauw, 2015[184]	Early childhood education or daycare School	Non-Governmental	Child	Questionnaire	Parent questionnaire
Dzewaltowski, 2009[187]	School	Local	Child	Food frequency questionnaire	The Youth Adolescent Questionnaire (YAQ)

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Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Economos, 2007[189]	Community or neighborhood	Non-Governmental	Child	Questionnaire	Instrument with validation
Elinder, 2012[190]	School	Other country	Child	Questionnaire	Health quesionnaire
Eriksen, 2003[191]	School	Other country	Child	24-hour recall	developed for this study -precoded 24-hour recall and a short food-frequency questionnaire (Food Frequency Questionnaire)
Eriksen, 2003[191]	School	Other country	Child	Food Frequency Questionnaire	developed for this study -precoded 24-hour recall and a short food-frequency questionnaire (Food Frequency Questionnaire)
Ermetici, 2016[192]	School	Other country	Child	Questionnaire	Italian National Institute of Health, adapted from a validated international standard questionnaire targeting adolescents
Esquivel, 2016[193]	Early childhood education or daycare	State/Regional	Child	Observation	observed plate waste
Evans, 2013[194]	School	Other country	Child	Food frequency questionnaire	24 h dietary assessment tool, the Child and Diet Evaluation Tool Intervention (CADET) diary
Foster, 2008[199]	School	Local	Child	Questionnaire	Youth/Adolescent Questionnaire
French, 2010[200]	Employer or worksite	Local	Adult	Food Frequency Questionnaire	self-report food frequency questionnaire (adapted from Thompson et al., 2002; Thompson et al., 1998)
Gatto, 2017[202]	School	Local	Child	Food Frequency Questionnaire	Block Kids Food Screener
Gittelsohn, 2010[204]	Community or neighborhood	Non-Governmental	Adult	Questionnaire	the Customer Impact Questionnaire (CIQ) and the Child Customer Impact Questionnaire
Haerens, 2006[208]	School	Local	Child	Food frequency questionnaire	NR

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Haerens, 2007[209]	School	Other country	Child	Food Frequency Questionnaire	pieces/week and below fruit recommendations
Hardy, 2010[210]	Early childhood education or daycare	State/Regional	Child	Observation	Observation and census of lunch content
He, 2009[211]	School	Other country	Child	24-recall	pre-coded 24 h fruit and vegetable recall
He, 2009[211]	School	Other country	Child	Other questionnaire	Pro-Children Questionnaire
Hendy, 2011[212]	School	Local	Child	Food frequency questionnaire	FVFIRST
Hoefkens, 2011[213]	University	Other country	Adult	record/log	The awareness of participants of the relation between diet and health was measured by using the 7-point scale described by Ragaert et al (30)
Jago, 2011[216]	School	Non-Governmental	Child	Other	Structured interviews, focus groups
Jones, 2015[218]	Early childhood education or daycare	Other country	Child	Observation	Ball S, Benjamin S, Ward D. Development and reliability of an observation method to assess food intake of young children in child care. J Am Diet Assoc. 2007;107:656–61.

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Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Jordan, 2008[219]	School	State/Regional	Child	Questionnaire	Student survey
Kastorini, 2016[160]	School	Other country	Child	Food Frequency Questionnaire	KIDMED score
Kloek, 2006[166]	Community or neighborhood	Other country	Adult	Other questionnaire	F&V grams/day
LaCaille, 2016[168]	Employer or worksite	State/Regional	Adult	Food frequency questionnaire	"The National Cancer Institute Multifactor Screener is a 17-item self-report food frequency questionnaire that estimates daily fruit and vegetable intake, grams of fiber, and percent of energy from fat."
Llargues, 2011[179]	School	Other country	Child	Food frequency questionnaire	food frequency questionnaire
Llargues, 2011[179]	School	Other country	Child	Other questionnaire	Krece Plus test
Lubans, 2016[181]	School	Local	Child	Questionnaire	Two items from the NSW Schools Physical Activity and Nutrition Survey (SPANS)
Lv, 2014[183]	Community or neighborhood, Employer or worksite	Local	Adult	Other questionnaire	Study questionnaire
Madsen, 2015[186]	School	Non-Governmental	Child	Other	digital images of students' lunch trays before and after meal consumption
Morrill, 2016[197]	School	Local	Child	Other	Blinded observers recorded F&V intake
Murphy, 2011[201]	School	Other country	Child	Other questionnaire	Dietary recall questionnaire
Neumark-Sztainer, 2010[208]	School	Non-Governmental	Child	24-hour recall	Dietary intake was assessed with one 24-hour dietary recall conducted by trained research staff (Nutrition Data System for Research software version 2006 developed by the Nutrition Coordinating Center (NCC), University of Minnesota, Minneapolis, MN.) Other measures were assessed with the New Moves survey (available at www.newmovesonline.com).

Author, year	**Setting**	**Level**	**Adult/Child**	**Measure type**	**Diet Fruit/Vegetable Intake Measure**
Nicklas, 2017[210]	School	Local	Child	Observation	Digital photography, Trained assessors used digital cameras to capture images of the vegetable dishes for initial serving, before additional servings, and after additional servings of vegetable dishes.
Ortega, 2016[213]	Community or neighborhood	Local	Adult	Other	Townsend MS et al. Selecting items for a food behavior checklist for a limited-resource audience. J Nutr Educ Behav. 2003;35(2):69–82
Pbert, 2016[217]	School	Non-Governmental	Child	24-hour recall	24-hour dietary recall interview22 using the Interactive Nutrition Data System (NDS, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).
Perry, 2004[218]	School	Non-Governmental	Child	Observation	Nutrition Data System (version 2.6, 1993, University of Minnesota, Minneapolis),
Ransley, 2007[223]	School	Other country	Child	record/log	Child and diet evaluation tool (CADET)
Reynolds, 2000[228]	School	Local	Child	24-recall	24-hour recall interview
Sharma, 2016[245]	Food assistance program	Other country	Child	Food Frequency Questionnaire	Block Kids Food validated food frequency questionnaire (for children) and itemFruits and Vegetables Screener (for parents)
Shive, 2006[246]	University	State/Regional	Adult	Questionnaire	Questionnaire

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Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Steenhuis, 2004[251]	Employer or worksite	Other country	Adult	Food frequency questionnaire	F&V intake
Story, 2012[253]	School	State/Regional	Child	Questionnaire	In-person survey completed by parents
Te Velde, 2008[265]	School	State/Regional	Child	24-hour recall	24 hour recall method and food frequency questionnaire (Haraldsdo´ttir J, Tho´rsdo´ ttir I, de Almeida MDV, Maes L, Pe´rez Rodrigo C, Elmadfa I & Frost Andersen L (2005) Validity and reproducibility of a precoded questionnaire to assess fruit and vegetable intake in European 11- to 12-year-old schoolchildren. Ann Nutr Metab 49, 221–227.)
Te Velde, 2008[265]	School	State/Regional	Child	Food Frequency Questionnaire	24 hour recall method and food frequency questionnaire (Haraldsdo´ttir J, Tho´rsdo´ ttir I, de Almeida MDV, Maes L, Pe´rez Rodrigo C, Elmadfa I & Frost Andersen L (2005) Validity and reproducibility of a precoded questionnaire to assess fruit and vegetable intake in European 11- to 12-year-old schoolchildren. Ann Nutr Metab 49, 221–227.)
Waters, 2017[276]	School	Other country	Child	24-recall	24-h record
Waters, 2017[276]	School	Other country	Child	Other questionnaire	Parental questionnaire covering issues such as family food habits, and usual intake of fruit, vegetable, dairy and drink consumption
Waters, 2017[276]	School	Other country	Child	Other questionnaire	Child questionnaire assessing food behaviours
Wright, 2012[291]	School	State/ Regional	Child	Questionnaire	The Child and Adolescent TRial for Cardiovascular Health After-School Student Questionnaire (ASSQ)--self administered survey for kids that measures dietary intake for previous day, healthy dietary behaviors, food knowledge, nutrition knowledge, food intentions, and dietary self efficacy.
Other Study Designs					
Ashfield-Watt 2007[8]	Community or neighborhood	Other country	Adult	Food frequency questionnaire	FACET – Five-a-day Community Evaluation Tool
Blake, 2013[28]	Employer or worksite	Other country	Adult	Questionnaire	they do not explain

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Cheadle, 2012[52]	After school or summer school, Community or neighborhood , Employer or worksite, School	Non-Governmental	Child	Questionnaire	Youth survey
de Silva-Sanigorski, 2011[79]	Early childhood education or daycare	Non-Governmental	Child	Questionnaire	Eating and Physical Activity Questionnaire (EPAQ)
Geaney, 2010[110]	Employer or worksite	Other country	Child	24-hour recall	24 hour recall and questionnaire
Kim, 2012[164]	School	Other country	Child	Food frequency questionnaire	types of food purchased and how often they were consumed
Magarey, 2013[190]	School	Other country	Child	Questionnaire	Child nutrition questionnaire

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Author, year	Setting	Level	Adult/Child	Measure type	Diet Fruit/Vegetable Intake Measure
Rogers, 2013[235]	After school or summer school, Community center (e.g., job training, youth), Community or neighborhood , Early childhood education or daycare , Employer or worksite, School	Non-Governmental	Child	Questionnaire	Questionnaire conducted by researcher
Tomlin, 2012[267]	School	Other country	Child	24-recall	24-hour dietary recall
Vasquez, 2016[273]	Employer or worksite	State/Regional	Adult	Food Frequency Questionnaire	Based on previously validated Block Food Frequency Questionnaire
Whaley, 2010[284]	Community or neighborhood	Local	Child	Food frequency questionnaire	Questions from WIC child

BRFSS= Behavioral Risk Factor Surveillance System; CADET=Child and Diet Evaluation Tool; CHIS= California Health Interview Survey; F&V=fruits and vegetables; FVFIRST=Fruit and Vegetable FIRST; NHANES=National Health and Nutrition Examination Survey; No.=Number; NR=not reported; US=United States; WIC= Women, Infants, and Children program

Evidence Table H12. Change in fiber intake measures

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fiber Measure
Natural Experiment Studies					
Cullen, 2006[67]	School	Local/Other country	Child	record/log	Anonymous food record entered into Nutrition Data System (version 4.2), Objective measure: Electronic data from POS purchase machine
Cullen, 2008[66]	School	State/Regional	Child	Record/log	Anonymous record immediately after lunch
Fung, 2013[108]	School	Other country	Child	Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ) adapted for Canadian settings
Hilmers, 2014[136]	Community or neighborhood , Food assistance program	US/Federal	Adult	record/log	24-hour dietary food record
Leung, 2013[174]	Food assistance program	US/Federal	Child	Questionnaire	NHANES
Taber, 2002[257]	School	State/Regional	Child	24-recall	National Youth Physical Activity and Nutrition Study (NYPANS), written survey and 24 hour recall
Experimental Studies					
Alaimo, 2013[3]	School	State/Regional	Child	Food Frequency Questionnaire	Block Kids Food Frequency Questionnaires
Ayala, 2013[11]	Community or neighborhood	Local	Adult	Other questionnaire	shorter version of a thirty-item scale used to assess behavioural strategies to increase fibre and decrease fat
LaCaille, 2016[168]	Employer or worksite	State/Regional	Adult	Food Frequency Questionnaire	The National Cancer Institute Multifactor Screener is a 17-item self-report food frequency questionnaire that estimates daily fruit and vegetable intake, grams of fiber, and percent of energy from fat.
Gatto, 2017[109]	School	Local	Child	Food Frequency Questionnaire	Block Kids Food Screener
Sharma, 2016[245]	Food assistance program , School	Other country	Child	Food Frequency Questionnaire	Block Kids Food validated food frequency questionnaire

Author, year	Setting	Level	Adult/Child	Measure type	Diet Fiber Measure
Wright, 2012[291]	School	State/ Regional	Child	Questionnaire	The Child and Adolescent Trial for Cardiovascular Health After-School Student Questionnaire (ASSQ)

NHANES= National Health and Nutrition Examination Survey; No.=Number; US=United States

Evidence Table H13. Change in sugar sweetened beverage intake measures

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Natural Experiment Studies					
Bauhoff, 2014[18]	School	State/ Regional	Child	Questionnaire	The California Healthy Kids Survey (CHKS)
Bowling, 2016[33]	Community or neighborhood , Food assistance program	State/Regional	Adult	Questionnaire	Internally designed surveys
Cradock, 2011[64]	School	Local	Child	Questionnaire	The Boston Youth Survey has a 7-day recall horizon, and the NHANES recall covers the previous 24-hour period
Cullen, 2006[67]	School	Local/Other country	Child	record/log	Anonymous food record entered into Nutrition Data System (version 4.2; Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA), diet_ssb_obj: Electronic data from POS purchase machine
Cullen, 2008[66]	School	State/Regional	Child	Record/log	Anonymous record immediately after lunch
Datar, 2016[71]	School	Local	Child	Food frequency questionnaire	Beverage and Snack Questionnaire
de Visser, 2016[80]	School	Non-Governmental	Child	Questionnaire	the School Physical Activity and Nutrition (SPAN) survey
Elbel, 2015[88]	Community or neighborhood	Local	Adult	24-recall	24-hours dietary recall survey
Elbel, 2015[88]	Community or neighborhood	Local	Adult	Other questionnaire	Eating and Physical Activity Questionnaire (EPAQ)
Elbel, 2017[87]	Community or neighborhood	State/Regional	Adult	Food frequency questionnaire	Eating and Physical Activity Questionnaire
Falbe, 2016[95]	Community or neighborhood	Local	Adult	Questionnaire	We assessed beverage consumption via interviewer-administered intercept surveys with a beverage frequency questionnaire modified from the Behavioral Risk Factor Surveillance System 2011 SSB module
Fung, 2013[108]	School	Other country	Child	Questionnaire	Harvard Youth Adolescent Food Frequency Questionnaire (YAQ) adapted for Canadian settings

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Hilmers, 2014[136]	Community or neighborhood	US/Federal	Adult	record/log	24-hour dietary food record
Jia, 2017[152]	School	Other country	Child	Questionnaire	Self-reported weekly frequency of sugary beverage
King, 2014[165]	School	Local	Child	24-hour recall	Student Health Assessment Questionnaire/ 24-hour recall
Leung, 2013[174]	Food assistance program	US/Federal	Child	Questionnaire	NHANES
Liu, 2016[178]	Food assistance program	US/Federal	Child	Questionnaire	Telephone survey

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Malakellis, 2017[191]	School	Other country	Child	Questionnaire	Adolescent Behaviours Attitudes and Knowledge Questionnaire (ABAKQ)
Masse, 2014[192]	School	Local	Child	Questionnaire	BC Adolescent Health Survey (AHS)
Molitor, 2015[196]	Home	US/Federal	Both	Food frequency questionnaire	2011–2012 CHIS
Nanney, 2014[202]	School	State/Regional	Child	Questionnaire	Instrument with validation
Nanney, 2016[203]	School	Local	Child	Questionnaire	Questionnaire
Nguyen, 2015[209]	After school or summer school	US/Federal	Adult	Questionnaire	National Health and Nutrition Examination Survey
Robles, 2017[234]	Community or neighborhood	Local	Adult	Food frequency questionnaire	National Institute of Health's Eating at America's Table Quick Food Scan
Sturm, 2010[256]	School	US/Federal	Child	Other questionnaire	child food consumption questionnaire
Sturm, 2015[255]	Community or neighborhood	Local	Adult	Other questionnaire	Telephone interview
Taber, 2011[261]	School	State/ Regional	Child	Questionnaire	Survey (not specified)
Taber, 2012[260]	School	State/ Regional	Child	Questionnaire	Staff administered questionnaire
Whetstone, 2012[285]	Community or neighborhood , faith-based, School ,	State/Regional	Child	Questionnaire	Physical Activity and Nutrition (PAN) Monitoring Tool
Woodward-Lopez, 2010[289]	School	State/ Regional	Child	Questionnaire	survey
Experimental Studies					
Bere, 2005[24]	School	Other country	Child	24-recall	24-hour recall

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Bere, 2007[25]	School	Other country	Child	24-hour recall	Self reported 24 hr recall and Food Frequency Questionnaire (with references cited for validity and reliability)
Blum, 2008[29]	School	State/ Regional	Child	Food Frequency Questionnaire	youth food frequency questionnaire
Crespo, 2012[65]	Community or neighborhood , School	Local	Child	Food frequency questionnaire	daily sevings of SSB
De Henauw, 2015[77]	Early childhood education or daycare School	Non-Governmental	Child	Questionnaire	Parent questionnaire
Economos, 2007[86]	Community or neighborhood	Non-Governmental	Child	Questionnaire	
Elinder, 2012[89]	School	Other country	Child	Questionnaire	Questionnaire
Ermetici, 2016[91]	School	Other country	Child	Questionnaire	Italian National Institute of Health, adapted from a validated international standard questionnaire targeting adolescents

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
French, 2010[104]	Employer or worksite	Local	Adult	Food Frequency Questionnaire	self-report food frequency questionnaire (adapted from Thompson et al., 2002; Thompson et al., 1998)
Haerens, 2006[127]	School	Local	Child	Food frequency questionnaire	NR
Haerens, 2007[126]	School	Other country	Child	Food Frequency Questionnaire	glasses/day
Hardy, 2010[129]	Early childhood education or daycare	State/Regional	Child	Observation	Observation and census of lunch content
Hendy, 2011[133]	School	Local	Child	Food frequency questionnaire	HDRINK
Jago, 2011[149]	School	Non-Governmental	Child	Other	Structured interviews, focus groups
Jordan, 2008[155]	School	State/Regional	Child	Questionnaire	Parent survey
Lubans, 2016[181]	School	Local	Child	Questionnaire	Two items from the NSW Schools Physical Activity and Nutrition Survey (SPANS)
Madsen, 2015[186]	School	Non-Governmental	Child	Questionnaire	Survey questions adapted from the School Physical Activity and Nutrition Questionnaire and the Child Food Consumption Questionnaire
Pbert, 2016[217]	School	Non-Governmental	Child	24-hour recall	24-hour dietary recall interview22 using the Interactive Nutrition Data System (NDS, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN).
Sharma, 2016[245]	Food assistance program , School	Other country	Child	Food Frequency Questionnaire	Block Kids Food validated food frequency questionnaire
Waters, 2017[276]	School	Other country	Child	24-recall	24-h record
Waters, 2017[276]	School	Other country	Child	Other questionnaire	Parental questionnaire covering issues such as family food habits, and usual intake of fruit, vegetable, dairy and drink consumption

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Waters, 2017[276]	School	Other country	Child	Other questionnaire	Child questionnaire assessing food behaviours

Author, year	Setting	Level	Adult/Child	Measure type	Diet SSB Intake Measure
Other Study Designs					
de Silva-Sanigorski, 2011[79]	Early childhood education or daycare	Non-Governmental	Child	Questionnaire	Eating and Physical Activity Questionnaire (EPAQ)
Kim, 2012[164]	School	Other country	Child	Food frequency questionnaire	types of food purchased and how often they were consumed
Rogers, 2013[235]	After school or summer school, Community center (e.g., job training, youth), Community or neighborhood , Early childhood education or daycare , Employer or worksite, School	Non-Governmental	Child	Questionnaire	Questionnaire conducted by researcher
Tomlin, 2012[267]	School	Other country	Child	24-recall	24-hour dietary recall
Whaley, 2010[284]	Community or neighborhood	Local	Child	Food frequency questionnaire	Questions from WIC child questionnaire

ABAKQ=Adolescent Behaviours Attitudes and Knowledge Questionnaire; CHIS=California Health Interview Survey; NHANES=National Health and Nutrition Examination Survey; No.=number; NR=not reported; SSB=sugar sweetened beverage; US=United States; WIC=Women, Infants, and Children program

Evidence Table H14. Change in physical activity measures

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Natural Experiment Studies					
Anthamatten, 2011[7]	School	State/Regional	Child	Observation	System for Obser- ving Play and Leisure Activity in Youth (SOPLAY)
Azevedo, 2014[12]	School	Other country	Child	Electronic monitor	Accelerometer: Light PA, vigororous PA
Azevedo, 2014[12]	School	Other country	Child	Observation	20m shuttle run test (to test aerobic fitness)
Barroso, 2009[16]	School	State/Regional	Child	Observation	SOFIT (System for observing Fitness Instruction Time)
Barroso, 2009[16]	School	State/Regional	Child	Questionnaire	SPAN Questionnaire
Bauman, 2003[19]	Community or neighborhood	Other country	Adult	Questionnaire	New Zealand Sport and Physical Activity Survey
Bauman, 2003[19]	Early childhood education or daycare	Other country	Adult	Questionnaire	Stand alone household interviews
Benjamin Neelon, 2015[20]	School	Local	Child	Electronic monitor	accelerometer (ActiGraph GT1M, Pensacola, FL)
Bolton, 2017[30]	Employer or worksite, School	Other country	Both	Questionnaire	Victorian Population Health Survey
Bolton, 2017[30]	Employer or worksite, School	Other country	Child	Questionnaire	Victorian state government Local Level Child Health and Wellbeing Survey
Branas, 2011[34]	Community or neighborhood	Local	Adult	Questionnaire	Self reported (Southeastern Pennsylvania Household Health Survey)
Brown, 2008[35]	Community or neighborhood	Local	Adult	Questionnaire	BRFSS
Brown, 2015[38]	Transportation	Local	Adult	Electronic monitor	accelerometer counts per minute

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Brown, 2016[37]	Transportation, Community or neighborhood	Local	Adult	Electronic monitor	Accelerometer to measure moderate to vigorous PA
Brown, 2016[36]	Transportation	Local	Adult	Electronic monitor	Accelerometers and GPS units
Buscail, 2016[43]	Community or neighborhood	Other country	Adult	Questionnaire	Recent Physical Activity Questionnaire (RPAQ) validated in French
Calise, 2013[47]	Community or neighborhood	Local	Adult	Questionnaire	Neighborhood Physical Activity Questionnaire (NPAQ)
Cawley, 2007[51]	School	State/Regional	Child	Questionnaire	Survey
Cawley, 2007[50]	School	State/Regional	Child	Questionnaire	YRBSS Questionnaire

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Chen, 2015[53]	Home	Other country	Adult	Other	Compendium of Physical Activities
Cleland, 2008[55]	School	Other country	Adult	Questionnaire	International Physical Activity Questionnaire (IPAQ-L), Wearable device:Yamax Digiwalker pedometer
Cohen, 2012[58]	Community or neighborhood	Local	Both	Observation	METs: metabolic equivalents
Cohen, 2012[58]	Community or neighborhood	Local	Both	Questionnaire	Self-reported park use: self reprted park use , and engaging in more exercise
Cradock, 2014[63]	School	Local	Child	Electronic monitor	accelerometers (GT3X/GT1M or MTI/CSA 7164, Actigraph, Pensacola, Florida)
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time for physical activity, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time household PA, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time leisure time PA, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time moderate PA, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time transport-related PA, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time vigorous PA, minutes/wk

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time walking, minutes/wk
De Cocker, 2007[73]	Community or neighborhood , Transportation	Other country	Adult	Questionnaire	Total time work-related PA, minutes/wk
de Visser, 2016[80]	School	Non-Governmental	Child	Questionnaire	the School Physical Activity and Nutrition (SPAN) survey
Dill, 2014[81]	Community or neighborhood	Local	Both	Electronic monitor	accelerometer data

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Dill, 2014[81]	Community or neighborhood	Local	Both	Electronic monitor	GPS tracking
Dill, 2014[81]	Community or neighborhood	Local	Both	Record/log	Travel diaries
Eagle, 2013[85]	School	State/Regional	Child	Questionnaire	School-Based Nutrition Monitoring Questionnaire
Fitzpatrick, 2017[99]	School	Other country	Child	Electronic monitor	Accelerometer (Actigraph LS 7164)
Fuller, 2013[107]	Community or neighborhood	Other country	Adult	Questionnaire	International Physical Activity Questionnaire (IPAQ)
Gee, 2015[113]	School	State/Regional	Child	Questionnaire	Centers for Disease Control and Prevention. Youth Risk Behavior Survey (YRBS). Washington, D.C.
Giles-Corti, 2013[115]	Community or neighborhood	Other country	Adult	Questionnaire	Mean minutes of transportation-related walking.
Goodman, 2014[121]	Community or neighborhood	Other country	Adult	Questionnaire	7-day recall instrument
Goodman, 2014[121]	Community or neighborhood	Other country	Adult	Questionnaire	adapted version of the short form of the International Physical Activity Questionnaire40
Goodman, 2016[122]	School, Transportation	Other country	Child	Other	parent report of frequency of child's cycling
Gorely, 2011[123]	School	Other country	Child	Electronic monitor	number of steps taken in the previous 24 hours
Herrick, 2012[135]	After school or summer school	Non-Governmental	Child	Questionnaire	California Healthy Kids Survey; the NHBLI Growth and Health Study,10 and the Healthy Eating Active Communities survey,11 that assessed frequency of exercise (days per week), enjoyment of sports (I enjoy activities such as walking, playing ball, bike riding, dancing or skating) on a 4-point scale, and perception of physical activity level (Compared to most [boys/girls] your age, would you say you are: less active, about as active, or more active).
Hobin, 2014[138]	School	Other country	Child	Electronic monitor	Accelerometer

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Hobin, 2017[137]	School	Other country	Child	Electronic monitor	Accelerometer
Hoelscher, 2016[141]	School	Other country	Child	Questionnaire	School Physical Activity and Nutrition (SPAN) questionnaire.
Hoelscher, 2016[140]	School	State/Regional	Child	Questionnaire	Questionnaires
Hunter, 2016[148]	School	Other country	Child	Questionnaire	COMPASS Student Questionnaire (Cq): MVPA measured by two questions on the Cq
Kim, 2012[163]	School	State/Regional	Child	Questionnaire	NSCH survey

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
King, 2014[165]	School	Local	Child	Questionnaire	Student Health Assessment Questionnaire/ 24-hour recall
Johnson, 2017[153]	Community or neighborhood	Other country	Adult	Questionnaire	Number of episodes of physical activity or walking of at least 30 min per week
Lachapelle, 2009[169]	Community or neighborhood , Transportation	Local	Adult	Questionnaire	Total distance walked for transportation: non-walker; walk up to 2.4 km=moderate; walk more than 2.4 km=meets PA recommendation
LaRowe, 2016[170]	Early childhood education or daycare	State/Regional	Child	Electronic monitor	Child physical activity (PA) was measured using Actical triaxial accelerometers (Bio-Lynx, Montreal, Quebec, Canada)
LaRowe, 2016[170]	Early childhood education or daycare	State/Regional	Child	Questionnaire	modified version of the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) - only at baseline
Ling, 2014[177]	Community or neighborhood , School	Local	Child	Electronic monitor	Pedometer
MacDonald, 2010[184]	Transportation	Local	Adult	Questionnaire	International Physical Activity Questionnaire (IPAQ)
Maddock, 2006[185]	Community or neighborhood, School	State/Regional	Child	Questionnaire	Surveys
Malakellis, 2017[191]	School	Other country	Child	Questionnaire	The Adolescent Behaviours, Attitudes, and Knowledge Questionnaire (ABAKQ)
Harding, 2017[128]	Community or neighborhood	State/Regional	Adult	Other	Behavioral Risk Factor Surveillance System (BRFSS)/leisure time PA
Miller, 2015[195]	Transportation, Community or neighborhood	Local	Adult	Electronic monitor	measured overall PA, transit-related PA, and other PA

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Molitor, 2015[196]	Home	US/Federal	Both	Questionnaire	2011–2012 CHIS
Morton, 2016[198]	School	Other country	Child	Electronic monitor	Actigraph (GT1M; Pensacola, FL) accelerometer
Mumford, 2011[200]	Community or neighborhood , Transportation	Local	Adult	Questionnaire	The 148-item self-administered survey

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Nanney, 2014[202]	School	State/Regional	Child	Questionnaire	Minnesota Student Survey (MSS)
Nehme, 2017[207]	Employer or worksite	State/Regional	Adult	Questionnaire	Past Week Modifiable Activity Questionnaire (PWMAQ)
Nehme, 2017[207]	Employer or worksite	State/Regional	Adult	Questionnaire	the International Physical Activity Questionnaire Long form (IPAQ-L)
Panter, 2016[214]	Transportation	Other country	Adult	Questionnaire	Recent Physical Activity Questionnaire (RPAQ)
Peterson, 2015[219]	After school or summer school, School	State/Regional	Child	Questionnaire	use of risk behavior survey-daily physical activity
Quig, 2012[222]	Community or neighborhood	Local	Child	Electronic monitor	GT1M (Actigraph, Fort Walton Beach, FL)
Quig, 2012[222]	Community or neighborhood	Local	Child	Questionnaire	self-administered questionnaire
Reger-Nash, 2005[224]	Community or neighborhood	Local	Adult	Questionnaire	Telephone survey
Reger-Nash, 2008[225]	Community or neighborhood	Non-Governmental	Adult	Questionnaire	Behavioral Risk Factor Surveillance System physical activity questions and media-recall questions
Reger-Nash, 2008[225]	Community or neighborhood	Non-Governmental	Adult	Questionnaire	random-digit-dial telephone surveys
Ridgers, 2007[231]	School	Other country	Child	Electronic monitor	physical activity levels during recess were quantified using heart rate (HR) telemetry and accelerometry
Ridgers, 2007[230]	School	Other country	Child	Electronic monitor	Accelerometry, ActiGraph (Model 7164, MTI Health Services, Florida, USA)
Riis, 2012[232]	School	State/Regional	Child	NR	instrument not described
Sabia, 2016[238]	School	State/Regional	Child	Questionnaire	NYRBS

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Slater, 2014[249]	School	State/Regional	Child	Questionnaire	Days physically active for 60 min/day
Slater, 2014[249]	School	State/Regional	Child	Questionnaire	Vigorous exercise--no timing.
Stephens, 2014[252]	Early childhood education or daycare	Local	Child	Electronic monitor	accelerometer (ActiGraph GT3X)
Stratton, 2005[254]	After school or summer school	Other country	Child	Electronic monitor	Sportstester heart rate telemeters (Electro-Polar, Kempele, Finland)
Taber, 2013[259]	School	State/ Regional	Child	Questionnaire	Written questionnaire, students reported the numberof days they engaged in at least 20 mins of activity that made them sweat or breathe hard in the past week
Veugelers, 2005[274]	School	Other country	Child	NR	NR

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Webb, 2016[278]	Transportation	Other country	Adult	Questionnaire	English Longitudinal Study of Ageing (ELSA)
West, 2011[283]	Community or neighborhood	Local	Adult	Questionnaire	Non-validated survey questions
Whetstone, 2012[285]	Community or neighborhood , faith-based, School ,	State/Regional	Child	Questionnaire	Physical Activity and Nutrition (PAN) Monitoring Tool
Zhu, 2013[295]	Community or neighborhood	Local	Adult	Questionnaire	NR
Zhu, 2014[296]	Community or neighborhood	Local	Adult	Record/log	Self-reported
Experimental Studies					
Angelopoulos, 2009[6]	School	Other country	Child	Questionnaire	Standardized questionnaire,
Audrey, 2015[10]	Employer or worksite	Other country	Adult	Electronic monitor	ActiGraph GT3X+; ActiGraph LLC, FL, US
Audrey, 2015[10]	Employer or worksite	Other country	Adult	Questionnaire	Study questionnaire
Bastian, 2015[17]	School	Non-Governmental	Child	Electronic monitor	number of steps during weekdays and weekends Omron Hj-720ITC time-stamped piezoelectric pedometer (Omron, Toronto Ontario, Canada
Bonvin, 2013[32]	Early childhood education or daycare	Other country	Child	Other	Motor skill measures were adapted from the Zurich Neuromotor Assessment (ZNA) test,
Caballero, 2003[45]	School	State/Regional	Child	Electronic monitor	motion sensor mesures PA over a 24 hour period

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Caballero, 2003[45]	School	State/Regional	Child	Questionnaire	self-reported PA
Chomitz, 2010[54]	School	Non-Governmental	Child	Other	Fitness test scores
Cochrane, 2012[56]	Primary care centers	Other country	Adult	Questionnaire	General Practice Physical Activity Questionnaire
Cortinez-O'Ryan, 2017[61]	Community or neighborhood	Other country	Child	Electronic monitor	pedometer

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Crespo, 2012[65]	Community or neighborhood, School	Local	Child	Questionnaire	per parents: comparison of their child's PA to others
Crespo, 2012[65]	Community or neighborhood, School	Local	Child	Questionnaire	per parents: sports participation over the past year
de Greeff, 2016[76]	School	Other country	Child	Questionnaire	Eurofit physical fitness test battery
De Henauw, 2015[77]	Early childhood education or daycare, School	Non-Governmental	Child	Electronic monitor	The ActiGraph and the ActiTrainer (Pensacola, FL, USA) accelerometers
Dunton, 2015[83]	School	Non-Governmental	Child	Electronic monitor	Actigraph GT2M accelerometers
Dunton, 2015[83]	School	Non-Governmental	Child	Record/log	Time diaries completed by parents
Dzewaltowski, 2009[84]	School	Local	Child	Questionnaire	Previous Day Physical Activity Recall (PDPAR)
Elinder, 2012[89]	School	Other country	Child	Electronic monitor	Accelorometer (Actigraph GT1M)
Elinder, 2012[89]	School	Other country	Child	Questionnaire	Questionnaire
Ermetici, 2016[91]	School	Other country	Child	Questionnaire	A simple self-completion questionnaire designed by the Italian National Institute of Health, adapted from a validated international standard questionnaire targeting adolescents
Fairclough, 2016[94]	School	Other country	Child	Electronic monitor	ActiGraph GT9X
Farley, 2007[96]	Community or neighborhood	Local	Child	Observation	modified System of Observing Play and Leisure Activity in Youth measure, observation within 8x8 block area of neighborhood
Farley, 2007[96]	Community or neighborhood	Local	Child	Record/log	Child annual self-reported survey of physical activity

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Farmer, 2017[97]	School	Other country	Child	Electronic monitor	ActiGraph GT3X
Finch, 2014[98]	Early childhood education or daycare	State/Regional	Child	NR	NR
Foster, 2008[102]	School	Local	Child	Questionnaire	Youth/Adolescent Activity Questionnaire, a self-administered 24-item questionnaire
French, 2010[104]	Employer or worksite	Local	Adult	Questionnaire	Godin leisure time physical activity questionnaire

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Fu, 2016[106]	School	State/Regional	Child	Electronic monitor	Pedometer
Goetzel, 2010[119]	Employer or worksite	Non-Governmental	Adult	Questionnaire	using several health risk assessment questions
Gustat, 2012[125]	Community or neighborhood	Non-Governmental	Adult	Questionnaire	self-reported PA through interviewer-administered household surveys conducted door to door, SOPLAY (System for Observing Play and Leisure Activity in Youth) methods to objectively measure neighborhood PA on streets, sidewalks, and outside public areas on every block in each of the 3 neighborhoods
Haerens, 2006[127]	School	Local	Child	Questionnaire	Adapted version of the International Physical Activity Questionnaire
Hardy, 2010[129]	Early childhood education or daycare	State/Regional	Child	Questionnaire	Test of Gross Movement Development (TMGD-2) checklist,
Hendy, 2011[133]	School	Local	Child	Electronic monitor	Pedometer
Hollis, 2016[142]	School	Non-Governmental	Child	NR	NR
Huberty, 2011[146]	School	State/Regional	Child	Electronic monitor	MVPA (defined as 3 METs)
Jago, 2011[149]	School	US/Federal	Child	Other	Met-S, PA activity
Janssen, 2015[150]	School	Other country	Child	Electronic monitor	Accelerometers
Janssen, 2015[150]	School	Other country	Child	Questionnaire	SOPLAY protocol
Jones, 2015[154]	Early childhood education or daycare	Other country	Child	Observation	System for Observing Play and Leisure in Youth (SOPLAY) tool
Jordan, 2008[155]	School	State/Regional	Child	Questionnaire	Parent and student survey

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Jurg, 2006[156]	After school or summer school, School	Non-Governmental	Child	Other	analysing participation lists
Kain, 2004[158]	School	Other country	Child	Other	20 m shuttle run test
Kamada, 2013[159]	Community or neighborhood	Local	Adult	Questionnaire	Self-administered
Kloek, 2006[166]	Community or neighborhood	Other country	Adult	Questionnaire	30 minutes of MVPA/week
LaCaille, 2016[168]	Employer or worksite	State/Regional	Adult	Questionnaire	Two self-report measures were used to gather data about physical activity; the Godin Leisure Time Exercise Questionnaire (GLTEQ), The International Physical Activity Questionnaire (IPAQ)

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Linde, 2012[176]	Employer or worksite	Non-Governmental	Adult	Electronic monitor	stati use recorded by laser counter
Llargues, 2011[179]	School	Other country	Child	Record/log	Self-reported
Lorentzen, 2009[180]	Community or neighborhood	Other country	Adult	Questionnaire	an instrument developed by Prochaska and Marcus (1994)
Lorentzen, 2009[180]	Community or neighborhood	Other country	Adult	Record/log	self-reported weekly strenuous physical activity
Lubans, 2016[181]	School	Local	Child	Electronic monitor	actigraph accelerometers, CPM and MVPA
Lv, 2014[183]	Community or neighborhood , Employer or worksite	Local	Adult	Questionnaire	International Physical Activity Questionnaire (IPAQ)
Madsen, 2013[187]	After school or summer school	Non-Governmental	Child	Electronic monitor	GT1M or GT3X accelerometer (Actigraph LLC)
Madsen, 2015[186]	School	Non-Governmental	Child	Electronic monitor	Actigraph GT1M or GT3X accelerometer (AG; Actigraph, LLC, Pensacola, FL)
Naylor, 2006[206]	School	Other country	Child	Record/log	Activity Logs
Naylor, 2008[205]	School	Other country	Child	Electronic monitor	pedometers
Neumark-Sztainer, 2010[208]	School	Non-Governmental	Child	Questionnaire	Physical activity was assessed with the 3-Day Physical Activity Recall (3-DPAR) survey. (Pate RR, Ross R, Dowda M, Trost SG, Sirard JR. Validation of a three-day physical activity recall instrument in female youth. Pediatric Exercise Science 2003;15:257–265.)
Pate, 2005[216]	School	Non-Governmental	Child	Questionnaire	The 3-Day Physical Activity Recall (3DPAR), a modification of the Previous Day Physical Activity Recall
Pbert, 2016[217]	School	Non-Governmental	Child	NR	NR

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Ploeg, 2014[272]	School	Other country	Child	Electronic monitor	Omron HJ-720 ITC time-stamped pedometer
Ridgers, 2010[229]	School	Other country	Child	Electronic monitor	Heart rate telemetry (The Polar Team System) and Accelorometers (Actigraph)
Sallis, 2003[240]	School	Local	Child	Observation	The validated SOFIT (System for Observing Fitness Instruction Time) method27,28 was used to evaluate student physical activity in a random sample of PE classes. The SOPLAY (System for Observing Play and Leisure Activity of Youth) method29 was developed for the present study to assess the number and activity level of students during leisure times. For SOPLAY observations, all locations used for physical activity at school were identified, and observers collected data in all locations before school, after lunch, and after school on randomly selected days.
Sigmund, 2012[247]	School	Other country	Child	Electronic monitor	Yamax Digiwalker SW-200 pedometer (Yamax Corporation, Tokyo, Japan)
Sigmund, 2012[247]	School	Other country	Child	Record/log	a PA log book for inputting the Yamax data

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Simon, 2008[248]	School	Non-Governmental	Child	Record/log	Self reported leisure PA using the Modified Activity Questionnaire for adolescents
Story, 2012[253]	School	State/Regional	Child	Questionnaire	Survey completed by classroom and PE teachers
Van Cauwenberghe 2012[271]	School	Other country	Adult	Electronic monitor	accelerometry (GT1M Actigraph; 15 s epoch)
Wells, 2014[281]	School	Local	Child	Electronic monitor	Actigraph GT3X+ or GT1M accelerometers
Wells, 2014[281]	School	Local	Child	Observation	the Physical Activity Research & Assessment tool for Garden Observation (PARAGON), direct observation was conducted by trained research staff
Wells, 2014[281]	School	Local	Child	Questionnaire	The Girls Health Enrichment Multi-site Study (GEMS) Activity Questionnaire (GAQ)
Tarp, 2016[264]	School	Other country	Child	Electronic monitor	Accelerometer (GT3X and GT3X+ devices ActiGraph LLC, Pensacola, FL,USA)
Waters, 2017[276]	School	Other country	Child	Observation	SOPLAY (System for Observing Play and Leisure Activity in Youth)
Waters, 2017[276]	School	Other country	Child	Questionnaire	Primary study parent questionnaires: covering issues such as family physical activities and child sedentary and physical activities and level of active transport
Waters, 2017[276]	School	Other country	Child	Questionnaire	Primary study child questionnaire: covering issues such as family physical activities and child sedentary and physical activities and level of active transport (
Whitt-Glover, 2011[286]	School	Local	Child	Observation	System for Observing Instructional Fitness Time (SOFIT)
Williamson, 2012[287]	School	State/Regional	Child	Questionnaire	Self-Administered Physical Activity Checklist (SAPAC)
Wilson, 2015[288]	Community or neighborhood	Non-Governmental	Adult	Observation	Staff collected data
Wright, 2013[290]	After school or summer school, School	Non-Governmental	Child	Questionnaire	Child and Adolescent Trial for Cardiovascular Health (CATCH) School Physical Activity and Nutrition (SPAN) Student Questionnaire.

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Yildirim, 2014[293]	School	Other country	Child	NR	NR
Zhou, 2014[294]	Early childhood education or daycare	Other country	Child	Electronic monitor	accelerometers (GT3X, Acti- Graph Manufacturing Technology Inc., FL., USA)
Zhou, 2014[294]	Early childhood education or daycare	Other country	Child	Other	battery test from the Chinese National Measurement Standards on People's Physical Fitness for young children

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
Other Study Designs					
Blake, 2013[28]	Employer or worksite	Other country	Adult	Questionnaire	Physical Activity Questionnaire
Brownson 2004[39]	Community or neighborhood	Local	Adult	Other	Personal cards swiped as they entered and left the trail
Brownson 2004[39]	Community or neighborhood	Local	Adult	Questionnaire	The self reported (telephone survey) walking behavior assessment used a four-item scale developed at San Diego State University
Brownson, 2005[40]	Community or neighborhood	US/Federal	Adult	Questionnaire	NR
Brusseau, 2016[41]	School	State/Regional	Child	Electronic monitor	Yamax DigiWalker CW600 pedometers (Tokyo, Japan) and ActiGraph wGT3X-BT triaxial accelerometers (Pensacola, FL).
Cheadle, 2012[52]	After school or summer school, Community or neighborhood , Employer or worksite, School	Non-Governmental	Child	Other	Fitnessgram test
De Cocker, 2011[74]	Community or neighborhood	Other country	Adult	Electronic monitor	Pedomotor: Yamax Digiwalker SW-200 (Yamax, Tokyo, Japan)
De Cocker, 2011[74]	Community or neighborhood	Other country	Adult	Questionnaire	International Physical Activity Questionnaire (IPAQ)
De Cocker, 2011[74]	Community or neighborhood	Other country	Adult	Record/log	Activity log

Author, year	Setting	Level	Adult/Child	Measure type	Physical activity measure
de Silva-Sanigorski, 2011[79]	Early childhood education or daycare	Non-Governmental	Child	Questionnaire	Romp & Chomp Audit survey
Gebel, 2011[112]	Community or neighborhood	Local	Adult	Questionnaire	Participants reported the number of days per week and the minutes per day of walking for at least 10 minutes at a time
Heelan, 2009[131]	School	State/Regional	Child	Electronic monitor	steps per day
Heelan, 2009[131]	School	State/Regional	Child	Questionnaire	School-wide prevalence of walking to school
Huberty, 2013[145]	After school or summer school	Non-Governmental	Child	NR	NR
Naul, 2012[204]	School	Other country	Child	Other	amount of specific activities

Author, year	**Setting**	**Level**	**Adult/Child**	**Measure type**	**Physical activity measure**
Rogers, 2013[235]	After school or summer school, Community center (e.g., job training, youth), Community or neighborhood , Early childhood education or daycare , Employer or worksite, School	Non-Governmental	Child	Questionnaire	Questionnaire conducted by researcher
Tomlin, 2012[267]	School	Other country	Child	Questionnaire	Physical Activity Questionnaire for Children (PAQ-c) or Adolescents (PAQ-a)
Weaver, 2017[277]	School	Local	Child	Electronic monitor	accelerometer (ActiGraph GT3Xþ, Shalimar, Florida)
Whaley, 2010[284]	Community or neighborhood	Local	Child	Questionnaire	Questions taken from the standaed WIC child questionnaire

CPM=counts per minute; GPS=global positioning system; MET=metabolic equivalent of task; MVPA=moderate to vigorous physical activity; No.=number; NR=not reported; NSCH=National Survey of Children’s Health; NYRBS=National Youth Risk Behavior Survey; PA=physical activity; PE=physical education; SPAN=School Physical Activity and Nutrition Survey; US=United States; YRBSS=Youth Risk Behavior Surveillance System

Evidence Table H15. Co-outcomes measures

Author, year	Setting	Co-Outcome	Co-Outcome Description
Natural Experiment Studies			
Bolton, 2017[30]	School	Food environment	School-related food services, the existence of nutrition/physical activity policies and the environment
Bolton, 2017[30]	School	PA environment	the existence of nutrition/physical activity policies and the environment
Brown, 2008[35]	Community or neighborhood	Commuting behavior	Transport behaviour
Calise, 2013[47]	Community or neighborhood	PA environment	Neighborhood characteristics to facilitate walking
Cohen, 2012[58]		Other	METs generated per cost of equipment
Cullen, 2006[67]	School	Purchasing behavior	more vending machines installed in schools
Cummins, 2008[68]	Community or neighborhood	Other	Retail shop count survey
Dubowitz, 2015[82]	Community or neighborhood	Purchasing behavior	questionnaire
Elbel, 2017[87]	Community or neighborhood	Purchasing behavior	how often they usually bought fresh fruits and vegetables; and where they usually shopped for food
Fitzpatrick, 2017[99]	School	Food environment	record specific features of the school food environment
Fitzpatrick, 2017[99]	Community or neighborhood	Food environment	To identify and map convenience stores and fast-food restaurants within a 750 m road network buffer for each schoo
Goodman, 2016[122]	Community or neighborhood	Other	PA behavior - Bikeability
Hoelscher, 2016[140]	School	Commuting behavior	2 day self reported walking or biking to or from school
Just, 2014[157]	School	Purchasing behavior	items purchased at school cafeteria

Author, year	Setting	Co-Outcome	Co-Outcome Description
LaRowe, 2016[170]	Early childhood education or daycare	PA environment	Day long observation using the Physical Activity Environment and Policy Assessment Observation (PA-EPAO) scores
Morton, 2016[198]	School	PA environment	Changes in school environment for PA from primary to secondary school

Author, year	Setting	Co-Outcome	Co-Outcome Description
Nanney, 2016[203]	School	Food environment	Greater school-reported soda availability was associated with an increase in intake of 0.3 daily servings of soda among ninth grade students relative to no soda availability. This association was more pronounced among ninth grade boys than among ninth grade girls, but the difference in the effect between girls and boys was not statistically significant (p=0.23).
Olsho, 2015[212]	Community or neighborhood	Purchasing behavior	Purchase of fruit and vegetables at farmers market
Robles, 2017[234]	Community or neighborhood	Commuting behavior	Transportation behaviors were measured by asking survey questions (un-validated questionnaire)
Rushakoff, 2017[237]	Community or neighborhood	Purchasing behavior	Residents were surveyed about their purchasing and eating patterns over a one-month period
Schwartz, 2016[243]	School	Purchasing behavior	Milk purchases
Sturm, 2015[255]	Community or neighborhood	PA environment	Using LA Department of Public Health data
Taber, 2012[260]	School	Purchasing behavior	Questionnaire
Vadiveloo, 2011[270]	Fast food chains	Purchasing behavior	Frequency of fast food dinner purchases
Wells, 2005[280]	School	Purchasing behavior	Parents of 4-6 year old who recieved free school fruit were asked if they had changed the amout of fruit they gave their children at home
Woodward-Lopez, 2010[289]	School	Purchasing behavior	Food and Beverage Sales
Wrigley, 2003[292]	Community or neighborhood	Purchasing behavior	Switch to the new store in the neighborhood as their main food purchasing source
Experimental Studies			
Audrey, 2015[10]	Employer or worksite	Commuting behavior	Average daily commute mode of transport and time
Busch, 2015[44]	School	Food environment	NR

Author, year	Setting	Co-Outcome	Co-Outcome Description
Coleman, 2012[60]	School	Food environment	Observed changes in food/beverages on campus
French, 2010[104]	Employer or worksite	PA environment	Questionnaire
Gittelsohn, 2010[117]	Community or neighborhood	Purchasing behavior	purchasing of healthy and unhealthy food score
Gittelsohn, 2013[116]	Community or neighborhood	Purchasing behavior	Shelf label–driven healthy food purchasing assessed change in frequency of purchasing a food due to an NHS label (Labelling was part of intervention)
Haerens, 2007[126]	School	Other	In girls only, fat intake and percentage of energy from fat decreased significantly more in the intervention group with parental support
Lent, 2014[173]	School	Purchasing behavior	total energy purchases, purchase of fat, sodium, carbohydrate, sugar, protein and fiber

Author, year	Setting	Co-Outcome	Co-Outcome Description
Mead, 2013[193]	Community or neighborhood	Purchasing behavior	Healthy food acquisition
Sharma, 2016[245]	Food assistance program , School	Purchasing behavior	Frequency of cooking from scratch at home, eating out, using nutrition facts labels, serving F&V at mealtimes and snacks, serving sugary cereals and sugary drinks at meals, limiting portion sizes, screen time, fried foods, fast food and/or sugary beverages, as well as eating family dinners, and requiring that children finish the food on their plate were assessed
Waters, 2017[276]	School	PA environment	Physical activity facilities/policies
Waters, 2017[276]	School	Food environment	Canteen facilities/policies
Other Study Designs			
Cheadle, 2012[52]	After school or summer school, Community or neighborhood , Employer or worksite, School	PA environment	NR

F&V=fruits and vegetables; LA=Los Angeles; METs=metabolic equivalent of task; No.=Number; PA=physical activity

Evidence Table H16. List of distinct secondary data sources by study method

Data source	Population (Adult, Child, Both)	Number of studies	Outcomes		
			Weight	Diet	Physical Activity
Natural Experiment					
Food environment atlas	Adult	1	x		
2006 Canadian Census	Child	1		x	
Americans for Nonsmokers' Rights	Adult	1	x	x	
Anchorage School District's student health data	Child	1	x		
Australian Schools Health and Fitness Survey (ASHFS)	Adult	1	x		x
Beer taxes	Adult	1	x	x	
Behavioral Risk Factor Surveillance System (BRFSS)	Adult	4	x	x	
Boston Youth Survey	Child	1		x	
Bridging the Gap Community Obesity Measures Project (BTG_COMP)	Child	3	x	x	x
Bureau of Labor Statistic (County-level Unemployment Rates)	Adult	1	x	x	
CACI Ltd.	Adult	1		x	
California FITNESSGRAM Physical Fitness Test (PFT)	Child	1	x	x	
California Health Interview Survey	Both	2	x	x	x
California Healthy Kids Survey (CHKS)	Child	1	x	x	
Callorie Labelling Laws	Adult	1	x	x	
CDE DataQuest	Child	1	x		
Census Tiger Files	Adult	1	x	x	
Child and Diet Evaluation Tool	Child	1	x		
Childhood Obesity Study in China Megacities (COCM)	Child	1	x	x	
Cigarette taxes	Adult	1	x	x	
Classification of Laws Associated with School Students	Child	1	x		
Cohort for obesity, marijuana use, physical activity, alcohol use, smoking and sedentary behavior (COMPASS)	Child	1			x
Common Core of Data (CCD)	Child	1	x		
Community Health Information Profile (CHIP)	Child	1	x	x	
Defense Manpower Data Center	Child	1	x	x	
Dunedin City Council	Child	1			x
Early Childhood Longitudinal Study—Kindergarten Cohort (ECLS-K)	Child	1	x	x	
ELSA (wave 6)	Adult	1	x		x
English Longitudinal Study of Ageing (ELSA)	Adult	1	x		

Data source	Population (Adult, Child, Both)	Number of studies	Outcomes Weight	Diet	Physical Activity
Family Activity Study (FAS)	Both	1			x
FitnessGram	Child	2	x		

			Outcomes		
Data source	**Population (Adult, Child, Both)**	**Number of studies**	**Weight**	**Diet**	**Physical Activity**
Health and Health Care Utilization	Adult	1	x		
Health Behavior and Health	Adult	1	x		
Health Survey for England	Adult	1	x		
Healthy Eating, Active Communities study (HEAC)	Child	1	x		
Household food security survey module	Adult	1		x	
Index of Multiple Deprivation (IMD)	Child	1			x
Jamie's Ministry of Food	Adult	1		x	
LA County Food Retail	Adult	1	x	x	
Liveable Neighbourhoods Guidelines'	Adult	1			x
Los Angeles County Health and Nutrition Examination Survey (LAHANES-II)	Adult	1		x	
Manitoba (Youth Health Survey)	Child	1	x		x
Military Teenagers Environment Exercise and Nutrition Study (M-TEENS)	Adult	1	x	x	
Minnesota Student Survey (MSS)	Child	1	x	x	
Monitoring the Future	Child	1			x
Montreal Epidemiological and Geographical Analysis of Population Health Outcomes and Neighborhood Effects (MEGAPHONE)	Child	1	x		x
Multipurpose Family Survey	Adult	1	x		
National Diet and Nutrition Survey data	Child	1		x	
National Health and Nutrition Examination Survey (NHANES)	Adult	1		x	
National Household Travel Survey	Adult	1			x
National School Lunch Program (NSLP)	Child	1	x	x	
National Survey of Children's Health	Child	1	x	x	x
National Youth Physical Activity and Nutrition Study (NYPANS)	Child	1		x	
New Zealand Ministry of Education	Child	1			x
NHS Health Scotland	Both	1		x	
The Northeast Iowa Food and Fitness Initiative	Child	1	x		
NYC School Food Database	Child	1	x		
Ongoing Survey of Living Conditions (DLO)	Adult	1	x		
Output area classification	Child	1		x	
Pediatric Nutrition Surveillance System (PedNSS)	Child	1	x		
Permanent Survey of Living Conditions (POLS)	Adult	1	x		
Philadelphia Bureau of Revision of Taxes	Adult	1			x

			Outcomes		
Data source	**Population (Adult, Child, Both)**	**Number of studies**	**Weight**	**Diet**	**Physical Activity**
Philadelphia Department of Licenses and Inspections	Adult	1			x
Philadelphia Police Department	Adult	1			x
Physical Education-Related State Policy Classification System (PERSPCS)	Child	1	x		x
Quebec Adipose and Lifestyle Investigation in Youth (Quality) Study	Child	1	x		x
School Breakfast Program (SBP)	Child	1	x	x	
School Health Policies and Programs Study (SHPPS)	Child	1	x	x	
School Health Policy Database - State	Child	1			x
School Nutrition Dietary Assessment Study-III (SNDA-III)	Child	2	x	x	
School Nutrition-Environment State Policy Classification System	Child	1			x
School Wellness Study (SWS)	Child	1		x	
Shape of the Nation Reports	Child	1			x
SNAP Data System of the Economic Research Service	Child	1	x		
SNAP Supplemental	Both	2		x	x
Socio-Economic Index for Areas (SEIFA)	Child	1	x	x	x
Southeastern Pennsylvania Household Health Survey	Adult	1			x
Texas Childhood Obesity Prevention Policy Evaluation	Child	1			x
Texas Fitness Now	Child	1	x		
The High School Study (HSS)	Child	1		x	
The New York City Community Health Survey (CHS)	Adult	1		x	
The Pediatric Nutrition Surveillance System	Child	1	x		
The School Health Profiles (Profiles)	Child	1	x	x	
Trip Identification and Analysis System (TIAS)	Adult	1			x
UK index of multiple deprivation, 2004	Child	1		x	
U.S. GDC Park Landmarks	Adult	1	x		x
US Census	Adult	2	x	x	
US Postal Service records	Adult	1			x
U.S. Department of Agriculture (USDA) Economic Research Service's (ERS) Food Environment Atlas	Child	1	x		
Utah Population Database (UPDB)	Child	1	x		
Washington State Healthy Youth Survey (HYS)	Child	1	x		

			Outcomes		
Data source	**Population (Adult, Child, Both)**	**Number of studies**	**Weight**	**Diet**	**Physical Activity**
Westlaw	Child	1	x		
WIC Data (LA-County)	Child	1		x	

Data source	Population (Adult, Child, Both)	Number of studies	Outcomes: Weight	Outcomes: Diet	Outcomes: Physical Activity
Youth Risk Behavior Survey Surveillance - National	Child	3	x	x	x
ZipCom commercial database	Child	1	x		x
Experimental studies					
Moving to Opportunity	Adult	1	x		
National Foundation for Educational Research	Child	1		x	
Nutrition Data System	Child	1		x	
Project CHOICE (Center for Healthy Options and Community Empowerment)	Child	1	x		
School Action Inventory	Child	1			x
Other study designs					
Child Health and Intervention Research Project (CHIRP)	Child	1		x	x
Documentation of Community Change (DOCC)	Child	1		x	x
Maternal and Child Health (MCH) Key Age and Stage (KA&S)	Child	1	x	x	x
Romp & Chomp	Child	1	x	x	x

GDC=Geographic Data Center; LA=Los Angeles; NHS=National Health Services; NYC=New York City; SNAP=Supplemental Nutrition Assistance Program; US=United States ; WIC=Women, Infants, and Children

Evidence Table H17. Identified questionnaires by study method

Questionnaire	Population	Studies	Outcome: Diet	Outcome: Physical Activity
Natural Experiment				
7-day recall instrument	Adult	1		x
Adolescent Behaviours, Attitudes, and Knowledge Questionnaire (ABAKQ)	Child	1	x	x
BC Adolescent Health Survey (AHS)	Adult	1	x	
Behavioral Risk Factor Surveillance System	Both	4	x	x
Beverage and Snack Questionnaire	Child	1	x	
California Health Interview Survey	Both	1		x
California Healthy Kids Survey	Child	2	x	x
Child Food Consumption Questionnaire	Child	1	x	
COMPASS Student Questionnaire (Cq)	Child	1		x
Dietary Quality Index (DQI)	Adult	1	x	
Eating and Physical Activity Questionnaire (EPAQ)	Adult	2	x	
Eating Behaviour Study questionnaire	Child	1	x	
English Longitudinal Study of Ageing (ELSA)	Adult	1		x
Food tick list adapted from FAST	Child	1	x	
Harvard Youth Adolescent Food Frequency Questionnaire (YAQ)	Child	2	x	
Health Survey for England	Adult	1	x	
International Physical Activity Questionnaire (IPAQ)	Adult	5		x
Mean minutes of transportation-related walking.	Adult	1		x
Minnesota Student Survey (MSS)	Child	1		x
National Diet and Nutrition Survey (NDNS)	Adult	1	x	
National Health and Nutrition Examination Survey	Adult	1	x	
National Institute of Health’s Eating at America’s Table Quick Food Scan	Adult	1	x	
National Survey of Children’s Health (NSCH) survey	Child	1		x
Neighborhood Physical Activity Questionnaire (NPAQ)	Adult	1		x
NHANES	Child	1	x	
Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC)	Child	1		x
Past Week Modifiable Activity Questionnaire (PWMAQ)	Adult	1		x
Phone interviews (unspecified)	Adult	1	x	
Physical Activity and Nutrition (PAN) Monitoring Tool	Child	1	x	x
Random-digit-dial telephone surveys (unspecified)	Adult	1		x
REACH Risk Factor Survey	Adult	1	x	
Recent Physical Activity Questionnaire (RPAQ)	Adult	2		x
School Physical Activity and Nutrition (SPAN) questionnaire	Child	5	x	x
School-Based Nutrition Monitoring Questionnaire	Child	1		x

Questionnaire	Population	Studies	Outcome	
			Diet	Physical Activity
Self-administered questionnaire (unspecified)	Child	1		x
Southeastern Pennsylvania Household Health Survey	Adult	1		x
SPAN Questionnaire	Child	1		x
Staff administered questionnaire	Child	1	x	
Street-intercept survey	Adult	1	x	
Student Health Assessment Questionnaire/ 24-hour recall	Child	1		x
Surveys by trained interviewers at farmers market	Adult	1	x	
The 148-item self-administered survey	Adult	1		x
The Boston Youth Survey	Child	1	x	
The California Healthy Kids Survey (CHKS)	Child	1	x	
the School Physical Activity and Nutrition (SPAN) survey	Child	1	x	x
Use of risk behavior survey-daily intake(unspecified)	Child	1	x	x
Victorian Population Health Survey	Both	1		x
Victorian state government Local Level Child Health and Wellbeing Survey	Child	1	x	
Written questionnaire, students reported the number of days they engaged in at least 20 mins of activity that made them sweat or breathe hard in the past week	Child	1		x
Youth Risk Behavior Survey (YRBS)	Both	3	x	x
Experimental studies				
Adapted version of the International Physical Activity Questionnaire	Child	1		x
3-Day Physical Activity Recall (3-DPAR) survey	Child	3		x
Block Kids Food Screener	Child	1	x	
Child and Adolescent Trial for Cardiovascular Health (CATCH) School Physical Activity and Nutrition (SPAN) Student Questionnaire.	Child	1		x
Child and Adolescent Trial for Cardiovascular Health After-School Student Questionnaire (ASSQ)	Child	1	x	
Child Food Consumption Questionnaire	Child	1	x	
Customer Impact Questionnaire (CIQ)	Adult	1	x	
Eurofit physical fitness test battery	Child	1		x
General Practice Physical Activity Questionnaire	Adult	1		x
Girls Health Enrichment Multi-site Study (GEMS) Activity Questionnaire (GAQ)	Child	1		x
Godin leisure time physical activity questionnaire	Adult	12		x
In-person survey completed by parents	Child	1	x	
International Physical Activity Questionnaire (IPAQ)	Both	13		x
Interviewer-administered household surveys, SOPLAY (System for Observing Play and Leisure Activity in Youth) methods	Adult	1		x
Italian National Institute of Health	Child	1		x

			Outcome	
Questionnaire	**Population**	**Studies**	**Diet**	**Physical Activity**
Krece Plus test	Child	1	x	
National Cancer Institute Multifactor Screener	Adult	1	x	
Previous Day Physical Activity Recall (PDPAR)	Child	1	x	
Pro-Children Questionnaire	Child	1	x	
School Physical Activity and Nutrition Questionnaire (SPAN)	Child	2	x	
Self-Administered Physical Activity Checklist (SAPAC)	Child	1		x
SOPLAY protocol	Child	1		x
Test of Gross Movement Development (TMGD-2) checklist,	Child	1		x
Youth/Adolescent Activity Questionnaire	Child	2	x	x
Other study designs				
Child nutrition questionnaire	Child	1	x	
Eating and Physical Activity Questionnaire (EPAQ)	Child	1	x	
International Physical Activity Questionnaire (IPAQ)	Adult	1		x
Physical Activity Questionnaire for Children (PAQ-c) or Adolescents (PAQ-a)	Child	1		x
Romp & Chomp Audit survey	Child	1		x
WIC child questionnaire	Child	1		x
Youth survey	Child	1	x	

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Appendix I. Programs, Policies, or Built Environment Changes in Included Studies (U.S. Only)

Table I1. Program, policy, or built environment evaluations in the United States at the government level (local, state/regional, or Federal)

2005 Safe Routes to School (SRTS) initiative[1]	Healthy Foods, Healthy Families (HFHF)[2]	Reach 2010[3]
Act 1220 (Arkansas): NMI screening[4]	Healthy2Go: received training and technical assistance to increase availability and awareness of healthy foods[5]	Ready for Recess[6]
AHOME[7]	HEROES (Healthy, Energetic, Ready, Outstanding, Enthusiastic, Schools) Initiative[8]	Reduced availability of sugar sweetened beverage and diet soda in a la carte and vending programs in Maine public high schools.[9]
All Sugar Sweetened Beverage Ban and the only soda ban[10]	High 5[11]	Regulations governing minimum PA standards in child care centers[12]
an independent grocery store (Witherbee's Market) at the center of the Carriage Town neighborhood[13]	HUD assignment for urban housing.[14]	Residents moving to a new urbanist neighborhood[15]
Analysis of CLASS and NSCH[16]	installation of new bicycle boulevards.[17]	results of different school nutrition policies[18]
Anchorage School District's School Wellness Policy[19]	Instant Recess[20]	Route H[21]
ATLAS[22]	Joint Use Policies[23]	School Breakfast Program (SBP) and National School Lunch program[24]
Bootheel Walking Promotion Project (creation of walking trails)[25]	Kearney Public School (KPS) District; population dose study[26]	School garden[27]
Boston Active School Day Policy[28]	Kid's Choice Program[29]	School meals[30]
Boston Public Schools Snack and Beverage Policy[31]	LA Sprouts: gardening, nutrition and cooking intervention[32]	School Nutrition Policy Initiative (SNPI)[33]
Breakfast service policy[34]	Learning Landscape[35]	School-specific policies/program[36]
Bright Start[37]	LEED for Neighborhood Development (LEED-ND)[38]	Schoolwide food policies and practices[39]
Building new greenway[40]	Let's Go![41]	Senate Bill 12 (SB 12), California[42]
California Childhood Obesity Prevention Act: Obesity Prevention Motion; Obesity Prevention Motion[43]	Light rail transit[44, 45]	Senate Bill SB 677; Los Angeles Unified School District Nutrition Policy[46]
Calorie Labeling Laws in New York City jurisdictions[47]	Los Angeles Fast Food ban[48]	SNAP (Food stamp program)[49]
Calorie-labeling policy[50]	Mean distance walked per day for transportation purposes[51]	SPARK (Sports, Play and Active Recreation for Kids)[52]
Child Nutrition and WIC Reauthorization Act (CNRA)[53, 54]	Mebane on the Move Intervention[55]	Standing desks in classrooms[56]
Children's Healthy Living Program for Remote Underserved Minority Populations in the Pacific Region (CHL)[57]	Michigan Farmers' Market Nutrition Program[58]	State competitive food laws and state physical education laws [59]

Colorado Trust[60]	Michigan State Board of Education (MSBE) nutrition policy[61, 62]	state high school physical education requirements[63]
Communities Putting Prevention to Work (CPPW)[64]	Middle-School Physical Activity and Nutrition (M-SPAN)[65]	State laws regarding the nutrition content of competitive foods sold in high schools[66]
Community Health Advisor[67]	Mississippi Fresh Fruit and Vegetable Program (MFVP)[68]	State Soda Tax[69]
Community Interventions for Health: build walking trails, bike service system[70]	mixed-use redevelopment community in metropolitan Atlanta (Atlantic Station) that promotes walking and physical activity[71]	State-level grocery story and vending machine soda taxes[72]
Community-Supported Agriculture (CSA)[73]	Moving Across Places[74, 75]	Step Ahead trial[76]
Competitive Food Laws (varies by state) in 40 States[77]	Moving to a walkable community[78]	Supplemental Nutrition Assistance Program (SNAP)[79-83]
Competitive foods and beverages policies in public schools in multple states: NY, WA, NC, GA, TX, KY, TN, LA, GA, OK, KS[84]	Multilevel community intervention[85]	Texas Fitness Now (TFN)[86]
Complete streets design[87]	Multi-level intervention to influence children's' PA behaviors[88]	Texas Public School Nutrition Policy[89]
Comprehensive School Physical Activity Program (CSPAP)[90]	Multiple state laws for 50 states and DC[91]	Texas Senate Bill 42 (SB42)[92]
Comprehensive school-based intervention on healthy behavior[93]	Munch and Move[94]	The Active Early program[95]
Coordinated School Health Program (CSHP)[96]	National School Lunch Program[97, 98]	The COMMUNICATE (COMMUNIty-wide Campaign To promote Exercise)[99]
Electronic Benefit Transfer (EBT) at farmers markets[100]	Navajo Healthy Stores (NHS) program[101]	The HEALTHY Intervention[102]
Energize Your Life![103]	New urbanist neighborhood (in comparison to traditional suburban neighborhood)[104]	The Healthy Youth Places[105]
Environmental Modifications (EMs)[106]	New York City's Food Retail Expansion to Support Health (FRESH)[107]	The Learning, Cognition & Motion (LCoMotion) study[108]
Excise tax on SSB[109]	North Carolina Health and Wellness Trust Fund (NCHWTF)[110]	The Mālaekahana Bike Path[111]
Fitness Zone[112]	Opening access to schoolyard outside of regular operation hours[113]	The Northwest Iowa Food and Fitness Initiative: Regional Safe Routes to School Programming (see www.saferoutestoschools.org), Walking School Buses, and bike rodeos [114]
Food Dudes[115]	Partnerships for Active Children in Elementary Schools (PACES)[116]	The School Obesity-related Policy Evaluation study (ScOPE)[117]
Fresh fruit availability at worksites[118]	Pathways Program (food protion focused on providing lower fat foods)[119]	The Supplemental Nutrition Assistance Program (SNAP)[120]
Fresh to You Markets[121]	Pennsylvania Fresh Food Financing Initiative[122]	Vacant lot greening program[123]

Fruit and vegetable promotion in stores with staff training and installing new equipment[124]	Physical Activity and Healthy Food Intervention[125]	Walking school Bus[126]
Go![127]	Physical education state policies[128]	Wheeling Walks[129, 130]
Gold Medal Schools program[131]	playground upgrade program[132]	WIC[133, 134]
Head Start: classroom videotaped (DVD) puppet shows.[135]	Policy Changes Targeting Junk Food in School vending machines[136]	WIC and SNAP[137]
Health Bucks: Farmers' market incentive program[138]	Pro Children[139]	Workplace showers[140]
Healthier Missouri Communities[141]	Project CHOICE (Center for Healthy Options and Community Empowerment)- community-based participatory research study[142]	YRBSS merged with state policies[143, 144]
Healthier nutrition guidelines[145]	Project Healthy Schools[146]	
Healthy Choice[147]	Proyecto Mercado FRESCO[148]	
Healthy Communities Study (HCS)[149]	Railroad Park[150]	

Table I2. Program, policy, or built environment evaluations in the United States at the nongovernment level

Men on the Move: Growing Communities (MOTMGC)[151]	Movin' Afterschool[152]	Lifestyle Education for Activity Program[153]
Lookin' Good Feelin' Good: School nurse intervention and after-school exercise program[154]	Healthy Eating Active Living–Community Health Initiative (HEAL-CHI)[155]	Healthy Schools Program (HSP)[156]
Project Healthy Schools in two Cities in Michigan[157]	Kids N Fitness[158]	Choosing Healthy & Active Lifestyles for Kids (CHALK)[159]
Physical Activity 4 Everyone[160]	Sports, Play, and Active Recreation for Kids (SPARK)[161]	Positive Action for Today's Health[162]
Healthy Food Financing Initiative[163]	The Healthy Options for Nutrition Environments in Schools (Healthy ONES)[164]	New Moves intervention[165]
APPLE[166]	HealthWorks[167]	'Intervention Centered on Adolescents' Physical activity and Sedentary behavior' (ICAPS)[168]
Energy Balance for Kids with Play (EB4K with Play)[169]	Partnership for an Active Community Environment (PACE) and city of New Orleans[170]	America SCORES[171]
Healthy Store Intervention[172]	Water Jet installation in schools[173]	The Cafeteria Power Plus Intervention[174]
Physical activity intervention[175]	The Healthy Foods Hawaii (HFH)[176]	Creating Healthy, Active and Nurturing Growing-up Environments (CHANGE) study: serve healthier school breakfast and lunch[177]
The HealthMPowers program[178]	Healthy Living Cambridge Kids (KLCK)[179]	The 5 a Day intervention: newsletters and promotions to encourage healthy eating[180]
Multi-level weight-gain prevention[181]	Shape-Up Somerville[182]	Health promotion messaging and counseling [183]
Romp & Chomp[184]	JUMP-in[185]	A social marketing intervention promoted walking[186]

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Appendix J. Data Systems Identified by the Systematic Review*

Table J1. Data systems identified by the systematic review

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Natural Experiment Studies									
Bauhoff, 2014[1]	USA	N	Y	California Healthy Kids Survey (CHKS)	WestEd	http://chks.wested.org/reports/	http://chks.wested.org/administer/download/	-	-
Bauhoff, 2014[1]	USA	N	Y	California FITNESSGRAM Physical Fitness Test (PFT)	State of California - Department of Education	http://www.cde.ca.gov/ta/tg/pf/pftresearch.asp	https://pftdata.org/resources.aspx	http://www.cde.ca.gov/ta/tg/pf/	http://data1.cde.ca.gov/dataquest/
Branas, 2011[2]	USA	N	Y	PA Property Taxes	Philadelphia Bureau of Revision of Taxes	http://publicrecords.onlinesearches.com/Pennsylvania-Assessor-and-Property-Tax-Records.htm	-	-	-
Branas, 2011[2]	USA	N	Y	Philadelphia City Map	Philadelphia Department of Licenses and Inspections	http://gsg.phila.gov/map	-	-	-
Branas, 2011[2]	USA	N	Y	US Postal Service Records	US Postal Services	https://ribbs.usps.gov/index.cfm?page=address_info_systems	https://ribbs.usps.gov/addressing/documents/tech_guides/pubs/AIS_VIEWER_USER.PDF	-	-
Branas, 2011[2]	USA	N	Y	Philadelphia Crime Data	Philadelphia Police Department	https://www.opendataphilly.org/dataset/crime-incidents	https://www.opendataphilly.org/dataset/crime-incidents/resource/79134de9-56fa-41f2-b529-b660aaf1539b	-	https://www.opendataphilly.org/dataset/crime-incidents/resource/c57a9de2-e300-468a-9a20-3e64e5b9b2da

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Branas, 2011[2]	USA	N	Y	Southeastern Pennsylvania Household Health Survey	Philadelphia Health Management Corporation	http://www.chdbdata.org/data-data-tools	-	-	-
Camacho-Rivera, 2017[3]	USA	Y	N	The Affordable Housing as an Obesity Mediating	NYC-DofCityPlanning	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4074325/	-	-	
Capogrossi, 2016[4]	USA	N	Y	Common Core of Data (CCD)	National Center for Education Statistics	https://nces.ed.gov/ccd/ccddata.asp	-	-	-
Capogrossi, 2016[4]	USA	N	Y	Early Childhood Longitudinal Study-Kindergarten (ECLS-K)	National Center for Education and Statistics	https://nces.ed.gov/edat/	https://nces.ed.gov/ecls/instruments2011.asp	https://nces.ed.gov/ecls/dataproducts.asp	-
Chen, 2015[5]	China	N	Y	China Health and Nutrition Survey (CHNS)	Chinese Center for Disease Control and Prevention (CCDC)	-	http://www.cpc.unc.edu/projects/china/data/questionnaires	-	http://www.cpc.unc.edu/projects/china/data/datasets
Cleland, 2008[6]	Australia	N	Y	Australian Schools Health and Fitness Survey (ASHFS)	Australian Government	-	-	-	-
Coffield, 2011[7]	USA	N	Y	Utah Population Database (UPDB)	Utah State Government	Access with RGE and IRB approval: https://healthcare.utah.edu/huntsmancancerinstitute/research/updb/access.php	-	http://healthcare.utah.edu/huntsmancancerinstitute/research/updb/data/	http://healthcare.utah.edu/huntsmancancerinstitute/research/updb/data/
Cradock, 2011[8]	USA	N	Y	Boston Youth Survey	City of Boston and the Harvard Youth Violence Prevention Center	https://www.hsph.harvard.edu/wp-content/uploads/sites/120/2012/10/2004BYSfullreport.pdf	https://cdn1.sph.harvard.edu/wp-content/uploads/sites/120/2012/10/Inst_2006_BYS_survey_FINAL.pdf	-	https://www.hsph.harvard.edu/wp-content/uploads/sites/120/2012/10/Final_2006_BYS_Highlights_and_tables.pdf

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Cummins, 2005[9]	UK	N	Y	UK CACI Address Files	CACI Ltd.	http://www.caci.co.uk/integrated-marketing/consumer-data	http://research.caciconsult.co.uk/lifestyle-data/	-	-
Cummins, 2008[10]	UK	N	Y	Scottish Health Survey (Health Education Population Survey)	NHS Health Scotland	http://www.healthscotland.com/scotlands-health/population/HEPS.aspx	-	-	-
Cummins, 2014[11]	USA	N	Y	USDA Food Atlas	US Department of Agriculture	https://www.ers.usda.gov	https://www.ers.usda.gov/data-products/	-	https://www.ers.usda.gov/data-products/food-environment-atlas/data-access-and-documentation-downloads/
Datar, 2016[12]	USA	N	Y	State Laws for Snack Foods and Beverages	Bridging the Gap	http://foods.bridgingthegapresearch.org/#ng12s/2012	http://www.bridgingthegapresearch.org/_asset/44cmz6/btg_state_srts_0511_laws_codebook_14Nov11_puse-1.pdf	http://www.bridgingthegapresearch.org/research/state_obesity-related_policies/	http://www.bridgingthegapresearch.org/_asset/kxq8n0/BTG_SRTS_hazlaw_2005_2011_with_dummyvars_03Nov11.xlsx
Fitzpatrick, 2017[13]	Canada	N	Y	Montreal Epidemiological and Geographical Analysis of Population Health Outcomes and Neighborhood Effects	Université de Montréal	https://www.nature.com/ijo/journal/v41/n7/full/ijo201739a.html	-	-	
Fitzpatrick, 2017[13]	Canada	Y	N	Quebec Adipose and Lifestyle Investigation in Youth (Quality) Study	QUebec Adipose and Lifestyle InvesTigation in Youth	http://www.etudequalitystudy.ca/	-	-	
Fitzpatrick, 2017[13]	Canada	N	Y	ZipCom commercial database	Tamec Inc.	http://www.zipcom.ca/en/		-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Frongillo, 2017[14]	USA	Y	N	Community Policies and Programs	University of South Carolina	https://www.ncbi.nlm.nih.gov/pubmed/28688728	-	-	
Gee, 2015[15]	USA	N	Y	National Survey of Children's Health	Centers for Disease Control and Prevention	ftp://ftp.cdc.gov/pub/Health_Statistics/NCHS/slaits/nsch_2011_2012/03_Dataset	https://www.cdc.gov/nchs/data/slaits/2011nschquestionnaire.pdf	https://www.cdc.gov/nchs/slaits/nsch.htm	-
Giles-Corti, 2013[16]	Australia	N	Y	Western Australian Liveable Neighbourhoods Guideline	Western Australian Department of Planning	https://www.planning.wa.gov.au/Liveable-neighbourhoods.aspx	-	https://www.planning.wa.gov.au/dop_pub_pdf/mrsindex.pdf	https://www.planning.wa.gov.au/dop_pub_pdf/LN_Text_update_02.pdf
Hennessy, 2014[17]	USA	N	Y	Classification of Laws Associated with School Students	National Cancer Institute	https://class.cancer.gov/download.aspx	-	https://class.cancer.gov/	-
Hobin, 2014[18]	Canada	N	Y	Youth Health Survey	Canadian Cosortium	-	http://www23.statcan.gc.ca/imdb/p2SV.pl?Function=getSurvInstrumentList&Id=282165	-	http://www23.statcan.gc.ca/imdb/p3Instr.pl?Function=assembleInstr&lang=en&Item_Id=314505
Hobin, 2017[19]	Canada	N	Y	Manitoba (Youth Health Survey)	Partners in Planning for Healthy Living	http://partners.healthincommon.ca/tools-and-resources/youth-health-survey/	http://partners.healthincommon.ca/wp-content/uploads/2013/01/YHS_A.pdf	-	-
Hoelscher, 2016[20]	USA	Y	N	Texas Childhood Obesity Prevention Policy Evaluation	Texas State	-	-	https://sph.uth.edu/research/centers/dell/project.htm?project=1183cfc3-c761-442e-881f-297978d00fe8	https://sph.uth.edu/research/centers/dell/resources/2013-Texas-Health-Perception-Survey_Report1.pdf

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Howlett, 2016[21]	USA	N	Y	County Business Patterns	Census Bureau	https://www.census.gov/programs-surveys/cbp.html	https://www2.census.gov/programs-surveys/rhfs/cbp/technical%20documentation/2015_record_layouts/county_layout_2015.txt	-	https://www.census.gov/programs-surveys/cbp/data/datasets.html
Howlett, 2016[21]	USA	N	Y	Supplemental Nutrition Assistance Program	Department of Commerce	https://www.fns.usda.gov/pd/snap-state-activity-reports	https://www.fns.usda.gov/snap/supplemental-nutrition-assistance-program-snap	https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap	
Hu, 2016[22]	Finland	N	Y	Health Behavior and Health	National Institute for Health and Welfare	https://www.thl.fi/en/web/thlfi-en/whats-new?p_p_state=maximized&p_p_mode=view&saveLastPath=0&_58_struts_action=%2Flogin%2Flogin&p_p_id=58&p_p_lifecycle=0&_58_redirect=%2Fen%2Fweb%2Fthlfi-en%2Fresearch-and-expertwork%2Fpopulation-studies%2Fhealth-behaviour-and-health-among-the-finnish-adult-population-avtk	-	https://www.thl.fi/en/web/thlfi-en/research-and-expertwork/population-studies	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Hu, 2016[22]	Italy	N	Y	Multipurpose Family Survey	Italian National Institute of Statistics (ISTAT)	-	https://www.istat.it/it/archivio/91926	Health Statics => "Life styles and risk factors"=> Body mass Index : http://dati.istat.it/?lang=en	-
Hu, 2016[22]	Italy	N	Y	Health and Health Care Utilization	Italian National Institute of Statistics (ISTAT)	http://www.istat.it/en/archive/129376	-	-	http://www.istat.it/en/files/2014/07/pills_10_luglio_en01.pdf?title=Health+conditions+and+use+of+health+services+-+10+Jul+2014+-+Full+text.pdf
Hu, 2016[22]	Netherland	N	Y	Permanent Survey of Living Conditions (POLS)	Netherland Government	http://statline.cbs.nl/Statweb/search/?Q=POLS-Gezondheid+1997-2009&LA=NL	-	-	http://www.jpi-dataproject.eu/Home/Database/311?topicId=7#
Hu, 2016[22]	Netherland	N	Y	Ongoing Survey of Living Conditions (DLO)	Netherland Government	-	-	-	-
Hu, 2016[22]	UK	N	Y	Health Survey for England	National Health Service	-	https://data.gov.uk/dataset/health_survey_for_england	https://discover.ukdataservice.ac.uk/series/?sn=2000021	http://content.digital.nhs.uk/searchcatalogue?q=Health+Survey+for+England&area=&size=10&sort=Relevance#top
Hughes, 2012[23]	UK	Y	N	Child and Diet Evaluation Tool	Medical Research Council - National Prevention Research Institute	http://dapa-toolkit.mrc.ac.uk/	-	-	-
Hughes, 2012[23]	UK	N	Y	Index of Multiple Deprivation	UK Government	https://data.gov.uk/dataset/imd_2004	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Hughes, 2012[23]	UK	N	Y	Output Area Classification	UK Office for National Statistics	http://www.opengeodemographics.com/	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Hunter, 2016[24]	Canada	Y	N	Cohort for obesity, marijuana use, physical activity, alcohol use, smoking and sedentary behavior	Uni of Waterloo	https://uwaterloo.ca/compass-system/compass-system-projects/compass-study	-	-	
Jia, 2017[25]	China	Y	N	Childhood Obesity Study in China Megacities	Multi-City Center for Disease Control and Prevention, China	https://www.ncbi.nlm.nih.gov/pubmed/28074059	-	-	
Just, 2014[26]	USA	N	Y	School Nutrition Dietary Assessment Study-III (SNDA-III)	US Department of Agriculture	-	https://fns-prod.azureedge.net/sites/default/files/SNDAIII-Instruments.pdf	https://www.fns.usda.gov/school-nutrition-dietary-assessment-study-iii	https://fns-prod.azureedge.net/sites/default/files/SNDAIII-SummaryofFindings.pdf
Kern, 2014[27]	USA	N	Y	Washington State Healthy Youth Survey (HYS)	Washington State Department of Health	http://www.doh.wa.gov/DataandStatisticalReports/DataSystems/HealthyYouthSurvey/PastSurveys	http://www.doh.wa.gov/DataandStatisticalReports/DataSystems/HealthyYouthSurvey	-	-
Kim, 2012[28]	USA	N	Y	Physical Education-Related State Policy Classification System (PERSPCS)	National Cancer Institute (UBC: Centre for Community Child Health Research)	https://www.ncbi.nlm.nih.gov/pubmed/17884575	-	-	http://www.ihrp.uic.edu/study/nci-physical-education-related-state-policy-classification-system-perspcs-and-school-nutrition
Kubik, 2005[29]	USA	Y	N	Teens Eating for Energy and Nutrition at School	Penn State + Military	-	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Lachapelle, 2009[30]	USA	N	Y	National Household Travel Survey	US Department of Transportation - Federal Highway Administration	https://www.nationalhouseholdtravelsurvey.com/	http://nhts.ornl.gov/2009/pub/Codebook.pdf	http://nhts.ornl.gov/	http://nhts.ornl.gov/download.shtml
Liu, 2016[31]	USA	N	Y	WIC Data (LA-County)	Los Angeles County	http://www.healthycity.org/maps/	http://www.lawicdata.org/survey/	https://www.fns.usda.gov/pd/wic-program	http://lawicdata.org/topics/obesity-2/
Liu, 2016[31]	USA	N	Y	SNAP Supplemental	Los Angeles County	http://www.cdss.ca.gov/inforesources/Research-and-Data/CalFresh-Data-Tables	http://dpss.lacounty.gov/wps/portal/dpss/main/programs-and-services/calfresh/!ut/p/b1/04_Sj9Q1NDA1NDcyNrcw1o_Qj8pLLMtMTyzJzM9LzAHxo8zi3QwMDNz9nYKN3H2ATEf_ACdvr7BAAxMzE6CCSGQFBr5hbgaeQYbGvk7u5kYWYYaE9HvpR6Xn5CcBrQrXj0JVjMUssAIDHMDRQN_PIz83VT83KsciO8tEEQADFwf6/dl4/d5/L2dJQSEvUUt3QS80SmtFL1o2X0YwMDBHT0JTMjBFNkEwQU9TSjFVOEsxUzUw/	https://www.fns.usda.gov/pd/supplemental-nutrition-assistance-program-snap	-
MacDonald, 2010[32]	USA	N	Y	U.S. GDC Park Landmarks	ESRI	ESRI	-	-	-
MacDonald, 2010[32]	USA	N	Y	Census Tiger Files	Census	https://www.census.gov/geo/maps-data/data/tiger-line.html	https://www.census.gov/geo/maps-data/data/tiger-line.html	-	-
Madsen, 2011[33]	USA	N	Y	CDE DataQuest	The California Department of Education (CDE)	-	-	-	http://data1.cde.ca.gov/dataquest/

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Malakellis, 2017[34]	Australia	N	Y	Socio-Economic Index for Areas	ACT-IYM-Australia	http://www.health.act.gov.au/healthy-living/healthy-children-and-young-people/its-your-move	http://health.act.gov.au/sites/default/files//Questionnaire%20Planning%20Guide-webpublication%20version_AUG15.pdf	-	http://health.act.gov.au/sites/default/files//Systems%20approach%20to%20reducing%20unhealthy%20weight%20in%20Australian%20adolescents_%20ACT%20%C3%94%C3%87%C2%A3It%C3%94%C3%87%C3%96s%20Your%20Move%20%21%C3%94%C3%87%C3%98_.pdf
Masse, 2014[35]	Canada	N	Y	Canadian Census	Statistics Canada	http://www12.statcan.ca/census-recensement/2006/dp-pd/index-eng.cfm	-	http://www12.statcan.gc.ca/census-recensement/2006/dp-pd/index-eng.cfm	http://www12.statcan.ca/datasets/Index-eng.cfm?Temporal=2006

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Miewald 2012[36]	Canada	N	Y	Canadian Community Health Survey - Household Food Security Survey Module	Government of Canada	https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs.html	https://www.canada.ca/en/health-canada/services/food-nutrition/food-nutrition-surveillance/health-nutrition-surveys/canadian-community-health-survey-cchs/canadian-community-health-survey-cycle-2-2-nutrition-2004-income-related-household-food-security-canada-health-canada-2007.html#appa	-	-
Miller, 2015[37]	USA	Y	N	Trip Identification and Analysis System	Westat	https://www.westat.com/projects/using-gps-measure-physical-activity-levels	https://www.westat.com/expertise/statistical-research-survey-methods/survey-design	-	-
Miller, 2015[37]	USA	N	Y	National Youth Physical Activity and Nutrition Study (NYPANS)	Centers for Disease Control and Prevention	https://www.cdc.gov/healthyyouth/data/yrbs/nypans.htm	ftp://ftp.cdc.gov/pub/data/yrbs/nypans/nypans_data_users_manual.pdf	-	-
Nanney, 2016[38]	USA	N	Y	Minnesota Student Survey (MSS)	State of MN	http://www.health.state.mn.us/divs/chs/mss/specialreports/index.html	-	http://www.health.state.mn.us/divs/chs/mss/	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Nanney, 2016[38]	USA	N	Y	The School Health Profiles (Profiles)	Centers for Disease Control and Prevention	For actual Data you need to send a request: https://www.cdc.gov/healthyyouth/data/profiles/contact.htm	https://www.cdc.gov/healthyyouth/data/profiles/questionnaires.htm	https://www.cdc.gov/healthyyouth/data/profiles/results.htm	https://www.cdc.gov/healthyschools/physicalactivity/profiles.htm
Nguyen, 2015[39]	USA	N	Y	National Health and Nutrition Examination Survey (NHANES)	Centers for Disease Control and Prevention - National Center for Health Statistics	https://wwwn.cdc.gov/nchs/data/nhanes/survey_contents.pdf	https://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm	-	https://wwwn.cdc.gov/nchs/nhanes/continuousnhanes/default.aspx
Olsho, 2015[40]	USA	N	Y	NYC Community Health Survey	NYC Department of Health	http://www1.nyc.gov/site/doh/data/data-sets/community-health-survey.page	http://www1.nyc.gov/assets/doh/downloads/excel/episrv/chs-variable-crosswalk.xlsx	-	http://www1.nyc.gov/site/doh/data/data-sets/community-health-survey-public-use-data.page
Parsons, 2014[41]	USA	N	Y	Anchorage School District's student health data	Anchorage School District	-	-	-	http://www.asdk12.org/data/behaviordashboard/
Peterson, 2015[42]	USA	Y	N	Community Health Information Profile (CHIP)	Massachusetts Dept. of Public Health	http://www.mass.gov/eohhs/researcher/community-health/masschip/	-	-	-
Powell, 2009[43]	USA	N	Y	Business list developed by Dun and Bradstreet	Dun and Bradstreet	-	-	-	-
Powell, 2009[43]	USA	N	Y	Monitoring the Future	University of Michigan's Institute for Social Research	http://www.monitoringthefuture.org/data/data.html	-	http://www.monitoringthefuture.org/	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Powell, 2009[43]	USA	N	Y	Soda taxes	The MayaTech Corporation for the Robert Wood Johnson Foundation-supported ImpacTeen project	http://impacteen.uic.edu/statetaxdata/BTG_State_Soda_Sales_Tax_Jan012011_publuse_091911.pdf	http://impacteen.uic.edu/obesitystatedata.htm	-	-
Powell, 2009[43]	USA	N	Y	Sales Taxes	Federation of Tax Administrators	-	-	https://www.taxadmin.org/current-tax-rates	https://www.taxadmin.org/assets/docs/Research/Rates/sales.pdf
Quig, 2012[44]	New Zealand	N	Y	Education Review Office - Communities of Learning	New Zealand Ministry of Education	http://www.ero.govt.nz	http://www.ero.govt.nz/how-ero-reviews/ero-reviews-of-early-childhood-services-and-kohanga-reo/#self-reports-for-early-childhood-services	-	-
Quig, 2012[44]	New Zealand	N	Y	Dunedin City Population and Demography	Dunedin City Council	http://www.dunedin.govt.nz/	-	-	http://www.dunedin.govt.nz/your-council/long-term-plan-2015-2016/section-1-major-issues-and-strategies/city-profile/population-and-demography
Restrepo, 2016[45]	USA	N	Y	Bureau of Labor Statistic (County-level Unemployment Rates)	US Bureau of Labor	COUNTY DATA: https://www.bls.gov/lau/	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Restrepo, 2016[45]	USA	N	Y	Americans for Nonsmokers' Rights	Americans for Nonsmokers' Rights	http://www.no-smoke.org/goingsmokefree.php?id=519	-	-	http://www.no-smoke.org/document.php?id=675

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Restrepo, 2016[45]	USA	N	Y	Callorie Labelling Laws	Center for Science in the Public Interest	https://cspinet.org/resource/nutrition-labeling-standard-menu-items-chain-restaurants	-	https://cspinet.org/protecting-our-health/menu-labeling	https://cspinet.org/resource/nutrition-labeling-chain-restaurants-state-and-local-lawsbillsregulations-2009-2010
Restrepo, 2016[45]	USA	N	Y	Behavioral Risk Factor Surveillance System (BRFSS)	Centers for Disease Control and Prevention	https://www.cdc.gov/brfss/smart/smart_data.htm	https://www.cdc.gov/brfss/questionnaires/index.htm	https://www.cdc.gov/brfss/	https://www.cdc.gov/brfss/annual_data/annual_data.htm
Restrepo, 2016[45]	USA	N	Y	Cigarette taxes	Tax Burden on Tobacco	https://www.taxadmin.org/index.php?option=com_content&view=article&id=58:tobacco-tax-papers&catid=28:tobacco-tax&Itemid=205	https://www.healthdata.gov/dataset/tax-burden-tobacco-volume-49-1970-2014	https://www.taxadmin.org/assets/docs/Tobacco/papers/tax_burden_2014.pdf	-
Restrepo, 2016[45]	USA	N	Y	Beer taxes	Brewer's Almanac	http://www.beerinstitute.org/statistics/taxes-paid/	-	-	-
Riis, 2012[46]	USA	N	Y	School Nutrition-Environment State Policy Classification System	National Cancer Institute (UBC: Centre for Community Child Health Research)	https://www.ncbi.nlm.nih.gov/pubmed/17884576	-	-	https://class.cancer.gov/data/201201/CLASS_Nutrition_SCORING_KEY_and_variable_information_132012.pdf
Robles, 2017[47]	USA	N	Y	Los Angeles County Health and Nutrition Examination Survey	LA-County	http://publichealth.lacounty.gov/ha/	-	http://publichealth.lacounty.gov/ha/hasurveyintro.htm	

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Sabia, 2016[48]	USA	N	Y	Youth Risk Behavior Survey Suveillance – National	Centers for Disease Control and Prevention	https://nccd.cdc.gov/youthonline/App/Results.aspx?TT=B&OUT=0&SID=HS&QID=QNOBESE&LID=LL&YID=RY&LID2=&YID2=&COL=&ROW1=&ROW2=&HT=&LCT=&FS=&FR=&FG=&FI=&FP=&FSL=&FRL=&FGL=&FIL=&FPL=&PV=&TST=&C1=&C2=&QP=&DP=&VA=CI&CS=Y&SYID=&EYID=&SC=&SO=	https://www.cdc.gov/healthyyouth/data/yrbs/questionnaires.htm	https://www.cdc.gov/healthyyouth/data/topics/npao.htm	https://www.cdc.gov/healthyyouth/data/yrbs/data.htm
Sabia, 2016[48]	USA	N	Y	Shape of the Nation Reports	National Association for Sport and Physical Education and American Heart Association	http://www.shapeamerica.org/advocacy/son/2016/upload/Shape-of-the-Nation-2016_web.pdf	-	http://www.shapeamerica.org/advocacy/son/index.cfm	-
Sabia, 2016[48]	USA	N	Y	School Health Policy Database - State	National Association of State Boards of Education	http://www.nasbe.org/healthy_schools/hs/map.php	-	-	http://www.nasbe.org/healthy_schools/hs/search.php
Schwartz, 2016[49]	USA	N	Y	NYC School Food Database	New York City Department of Education	-	-	-	-
Schwartz, 2016[49]	USA	N	Y	FITNESSGRAM-NYC	The Cooper Institute	-	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Sekhobo, 2014[50]	USA	N	Y	The Pediatric Nutrition Surveillance System	Centers for Disease Control and Prevention	https://www.health.ny.gov/statistics/prevention/nutrition/pednss/	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Sturm, 2010[51]	USA	Y	N	Bridging the Gap - Community Obesity Measures Project	RWJ Foundation	http://www.bridgingthegapresearch.org/research/community_data/	http://www.bridgingthegapresearch.org/_asset/p5mswy/BTGCOMP_FoodStore_2012.pdf	-	-
Sturm, 2015[52]	USA	N	Y	California Health Interview Survey	University of California Los Angeles	http://healthpolicy.ucla.edu/chis/Pages/default.aspx	http://healthpolicy.ucla.edu/chis/design/Pages/questionnairesEnglish.aspx	https://www.cdc.gov/nchs/nhis/	http://healthpolicy.ucla.edu/chis/analyze/Pages/CHIS-Data-Documentation.aspx
Sturm, 2015[52]	USA	N	Y	LA County Food Retail	Los Angeles County Department of Public Health	-	-	-	-
Taber, 2011[53]	USA	N	Y	School Health Policies and Programs Study (SHPPS)	Centers for Disease Control and Prevention	-	https://www.cdc.gov/healthyyouth/data/shpps/questionnaires.htm	https://www.cdc.gov/healthyyouth/data/shpps/index.htm	https://www.cdc.gov/healthyyouth/data/shpps/data.htm
Taber, 2012[54]	USA	N	Y	Westlaw	Thomson Reuters	-	-	-	-
Toussaint, 2017[55]	USA	N	Y	The Northeast Iowa Food and Fitness Initiative	Kellogg Foundation Food	http://www.iowafoodandfitness.org/site/datacomm.html	http://www.iowafoodandfitness.org/site/cyclemenu.html	-	
Utter, 2016[56]	New Zealand	N	Y	Youth'12	Adolescent Health Research Group	https://www.fmhs.auckland.ac.nz/en/faculty/adolescent-health-research-group.html	https://cdn.auckland.ac.nz/assets/fmhs/faculty/ahrg/docs/youth12-questionnaire.pdf	-	https://www.fmhs.auckland.ac.nz/assets/fmhs/faculty/ahrg/docs/2012prevalence-tables-report.pdf

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
von Hippel, 2015[57]	USA	N	Y	Texas Fitness Now	Texas Government	http://tea.texas.gov/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=2147496810&libID=2147496807	http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/FITNESSGRAM%C2%AE_Procedures_Manual/	http://tea.texas.gov/Reports_and_Data/Program_Evaluations/Other_Initiatives/Program_Evaluation__Other_Initiatives/	http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/Fitness_Data/
von Hippel, 2015[57]	USA	Y	N	FitnessGram	The Cooper Institute	http://www.cooperinstitute.org/FitnessGram	http://tea.texas.gov/Texas_Schools/Safe_and_Healthy_Schools/Physical_Fitness_Assessment_Initiative/FITNESSGRAM%C2%AE_Procedures_Manual/	-	-
Webb, 2012[58]	UK	N	Y	English Longitudinal Study of Ageing (ELSA)	National Health Services	-	http://www.elsa-project.ac.uk/documentation	-	http://www.elsa-project.ac.uk/data_elsa
Wells, 2005[59]	UK	N	Y	National Diet and Nutrition Survey data	United Kingdom Government (Public Health England + UK Food Standards Agency)	https://www.gov.uk/government/collections/national-diet-and-nutrition-survey	-	http://webarchive.nationalarchives.gov.uk/20130402145952/http://transparency.dh.gov.uk/category/statistics/ndns/	-
Woodward-Lopez, 2010[60]	USA	Y	N	School Wellness Study (SWS)	Study Team	-	-	-	-
Woodward-Lopez, 2010[60]	USA	Y	N	the High School Study (HSS)	Study Team	-	-	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Woodward-Lopez, 2010[60]	USA	Y	N	Healthy Eating, Active Communities study (HEAC)	place-based initiative	-	-	https://portal.hud.gov/hudportal/HUD?src=/program_offices/economic_development/place_based	http://www.cssp.org/community/neighborhood-investment/place-based-initiatives

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Experimental studies									
Ludwig, 2011[61]	USA	N	Y	Moving to Opportunity	Housing and Urban Development	http://www.nber.org/mtopuf/#PUF	http://www.nber.org/mtopublic/instruments.html	-	-
Perry, 2004[62]	USA	Y	N	Nutrition Data System	University of Minnesota, Minneapolis	-	https://drive.google.com/drive/folders/0B7tgPhfpOAbTNTZ6UDBSMUV3MmM	-	-
Naylor, 2006[63]	Canada	N	Y	School Action Inventory	British Columbia Ministry of Education	-	http://www.actionschoolsbc.ca/	-	-
Pope, 2016[64]	USA	Y	N	Center for Healthy Options and Community Empowerment	National Center on Minority Health and Health Disparities	https://www.nimhd.nih.gov/		-	-
Rush, 2014[65]	New Zealand	Y	N	Project Energize	Waikato District Health Board	-	-	https://www.waikatodhb.health.nz/public-health-advice/project-energize/	https://www.waikatodhb.health.nz/assets/public-health-advice/project-energize/School-engagement-in-the-Project-Energize-health-intervention-programme.pdf
Lorentzen, 2009[66]	Norway	N	Y	Population and Demography	Statistics Norway	https://www.ssb.no/en/	https://www.ssb.no/en/befolkning/nokkeltall/summary-tables	-	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Evans, 2013[67]	UK	N	Y	UK School Surveys	National Foundation of Educational Research	https://www.nfer.ac.uk/schools/school-surveys/	https://www.nfer.ac.uk/schools/school-surveys/about-the-surveys/	https://www.nfer.ac.uk/about-nfer/strategy-and-vision/annual-report/	-

Author, year	Country	Primary	Secondary	Database	Custodian	Generic URL	Data Dictionary URL	Parent System URL	Data Access Link
Other Study Designs									
Cheadle, 2012[68]	USA	Y	N	Documentation of Community Change (DOCC)	Kaiser Permanente	-	-	http://www.healzones.org/resources/farmtoschool@caff.org	-
de Silva-Sanigorski, 2011[69]	Australia	Y	N	Romp & Chomp	Victoria State Government, Australia	-	-	-	-
de Silva-Sanigorski, 2011[69]	Australia	N	Y	Maternal and Child Health (MCH) Key Age and Stage (KA&S)	Victoria State Government, Australia	-	-	-	-

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Appendix K. Individual Study Risk of Bias Ratings

Table K1. Individual study EPHPP risk of bias ratings

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Natural Experiments							
Anderson, 2013[1]	M	M	M	L	H	H	H
Anthamatten, 2011[2]	M	M	H	H	M	H	H
Azevedo, 2014[3]	H	M	H	H	L	L	H
Barnidge, 2013[4]	L	M	H	H	L	H	H
Barroso, 2009[5]	M	H	M	M	L	H	H
Bauhoff, 2014[6]	H	M	L	M	M	H	H
Bauman, 2003[7]	M	H	H	H	H	H	H
Bere, 2010[8]	M	M	H	M	L	M	M
Berger-Jenkins, 2014[9]	H	M	M	M	H	H	H
Bolton, 2017[10]	M	M	L	H	L	H	H
Bowling, 2016[11]	M	M	H	M	L	H	H
Branas, 2011[12]	M	M	H	M	H	H	H
Brown, 2008[13]	H	H	H	M	M	M	H
Brown, 2015[14]	L	M	L	H	L	H	H
Brown, 2016[15]	L	M	L	H	L	H	H
Brown, 2016[16]	M	M	H	H	L	H	H
Burke, 2014[17]	M	M	H	M	L	H	H
Buscail, 2016[18]	H	M	L	H	L	H	H
Caldwell, 2009[19]	M	M	H	H	L	H	H
Calise, 2013[20]	M	H	L	L	M	M	M
Camacho-Rivera, 2017[21]	H	H	L	M	L	H	H
Capogrossi, 2016[22]	L	M	M	M	L	M	L
Cawley, 2007[23]	L	H	M	M	L	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Cawley, 2007[24]	L	H	H	M	L	H	H
Chen, 2015[25]	L	M	L	M	L	H	M
Cleland, 2008[26]	M	H	M	M	L	H	H
Coffield, 2011[27]	H	H	M	M	H	H	H
Cohen, 2012[28]	L	M	H	M	M	H	H
Coyle, 2009[29]	L	M	H	H	L	H	H
Cradock, 2011[30]	L	H	H	M	M	M	H
Cradock, 2014[31]	M	M	M	L	L	L	L
Cullen, 2006[32]	M	M	H	M	H	H	H
Cullen, 2008[33]	L	M	L	H	L	H	H
Cummins, 2005[34]	M	M	L	H	H	H	H
Cummins, 2008[35]	H	H	L	M	M	M	H
Cummins, 2014[36]	M	M	L	M	M	M	L
Datar, 2016[37]	M	H	L	M	L	H	H
de Visser, 2016[38]	H	H	H	M	L	M	H
De Cocker, 2007[39]	M	M	L	H	L	M	M
Dill, 2014[40]	H	M	H	M	M	H	H
Dubowitz, 2015[41]	L	M	L	M	M	M	L
Eagle, 2013[42]	L	M	H	H	L	H	H
Elbel, 2015[43]	H	M	L	H	L	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Elbel, 2017[44]	M	H	L	M	M	H	H
Falbe, 2016[45]	M	H	L	M	L	L	M
Fitzpatrick, 2017[46]	H	M	L	M	M	M	M
Flego, 2014[47]	L	M	L	H	L	H	H
Fogarty, 2007[48]	M	M	H	H	L	H	H
Fox, 2009[49]	H	H	H	M	M	M	H
Frongillo, 2017[50]	H	H	L	H	L	H	H
Fuller, 2013[51]	H	H	H	H	M	M	H
Fung, 2013[52]	H	H	M	H	M	H	H
Gee, 2015[53]	L	H	L	L	L	H	H
Gibson, 2006[54]	M	H	M	M	L	H	H
Giles-Corti, 2013[55]	L	M	H	M	L	L	M
Gleason, 2009[56]	H	H	H	H	L	H	H
Goldsby, 2016[57]	L	M	L	L	M	H	M
Goodman, 2014[58]	L	M	L	H	M	L	M
Goodman, 2016[59]	M	M	L	L	L	L	L
Gorely, 2011[60]	M	M	H	H	L	M	H
Gorham, 2015[61]	M	M	H	H	M	M	H
Harding, 2017[62]	H	M	L	H	L	H	H
Heelan, 2015[63]	L	M	H	M	L	L	M
Hennessy, 2014[64]	L	M	L	L	L	H	M
Herrick, 2012[65]	M	M	H	H	L	L	H
Hilmers, 2014[66]	H	H	M	M	H	H	H
Hobin, 2014[67]	M	M	M	M	H	H	H
Hobin, 2017[68]	M	H	L	M	L	H	H
Hoelscher, 2016[69]	M	M	L	M	L	L	L

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Hoelscher, 2016[70]	M	M	H	H	L	H	H
Howlett, 2016[71]	L	H	H	M	L	H	H
Hu, 2016[72]	M	M	L	M	H	M	M
Hughes, 2012[73]	L	M	L	H	L	H	H
Hunter, 2016[74]	H	M	H	H	M	M	H
Jennings, 2012[75]	L	M	L	H	L	H	H
Jia, 2017[76]	M	H	H	M	H	H	H
Johnson, 2017[77]	M	M	L	M	H	H	H
Just, 2014[78]	M	H	M	M	H	H	H
Kern, 2014[79]	M	M	H	M	H	H	H
Keyte, 2012[80]	H	H	H	M	L	M	H
Kim, 2012[81]	M	H	H	M	M	H	H
King, 2014[82]	M	M	H	M	H	H	H
Kubik, 2005[83]	L	H	H	M	H	H	H
Lachapelle, 2009[84]	H	H	H	H	H	H	H
LaRowe, 2016[85]	H	M	M	M	L	H	H
Leung, 2013[86]	H	H	M	L	M	H	H
Liao, 2015[87]	M	M	H	M	L	H	H
Ling, 2014[88]	L	M	L	H	L	H	H
Liu, 2016[89]	M	H	M	M	H	H	H
MacDonald, 2010[90]	M	M	L	M	L	L	L
Maddock, 2006[91]	M	M	H	M	H	H	H
Madsen, 2011[92]	L	H	L	M	M	M	M
Madsen, 2015[93]	L	H	L	M	H	H	H
Malakellis, 2017[94]	H	H	H	H	L	M	H
Masse, 2014[95]	M	H	H	M	H	M	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Miewald, 2012[96]	M	H	L	H	L	H	H
Miller, 2015[97]	M	M	H	M	L	H	H
Molitor, 2015[98]	M	M	L	M	M	M	L
Morton, 2016[99]	M	M	L	M	L	H	M
Mullally, 2010[100]	L	H	H	M	M	M	H
Mumford, 2011[101]	H	H	L	H	M	M	H
Nanney, 2014[102]	M	M	M	M	L	M	L
Nanney, 2016[103]	L	M	M	M	H	M	M
Benjamin Neelon, 2015[104]	H	M	H	M	M	H	H
Nehme, 2017[105]	H	M	L	H	M	H	H
Nguyen, 2015[106]	L	H	L	M	L	H	H
Oh, 2015[107]	H	H	H	M	L	H	H
Olsho, 2015[108]	M	M	H	H	M	M	H
Panter, 2016[109]	L	M	L	H	L	H	H
Parsons, 2014[110]	M	H	H	M	H	H	H
Peterson, 2015[111]	L	M	L	H	H	H	H
Powell, 2009[112]	M	H	H	L	H	H	H
Quigg, 2012[113]	H	M	L	M	H	L	H
Reger-Nash, 2005[114]	L	M	L	H	L	H	H
Reger-Nash, 2008[115]	H	M	L	M	M	H	H
Restrepo, 2016[116]	M	H	M	H	H	H	H
Ridgers, 2007[117]	M	M	M	M	M	L	L
Ridgers, 2007[118]	H	M	L	M	M	L	M
Riis, 2012[119]	M	H	H	M	L	H	H
Ritchie, 2016[120]	M	H	L	M	L	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Robles, 2017[121]	M	H	H	H	L	H	H
Rushakoff, 2017[122]	H	M	L	H	H	L	H
Sabia, 2016[123]	M	H	L	M	L	H	H
Sadler, 2013[124]	H	M	L	H	H	H	H
Sanchez-Vaznaugh, 2010[125]	L	M	L	M	H	H	H
Schanzenbach, 2005[126]	M	M	L	L	H	H	H
Schwartz, 2016[127]	L	H	L	M	L	M	M
Sekhobo, 2014[128]	L	M	H	M	L	H	H
Slater, 2014[129]	M	H	L	H	H	H	H
Spence, 2013[130]	H	H	H	M	M	H	H
Stephens, 2014[131]	L	H	H	M	L	H	H
Stratton, 2005[132]	M	M	H	H	L	M	H
Sturm, 2010[133]	H	H	H	H	H	H	H
Sturm, 2015[134]	M	H	L	M	H	M	H
Taber, 2011[135]	L	H	H	M	M	M	H
Taber, 2012[136]	M	H	M	H	H	M	H
Taber, 2012[137]	M	M	M	M	L	M	L
Taber, 2012[138]	M	M	H	M	M	M	M
Taber, 2013[139]	M	M	H	M	H	H	H
Tak, 2007[140]	M	M	H	H	L	H	H
Tak, 2009[141]	L	M	L	H	H	M	H
Tester, 2016[142]	L	M	L	M	L	H	M
Toussaint, 2017[143]	M	M	L	M	L	H	M

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Utter, 2016[144]	M	H	L	M	H	H	H
Vadiveloo, 2011[145]	L	H	L	M	M	L	M
Veugelers, 2005[146]	M	H	M	M	M	L	M
von Hippel, 2015[147]	M	M	H	M	M	H	H
Webb, 2012[148]	L	H	L	M	M	M	M
Webb, 2016[149]	M	H	L	M	M	M	M
Wells, 2005[150]	M	M	M	M	M	M	L
West, 2011[151]	H	H	L	H	H	H	H
Whetstone, 2012[152]	H	H	H	M	H	H	H
Woodward-Lopez, 2010[153]	L	M	H	M	L	M	M
Wrigley, 2003[154]	M	M	L	H	H	M	H
Zhu, 2013[155]	H	M	L	H	L	H	H
Zhu, 2014[156]	H	H	L	M	M	M	M
Experimental							
Alaimo, 2013[157]	H	M	L	M	M	M	M
Anderson, 2001[158]	L	M	L	H	L	H	H
Angelopoulos, 2009[159]	M	L	L	M	L	L	L
Ask, 2010[160]	M	H	H	M	M	H	H
Audrey, 2015[161]	H	L	H	H	H	M	H
Ayala, 2013[162]	H	L	H	M	M	M	H
Backman, 2011[163]	L	L	H	H	L	L	H
Baker, 2016[164]	H	M	L	M	H	H	H
Bastian, 2015[165]	M	M	M	M	L	L	L
Bere, 2005[166]	M	M	L	H	L	H	H
Bere, 2006[167]	M	L	H	H	M	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Bere, 2006[168]	H	L	H	M	L	H	H
Bere, 2007[169]	H	L	H	M	L	M	H
Beresford, 2010[170]	M	L	L	H	M	M	M
Blum, 2008[171]	M	L	H	M	L	L	M
Bonsergent, 2013[172]	L	L	L	M	L	M	L
Bonvin, 2013[173]	M	L	L	M	L	L	L
Busch, 2015[174]	M	M	H	H	L	H	H
Caballero, 2003[175]	L	M	H	M	L	L	M
Chomitz, 2010[176]	L	M	L	M	M	H	M
Cochrane, 2012[177]	H	L	L	M	L	L	M
Cohen, 2014[178]	L	L	H	H	M	H	H
Coleman, 2012[179]	H	L	M	M	L	M	M
Cortinez-O'Ryan, 2017[180]	M	M	L	M	L	L	L
Crespo, 2012[181]	M	M	L	H	L	M	M
Day, 2008[182]	M	L	H	H	L	H	H
de Meij, 2011[183]	L	M	L	M	L	M	L
De Coen, 2012[184]	M	M	H	H	L	M	H
De Greef, 2016[185]	M	L	L	H	L	H	H
Dunton, 2015[186]	M	L	L	M	L	M	L
Dzewaltowski, 2009[187]	M	M	L	M	L	H	M

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Economos, 2007[188]	M	M	L	M	L	M	L
Elinder, 2012[189]	M	M	M	H	M	L	M
Eriksen, 2003[190]	H	L	H	M	L	H	H
Ermetici, 2016[191]	M	M	L	H	L	L	M
Esquivel, 2016[192]	M	M	L	M	L	M	L
Evans, 2013[193]	L	L	H	H	M	M	H
Fairclough, 2016[194]	M	H	H	H	L	M	H
Farley, 2007[195]	M	M	H	M	H	H	H
Farmer, 2017[196]	H	L	L	M	L	M	M
Finch, 2014[197]	M	L	H	M	L	H	H
Foster, 2008[198]	M	L	L	M	L	M	L
French, 2010[199]	M	H	H	M	M	H	H
Fu, 2016[200]	M	H	H	M	L	H	H
Gatto, 2017[201]	H	L	L	H	L	L	H
Geaney, 2016[202]	M	L	L	H	M	M	M
Gittelsohn, 2010[203]	M	M	M	M	H	H	H
Gittelsohn, 2013[204]	M	L	M	M	M	H	M
Goetzel, 2010[205]	M	L	L	M	M	H	M
Gustat, 2012[206]	M	M	H	M	L	L	M
Haerens, 2006[207]	L	L	M	H	L	H	H
Haerens, 2007[208]	H	H	L	M	L	H	H
Hardy, 2010[209]	H	H	L	M	M	M	H
He, 2009[210]	M	H	L	H	L	L	H
Hendy, 2011[211]	M	L	L	M	L	H	M
Hoefkens, 2011[212]	M	M	M	M	L	H	M
Hollis, 2016[213]	L	L	L	M	L	L	L

Author, year	**Selection Bias**	**Study Design**	**Con-founders**	**Blinding**	**Data Collection Methods**	**Withdrawals and Drop Outs**	**Overall Rating**
Huberty, 2011[214]	M	L	H	H	L	H	H
Jago, 2011[215]	H	H	L	M	L	M	H
Janssen, 2015[216]	M	L	L	M	L	L	L
Jones, 2015[217]	L	L	L	M	M	L	L
Jordan, 2008[218]	M	L	H	M	M	M	M
Jurg, 2006[219]	L	M	L	M	H	H	H
Kain, 2004[220]	L	M	H	M	L	L	M
Kamada, 2013[221]	M	L	M	L	M	M	L
Kastorini, 2016[222]	H	M	L	M	H	H	H
Kloek, 2006[223]	M	M	H	M	L	M	M
LaCaille, 2016[224]	H	M	L	M	L	M	M
Lemon, 2010[225]	M	L	L	M	L	M	L
Lemon, 2014[226]	H	L	H	H	H	M	H
Lent, 2014[227]	H	L	L	M	H	M	H
Linde, 2012[228]	M	L	L	M	H	L	M
Llargues, 2011[229]	L	L	L	M	L	M	L
Lorentzen, 2009[230]	H	H	L	H	M	H	H
Lubans, 2016[231]	M	L	L	H	M	M	M
Ludwig, 2011[232]	L	L	L	M	L	M	L
Lv, 2014[233]	M	H	H	H	L	M	H
Madsen, 2013[234]	H	H	L	H	M	L	H
Madsen, 2015[235]	M	L	L	M	M	H	M
Mead, 2013[236]	M	H	L	M	L	M	M
Morrill, 2016[237]	L	M	H	M	M	H	H
Murphy, 2011[238]	H	L	H	H	M	L	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Naylor, 2006[239]	H	L	H	M	H	L	H
Naylor, 2008[240]	H	H	L	H	L	L	H
Neumark-Sztainer, 2010[241]	M	L	L	H	L	L	M
Nicklas, 2017[242]	M	L	L	H	H	L	H
Ortega, 2016[243]	M	M	L	M	L	M	L
Pate, 2005[244]	L	L	L	M	M	L	L
Pbert, 2016[245]	M	L	L	M	L	L	L
Perry, 2004[246]	M	H	H	H	H	H	H
Ploeg, 2014[247]	L	M	L	M	M	H	M
Pope, 2016[248]	L	M	H	H	L	M	H
Ransley, 2007[249]	M	L	L	M	L	M	L
Reilly, 2006[250]	L	L	L	L	L	H	M
Reynolds, 2000[251]	L	L	L	H	L	H	H
Ridgers, 2010[252]	M	M	M	M	H	H	H
Rush, 2014[253]	M	H	H	H	M	H	H
Sallis, 2003[254]	M	L	L	H	M	L	M
Sharma, 2016[255]	M	L	L	M	L	M	L
Shive, 2006[256]	M	M	H	H	M	H	H
Sigmund, 2012[257]	H	M	L	M	H	H	H
Simon, 2008[258]	M	L	L	H	L	M	M
Steenhuis, 2004[259]	M	L	H	H	L	H	H
Story, 2012[260]	L	L	L	M	L	H	M
Tarp, 2016[261]	M	L	L	H	L	M	M
Te Velde, 2008[262]	M	H	L	M	L	M	M
Van Cauwen, 2012[263]	H	M	L	M	L	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
Verloigne, 2015[264]	H	M	H	M	L	H	H
Waters, 2017[265]	H	L	L	M	M	H	H
Wells, 2014[266]	M	L	L	M	M	M	L
Wendel, 2016[267]	M	L	L	M	L	H	M
Whitt-Glover, 2011[268]	L	H	L	M	H	M	M
Williamson, 2012[269]	L	L	L	H	L	L	M
Wilson, 2015[270]	M	L	L	M	M	L	L
Wright, 2012[271]	M	L	L	M	M	L	L
Wright, 2013[272]	M	L	L	H	L	M	M
Yildirim, 2014[273]	M	L	L	M	L	H	M
Zhou, 2014[274]	L	M	M	M	L	L	L
Other Study Design							
Ashfield-Watt, 2007[275]	M	M	H	H	M	L	H
Blake, 2013[276]	M	M	L	H	H	M	H
Brownson, 2004[277]	M	L	L	H	L	H	H
Brownson, 2005[278]	L	M	L	H	L	H	H
Brusseau, 2016[279]	M	M	H	M	L	H	H
Cheadle, 2012[280]	H	M	H	M	H	H	H
De Cocker, 2011[281]	H	H	L	M	L	H	H

Author, year	Selection Bias	Study Design	Con-founders	Blinding	Data Collection Methods	Withdrawals and Drop Outs	Overall Rating
de Silva-Sanigorski, 2011[282]	H	H	H	H	M	H	H
Geaney, 2010[283]	H	H	H	M	L	H	H
Gebel, 2011[284]	H	M	L	M	M	M	M
Heelan, 2009[285]	M	M	H	H	L	H	H
Huberty, 2013[286]	H	M	H	M	L	M	H
Kim, 2012[287]	M	M	L	H	H	M	H
Magarey, 2013[288]	M	M	L	M	L	H	M
Naul, 2012[289]	H	H	H	H	H	M	H
Rogers, 2013[290]	H	H	H	M	H	H	H
Tomlin, 2012[291]	M	M	L	H	L	H	H
Vasquez, 2016[292]	M	M	L	M	M	L	L
Weaver, 2017[293]	L	M	L	M	L	H	M
Whaley, 2010[294]	L	M	L	H	L	H	H

EPHPP = Effective Public Health Practice Project*;* H = high risk of bias; L = low risk of bias; M = medium risk of bias

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Appendix L. Comparison of Two Tools for Assessing Study Risk of Bias

Table L1. Comparison of EPHPP and NOS ratings on select natural experiment studies*

	EPHPP							Newcastle-Ottawa Scale		
Author, Year	**Selection Bias**	**Study Design**	**Confounders**	**Blinding**	**Data Collection Methods**	**Withdrawals and Drop Outs**	**Overall rating**	**Selection, Max=4**	**Comparability, Max=2**	**Outcome, Max =3**
Barroso, 2009[1]	M	H	H	M	M	H	H	2	1	2
Berger-Jenkins, 2014[2]	H	H	L	M	H	H	H	2	2	1
Brown, 2015[3]	L	M	L	H	L	H	H	4	2	1
Brown, 2016[4]	L	M	L	H	L	H	H	4	1	2
Calise, 2013[5]	M	H	L	L	M	M	M	3	0	1
Cummins, 2014[6]	M	M	L	H	L	H	H	2	2	1
Jennings, 2012[7]	L	M	L	H	L	H	H	3	0	1
Just, 2014[8]	M	H	H	M	H	H	H	3	0	2
Kim, 2012[9]	M	L	M	M	L	M	H	3	2	1
King, 2014[10]	M	L	H	H	H	M	M	3	0	2
LaRowe, 2016[11]	H	M	M	M	L	H	H	4	1	3
Maddock, 2006[12]	M	H	H	M	L	H	H	3	0	1
Peterson, 2015[13]	L	H	L	M	L	H	H	3	1	2

	EPHPP						Newcastle-Ottawa Scale		
Author, Year	**Selection Bias**	**Study Design**	**Confounders**	**Blinding**	**Data Collection Methods**	**Withdrawals and Drop Outs**	**Overall rating**	**Selection, Max=4**	**Comparability, Max=2**	**Outcome, Max =3**
Reger-Nash, 2008[14]	H	M	L	M	M	H	H	2	1	1
Restrepo, 2016[15]	M	H	M	H	H	H	H	2	2	1
Riis, 2012[16]	M	H	H	M	M	H	H	3	2	1
Taber, 2012[17]	M	H	M	H	H	M	H	2	2	1
Veugelers, 2005[18]	M	L	L	M	M	L	L	2	2	1
Webb, 2012[19]	L	H	M	M	H	H	H	3	2	2
Zhu, 2013[20]	H	M	L	H	L	H	H	2	0	1

EPHPP = Effective Public Health Practice Project; H = high risk of bias; L = low risk of bias; M = medium risk of bias; NOS=Newcastle-Ottawa Scale

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