



Published in final edited form as:

Am J Prev Med. 2025 March ; 68(3): 627–637. doi:10.1016/j.amepre.2024.11.016.

Impact of Fruit and Vegetable Incentive Programs on Food Insecurity, Fruit and Vegetable Consumption, and Health Outcomes: A Community Guide Systematic Review

Renee Stein, PhD¹, Ramona K.C. Finnie, DrPH¹, Stacy Harmon, PhD², Yinan Peng, PhD, MPH¹, Chelsea Pritchard, MPH³, Heather Vecsey, MPH⁴, Karen M. Emmons, PhD⁵, Stephen Hargarten, MD, MPH⁶, Melissa A. Simon, MD, MPH⁷, Heidi M. Blanck, PhD⁸, Diane Harris, PhD, MPH, CHES⁸, Laura Bellows, PhD, MPH, RDN⁹, Alisha Coleman-Jensen, PhD¹⁰, Sheila Fleischhacker, PhD, JD, RDN¹¹, Mallory M. Koenings, PHD, RDN¹², Angela Odoms-Young, PhD⁹, Hilary K. Seligman, MD, MAS¹³, Clint Grant, MSPH¹⁴, Amanda Powell, PhD¹⁵, Community Preventive Services Task Force¹⁶

¹Community Guide Program, Office of Scientific Evidence and Recommendations, Office of Science, Centers for Disease Control and Prevention (CDC), Atlanta, Georgia

²Cherokee Nation Operational Solutions, Arlington, VA

³Office of the Chief Information Officer, Office of the Director, CDC, Atlanta, GA

⁴University of Florida, College of Public Health and Health Professions, Gainesville, FL

⁵Harvard T.H. Chan School of Public Health, Social and Behavioral Sciences Department, Boston MA, United States

⁶Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, WI, USA

Corresponding author: Renee Stein, Community Guide Program, Office of Scientific Evidence and Recommendations, Office of Science, Centers for Disease Control and Prevention, 1600 Clifton Road, Atlanta, GA 30329. rstein1@cdc.gov.

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

CREDIT AUTHOR STATEMENT

Renee Stein: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Software, Supervision, Validation, Writing- original draft, Writing-review and editing. Ramona K.C. Finnie: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Writing- original draft, Writing-review and editing. Stacy Harmon: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Writing- original draft, Writing-review and editing. Yinan Peng: Conceptualization, Data curation, Formal analysis, Methodology, Software, Validation, Writing-review and editing. Chelsea Pritchard: Conceptualization, Data curation, Methodology, Software, Validation, Writing-review and editing. Heather Vecsey: Conceptualization, Data curation, Methodology, Software, Validation, Writing-review and editing. Karen M. Emmons: Conceptualization, Data curation, Supervision, Writing-review and editing. Stephen Hargarten: Conceptualization, Data curation, Supervision, Writing-review and editing. Melissa Simon: Conceptualization, Data curation, Supervision, Writing-review and editing. Heidi M. Blanck: Conceptualization, Data curation, Writing-review and editing. Diane Harris: Conceptualization, Data curation, Writing-review and editing. Laura Bellows: Conceptualization, Data curation, Writing-review and editing. Alisha Coleman-Jensen: Conceptualization, Data curation, Writing-review and editing. Sheila Fleischhacker: Conceptualization, Data curation, Writing-review and editing. Mallory M. Koenings: Conceptualization, Data curation, Writing-review and editing. Angela Odoms-Young: Conceptualization, Data curation, Writing-review and editing. Hilary K. Seligman: Conceptualization, Data curation, Writing-review and editing. Clint Grant: Conceptualization, Data curation, Writing-review and editing. Amanda Powell: Conceptualization, Data curation, Writing-review and editing. Community Preventive Services Task Force: Supervision

⁷Division of General Obstetrics and Gynecology, Department of Obstetrics and Gynecology, Northwestern University Feinberg School of Medicine, Chicago, Illinois

⁸Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC, Atlanta, GA

⁹Division of Nutritional Sciences, College of Human Ecology/College of Agriculture and Life Sciences, Cornell University, Ithaca, New York

¹⁰Food Economics Division, Economic Research Service, United States Department of Agriculture, Washington, DC

¹¹National Institute of Food and Agriculture, United States Department of Agriculture, Washington, DC

¹²Nutrition Division, Institute of Food Safety and Nutrition, National Institute of Food and Agriculture, United States Department of Agriculture, Kansas City, MO

¹³Division of General Internal Medicine, Department of Medicine, University of California, San Francisco, CA

¹⁴Association of State and Territorial Health Officials, Arlington, VA

¹⁵America's Health Insurance Plans Liaison to the Community Preventive Services Task Force, Atlanta, GA

¹⁶Names and affiliations of Community Preventive Services Task Force members can be found at: <https://www.thecommunityguide.org/task-force/community-preventive-services-task-force-members>

Abstract

Introduction: Food and nutrition security is crucial for health, but many U.S. households experience food insecurity. This systematic review conducted in support of the Community Preventive Services Task Force (CPSTF) examines the effectiveness of Fruit and Vegetable Incentive (FVI) programs in reducing food insecurity, increasing fruit and vegetable (FV) consumption, and improving health outcomes among households with lower incomes.

Methods: Community Guide systematic review methods were applied. Studies were identified through a literature search (inception of each database to February 2023). U.S. studies were included if they evaluated programs offering participants financial incentives to purchase FV; were designed for or implemented among populations with lower incomes; reported health-related outcomes; and were published in English as peer-reviewed articles or government reports.

Results: This review included 30 studies. Thirteen of 14 datapoints from 12 studies indicated FVI programs reduced household food insecurity. Twenty-one of 29 datapoints from 23 studies showed increased FV consumption. Programs providing incentives to participants at risk for or with diet-related health conditions improved blood glucose levels by a median of 0.64 percentage points.

Discussion: Based on the review findings, CPSTF recommends FVI programs for populations with lower incomes to reduce household food insecurity, increase household FV consumption,

and improve blood glucose levels in participants at risk for or with diet-related health conditions. Although the review did not find direct evidence of reducing health disparities, the CPSTF expects that these programs will improve health equity across the US by improving the affordability and accessibility of healthier foods for households with lower incomes.

Introduction

Food and nutrition security—consistent and equitable access to healthy, safe, and affordable foods essential to optimal health and well-being—is an important social determinant of health (SDOH).¹ It reduces chronic disease risk, prevents unnecessary healthcare use, and supports overall health.² Food insecurity occurs when a household lacks sufficient resources to acquire adequate food,³ which may lead to higher risks of premature mortality and shorter life expectancy.⁴

In 2023, 13.5% of U.S. households experienced food insecurity, up from 12.8% in 2022.⁵ Food insecurity disproportionately affects households with lower incomes and some racial and ethnic groups. Between 2016 and 2021, 33.4% of households below 130% of the poverty threshold experienced food insecurity, as did 23% of American Indian or Alaska Native households, 21% of Black households, and 17% of Hispanic households.⁶

Research links food insecurity to lower dietary quality, particularly in fruit and vegetable (FV) consumption.⁷ FV consumption accounts for 20% of the overall diet quality score in the Healthy Eating Index (HEI), a measure used to assess how well diets align with dietary guidelines.⁸ FV intake is associated with health benefits, including healthy weight, reduced risk of type 2 diabetes, stroke, cardiovascular disease, cancer, and all-cause mortality.^{9–11} Yet, only 12% of U.S. adults meet fruit intake recommendations, and only 10% meet vegetable intake recommendations.¹² Among individuals with lower incomes and Black individuals, FV intake is notably low, with only 7% meeting daily intake recommendations.¹²

Structural barriers contribute to disparities in food insecurity and FV consumption, including under-resourced food environments that limit access to affordable, nutritious foods.¹³ Lower-income neighborhoods often have a higher concentration of fast food restaurants offering low-cost, low-nutrient foods compared to higher-income areas.¹³ Unfavorable SDOH—such as unstable employment and inadequate housing—further restrict access to nutritious food.¹³

To address these disparities, public health efforts increasingly focus on fruit and vegetable incentive (FVI) programs. These programs respond to evidence that cost is a major barrier to accessing healthy foods, particularly for Supplemental Nutrition Assistance Program (SNAP) recipients.¹⁴ FVI programs provide financial incentives for FV purchases, improving affordability and access and encouraging healthier choices through direct price effects.¹⁴ Some programs also include educational components, like cooking demonstrations and nutrition workshops. FVI programs can be implemented by community-based organizations, governments, and health systems at various locations, including farmers

markets and grocery stores and may take forms such as point-of-sale discounts, rebates, matches, and subsidies.

Engel et al. conducted a scoping review of FVI programs for SNAP participants, summarizing factors influencing their effectiveness and impacts on FV purchases and consumption.¹⁴ This paper presents a Guide to Community Preventive Services (Community Guide) systematic review that expands on previous research by assessing FVI programs' effects on food insecurity, FV consumption, and other health outcomes in populations with lower incomes. An analytic framework illustrating expected outcomes is available from: <https://www.thecommunityguide.org/media/2024/pdf/af-sdoh-fruit-vegetable-incentive-programs-p.pdf>

The Community Guide (<https://www.thecommunityguide.org/>) serves as a repository of recommendations on public health interventions, including modifications to SDOH to improve food and nutrition security (available at <https://www.thecommunityguide.org/topics/social-determinants-health.html>). These evidence-based recommendations are issued by the Community Preventive Services Task Force (CPSTF)—an independent panel of public health experts—based on systematic reviews conducted by the CDC's Community Guide Program and overseen by the CPSTF (<https://www.thecommunityguide.org/pages/about-community-preventive-services-task-force.html>).

Methods

This review employed Community Guide systematic review methods.^{15, 16 17} The *Methods Manual for Community Guide Systematic Reviews* outlines these methods and is available at <https://www.thecommunityguide.org/pages/methods-manual.html>. The review team included experts in food and nutrition security, SDOH, and health equity. It also included experts in systematic review methods from the CDC.

Librarians at CDC's Stephen B. Thacker Library conducted a search for relevant papers published from the inception of each database through February 2023. Databases included CINAHL, Cochrane Library, Embase, Google Scholar, Medline, PsycInfo, Scopus, Sociological Abstracts, and the U.S. Household Food Security Survey (USDA) website. The review team also recommended additional articles for inclusion as they identified them during the review process. The detailed search strategy is available at <https://www.thecommunityguide.org/findings/social-determinants-health-fruit-vegetable-incentive-programs.html>.

Studies were included if they evaluated FVI programs that provided financial incentives for purchasing FV, were designed for or implemented among populations with lower incomes, reported health-related outcomes, were conducted in the US, and were published as peer-reviewed articles or government reports in English. The inclusion criteria for populations with lower incomes were broad, encompassing participants eligible for federal nutrition assistance programs (e.g., SNAP), those reported to have lower incomes, and those residing in areas with limited access to nutritious food.

The review included randomized controlled trials (RCTs), other designs with a concurrent comparison group, and pre-post studies. Studies were excluded if they used cross-sectional designs, directly provided FV directly to participants, or had fewer than 25 participants in the intervention group. Additionally, studies that included FV incentives as part of larger federal nutrition assistance program, such as SNAP, were excluded, as it is difficult to attribute specific outcomes to the FVI component when integrated within broader nutrition assistance programs.

Two review team members independently screened search results using DistillerSR¹⁸ software and abstracted data from qualifying studies into Excel. Any disagreements during screening or data abstraction were reconciled through consensus. Data abstraction included participant demographics, setting and intervention characteristics, and outcomes of interest.

Reviewers assessed study quality based on program, population, and sampling frame description; the validity and reliability of program exposure and outcome assessment; description and use of analytic methods; attrition rates (less than 20% lost to follow-up); and control for confounding and biasing factors.^{16, 17} These criteria were part of a quality of execution assessment framework described in detail in the *Methods Manual for Community Guide Systematic Reviews*.^{16, 17} Studies were rated as having good (0–1 limitations), fair (2–4 limitations), or limited (>4 limitations) quality of execution, and studies rated as limited quality of execution were excluded.^{15, 16, 17}

The primary outcomes of interest were household food insecurity, FV consumption, and physical health outcomes. Food insecurity is commonly assessed using the USDA's U.S. Household Food Security Survey Module, which classifies food security into four categories: very low, low, marginal, and high.¹⁹ Effect sizes indicating reduced food insecurity suggest favorable intervention effects. Regardless of the version of the USDA module used, these categories allow for the combination of measures. In this analysis, the low and very low categories were combined into a single measure of food insecurity.

Measures of FV consumption—servings, cups, times per day, and whether daily recommendations were met—were abstracted, along with other dietary measures like diet quality and sugar-sweetened beverage intake. Physical health outcomes of interest included blood glucose (hemoglobin A1C), blood pressure, body mass index (BMI), cholesterol, and self-reported health quality.

Summary effect measures, including median absolute changes with interquartile intervals (IQIs), were calculated when 4 or more datapoints (effect sizes reported by studies or derived from pre- and post- intervention measures) were available for an outcome. For studies with multiple intervention arms, each effect size compared to the control group was included. Both statistically significant and non-statistically significant effect measures were included in the analysis. When fewer than 4 datapoints were reported for an outcome, or when outcomes could not be combined, individual study results were summarized narratively.

Absolute change was calculated using reported effect sizes or derived from pre- and post-intervention measures when available. For studies with a concurrent comparison group, the

effect estimate was determined as the difference in pre-post changes between intervention (I) and comparison (C) groups: $(I_{\text{post}} - I_{\text{pre}}) - (C_{\text{post}} - C_{\text{pre}})$. For studies without a concurrent comparison group, it was calculated as the difference between pre- and post- measurements for the intervention group: $I_{\text{post}} - I_{\text{pre}}$.

The pre-intervention measure (baseline) was the one taken nearest to the start of the intervention, while the post-intervention measure was either the last measure taken while incentives were still being provided or, if that was not available, the nearest measure taken after the intervention ended.

In addition to evaluating the effectiveness of FVI programs, the team systematically assessed the applicability of findings across populations, settings, and intervention characteristics. Key applicability factors were identified at the outset, and a priori hypotheses were developed based on theoretical frameworks and team expertise. To evaluate applicability, the team gathered and analyzed data on differences among study participants, settings, and intervention characteristics. This included examining the effectiveness of FVI programs across diverse populations and conditions, as well as considering within-study stratified analyses. Conclusions on applicability were based on the consistency of results across these factors to determine the generalizability of FVI programs to various populations and settings.

Results

Figure 1 summarizes the search process and yield. The search identified 16,633 potentially relevant publications identified through the librarian's database search, along with an additional 6 publications recommended by the team. After full-text screening of 204 publications, 31 studies advanced to the quality of execution assessment (Figure 1).^{20–50} Summaries of the included studies are available at <https://www.thecommunityguide.org/media/2024/pdf/set-sdoh-fruit-vegetable-initiatives-508.pdf>.

A variety of study designs were included to evaluate the effectiveness of FVI programs. Eligible studies included individual RCTs;^{22, 27, 33, 38, 50} pre-post studies with concurrent comparison groups;^{20, 34, 42, 43, 49} retrospective cohort studies;²⁸ single group pre-post studies;^{21, 23–26, 30–32, 35–37, 39–41, 44–48} and time series studies without a concurrent comparison group.²⁹

The quality of execution of these studies was assessed to identify internal and external threats to validity. Eight studies were rated as having good quality of execution,^{22–24, 35, 45–47, 50} while 22 had fair quality.^{20, 27, 28, 33, 34, 38, 42, 43, 49, 21, 25, 26, 29–32, 37, 39–41, 44, 48} One study with limited quality of execution was excluded,³⁶ resulting in a total of 30 included studies. Common limitations included high attrition (over 20%)^{20–22, 25, 29–32, 34, 35, 37, 38, 40, 42–44, 47–49} and sampling issues, such as unclear definitions of sampling frames or screening criteria and low participation rates.^{21, 23, 24, 26, 27, 29, 31–34, 37–39, 41, 49}

Appendix Table 1 provides study and FVI program characteristics. Most studies were published between 2016 and 2022. Studies were conducted in all four U.S. regions and were predominantly based in urban areas.^{23–29, 33, 34, 42–46, 48, 50}

Nearly half of the FVI programs offered incentives for purchasing FV through produce prescriptions from healthcare providers, ^{26–29, 32, 35, 37, 39, 41, 45–49} primarily for participants at risk for or with diet-related health conditions. ^{26–29, 32, 39, 41, 47, 48} More than half of the programs incorporated education on nutrition or diet-related disease prevention. ^{20, 22, 25–29, 31, 32, 35, 38, 41, 47–50} Incentives could be redeemed at farmers' markets, ^{20, 21, 25–30, 40, 41, 44–48, 50} grocery stores, ^{31, 35, 38} or both. ^{22–24, 32, 34, 37, 42, 43, 49}

Most programs offered incentives in the form of subsidies ^{20, 23–29, 31, 32, 34, 35, 37, 41–43, 45–48, 50} or matches. ^{21, 22, 30, 33, 40, 44} For studies where monthly maximum incentives could be calculated, the median was \$40 (IQI: \$20 to \$60), with dollar amounts reported reflecting the year the study was conducted. ^{22–24, 26, 31, 34, 40, 42, 43} Nearly a quarter of studies reported scaling the incentive amount by household size. ^{20, 29, 32, 33, 35, 41, 48} The frequency of incentive distribution varied, with most incentives being received at program site visits or redemption venues, ^{21, 22, 25, 27, 30, 33, 38, 40, 44, 46, 47} or disseminated monthly. ^{23, 32, 35, 41–43, 48} The median program duration was six months (IQI: 3.4 months to 6 months). ^{20–27, 29–35, 38, 41, 42, 45–48}

Table 1 presents the demographic characteristics of study participants. All studies were conducted among populations with lower incomes, with 55% of participants receiving SNAP benefits. ^{21–23, 25, 29–31, 35, 37, 38, 45, 47–49} Participants had a median age of 42 years. ^{20–27, 30, 33–35, 38–40, 43–48, 50} The median percentage of female participants across the studies was 72%. ^{21–27, 29–31, 33–35, 37–41, 44–50} Among studies reporting race and ethnicity, the median percentage self-identifying as Hispanic or Latino was 37%; ^{20–27, 29–34, 37, 39–44, 48–50} Black or African American was 28%; ^{20–29, 31, 33, 34, 37, 39–50} White was 27%; ^{20–22, 25–34, 37–44, 46, 48–50} Native Hawaiian or Other Pacific Islander was 14%; ³⁹ Asian American was 9%; ^{25, 31, 34, 39, 40, 42, 44} two or more races accounted for 3%; ^{29, 33, 39, 43} and American Indian or Alaska Native made up 2%. ^{34, 35, 39, 42} One study was conducted on tribal lands (Navajo Nation). ^{34, 35, 39, 42} Most participants (65%) had a high school education or higher. ^{20, 22–24, 29, 31, 37, 41, 46, 47, 50}

Table 2 reports summary measures of outcome findings for which there were 4 or more datapoints. Findings with fewer than 4 datapoints or from studies reporting measures that could not be combined are described narratively in the text. Figure 2 is a scatterplot illustrating the effects of FVI programs on food insecurity, stratified by studies with the greatest suitability of design (pre-post with comparison group) at the top and those with the least suitability (single group pre-post) at the bottom. Effect sizes less than 0 indicate a decrease in food insecurity, favoring the intervention.

Twelve studies reported household food insecurity using the USDA's U.S. Household Food Security Survey Module. ^{24, 29, 30, 33, 35, 39, 41–44, 46, 49} The original USDA module includes 6 items measuring food insecurity over the past 12 months. Ten studies used this 6-item module; with 8 not specifying the assessment time frame, ^{24, 29, 35, 39, 42–44, 46} and 2 assessing food insecurity over the past 30 days. ^{30, 33} One study used the 18-item module to measure food insecurity over the past 3 months, ⁴¹ while another employed the 10-item module to assess the past 30 days. ⁴⁹ Additionally, one study assessed food insecurity among children using the 9-question Self-Administered Food Security Survey Module for Youth. ⁴⁶

Seven of the 12 studies examined the change in the percentage of participants experiencing food insecurity. In these studies, FVI programs reduced the percentage of participants with food insecurity by a median of 18.00 percentage points (IQI=-25.95 to -12.30, 7 studies with 8 datapoints)^{29, 30, 33, 35, 39, 41, 43} (Figure 2). The remaining 5 studies could not be combined with the previously mentioned studies because they did not report percentages of participants experiencing food insecurity. Instead, one study used odds ratios to measure changes, while the others analyzed differences in module scale scores to assess variations in food security levels. Of these studies, 3 datapoints from 2 studies showed significant reductions in food insecurity;^{44, 46} 2 studies reported non-significant reductions (arm 1: OR=0.70, NS; arm 2: OR=0.75, NS)²⁴(adjusted mean difference=0.05; 95% CI: -0.35, 0.44);⁴² and 1 study reported no change.⁴⁹ Overall, 13 of 14 datapoints from 12 studies reported that FVI programs reduced household food insecurity.

FV consumption was assessed through dietary recalls and surveys, with 23 studies reporting outcomes in servings per day, cups per day, number of times per day, or other frequency measures of consumption.^{20-25, 30, 31, 33-35, 37-40, 42-49} Five studies (7 datapoints) measured servings per day, showing an increase of 1.10 servings per day (IQI=0.30 to 1.60; 5 studies with 7 datapoints).^{31, 33-35, 47} Additionally, one study that could not be combined with others reported a significant increase in FV servings per day post-FVI program implementation (OR=1.02; 95% CI: 1.01, 1.03; p=0.003).⁴⁰

Eight studies (10 datapoints) measured cups of FV consumed per day. Five programs showed an increase in FV consumption by a median of 0.13 cups (IQI=0.10 to 0.30; 8 studies with 10 datapoints).^{22-24, 37, 39, 42, 45, 46} One study⁴⁹ narratively described cups consumed per day and found no change. Another study⁴⁰ reported on half-cup servings per day and found an insignificant decrease in consumption for both children (absolute difference=-0.26, NS) and adults (absolute difference=-0.22, NS). Jones et al. (2020)³⁵ reported a statistically significant 16 percentage point increase in the number of children meeting the American Academy of Pediatrics recommendation of ≥ 5 servings per day.

Five studies^{21, 25, 30, 43, 48} analyzed the number of times FV were consumed per day, reporting a median increase of 0.49 times (IQI=-0.07 to 0.61). Two studies^{20, 44} reported frequency measures that couldn't be combined, with one study²⁰ reporting no change in consumption, and the other⁴⁴ reporting a nonsignificant increase (absolute difference=0.7, p=0.10). Overall, 21 of 29 datapoints from 23 studies showed increased FV consumption, 5 showed no change, and 3 showed a decrease.

Diet quality was assessed using either the Healthy Eating Index (HEI) or a self-reported measure ranging from very healthy to very unhealthy. The HEI (0-100) score compares consumption to USDA dietary recommendations, with higher scores indicating better dietary quality.⁵¹ FVI programs increased HEI scores by a median of 1.50 points (IQI=0.93 to 4.88; 6 datapoints from 3 studies).^{23, 24, 33} One study⁴⁰ reported a significant improvement in self-reported diet quality (OR =1.10; CI: 1.09, 1.11; p<0.001). Another study reported a decrease of 0.14 sodas per day (p<0.005),²⁵ and two arms of another study showed a 0.5 reduction in servings of sugar-sweetened beverages (p<0.05)³³. Overall, 3 studies reported improvements in diet quality, while 4 showed no change.

Studies measuring blood glucose, blood pressure, and cholesterol limited participation to individuals at risk for or with diet-related health conditions. Among these participants, FVI programs reduced blood glucose A1C levels by a median of 0.64 percentage points (IQI = -1.33 to 0.08; 6 studies).^{26, 27, 29, 32, 48, 50} Additionally, systolic blood pressure decreased by a median of 0.49 mmHg (IQI = -2.49 to 3.45; 5 studies) and diastolic blood pressure by 0.40 mmHg (IQI = -1.19 to 0.83; 5 studies).^{26, 27, 29, 48, 50} One study found no significant impact on total cholesterol, low-density lipoprotein, high-density lipoprotein, or triglycerides.⁵⁰

FVI programs showed no impact on adult BMI with a change of -0.05 kg/m² (IQI = -0.57 to 0.10; 7 datapoints from 6 studies).^{27-29, 33, 48, 50} However, Jones et al.³⁵ found a statistically significant reduction in BMI percentile among children who were overweight or had obesity at baseline. One study³⁹ measured participants' self-reported health and found a 3.6 percentage point increase in those describing their health as "good," "very good," or "excellent." Community Guide methods assess the applicability of FVI programs across different settings, populations, and intervention characteristics.¹⁷ This review indicates that findings are applicable across various contexts, including different regions of the US, varying population densities, males and females, all age groups, diverse races and ethnicities, and to populations with lower incomes and differing education levels. Several studies conducted stratified analyses for different subgroups: sex^{22, 39, 41, 45, 46} (n=5); age^{22, 32, 39, 41, 45, 46} (n=6); race/ethnicity^{22, 32, 39, 41, 45, 46} (n=6); educational level^{22, 41, 45, 46} (n=4); nutrition assistance program participation^{22, 38, 41, 45} (n=4); and employment status⁴⁵ (n=1). However, overall, the analyses did not reveal differences in effectiveness among the subgroups examined.

Discussion

The findings from this systematic review formed the basis for the CPSTF recommendation of FVI programs for households with lower incomes due to their strong effectiveness in reducing household food insecurity, increasing FV consumption, and improving blood glucose levels among participants at risk for or with diet-related health conditions. CPSTF also highlights these programs' potential to improve health equity across the US by making healthier foods more affordable and accessible to households with lower incomes.

Twelve studies reported on food insecurity, with 7 showing a median reduction of 18 percentage points among participants. The remaining 5 studies, using non-combinable measures, showed a general trend toward reductions. Twenty-three studies assessed FV consumption, with the majority showing overall increases. Lastly, 6 studies found that FVI programs for individuals at risk for or with diet-related health conditions reduced blood glucose A1C levels by a median of 0.64 percentage points.

The substantial reduction in food insecurity underscores the effectiveness of FVI programs in improving food access for households with lower incomes. Food insecurity occurs when a household is unable to consistently obtain adequate food due to financial constraints or limited resources.³ This situation is often exacerbated by economic or national crises, such as the COVID-19 pandemic. FVI programs provide direct financial incentives to help offset

the cost of FV, which can be prohibitively expensive for these families. When integrated with broader food assistance initiatives like SNAP or the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), FVI programs strengthen food support systems and promote health equity for those facing economic hardship.⁵²

The observed increases in FV consumption align with the national objectives set by Healthy People 2030, which targets incremental increases of 0.05 cups of fruits and 0.08 cups of vegetables per 1,000 calories.^{53, 54} This review indicates that FVI programs may help participants reach these targets, demonstrating median increases of 1.10 servings, 0.13 cups, and 0.49 times per day. By providing financial incentives that enhance the affordability and accessibility of FV, FVI programs can help individuals and families with limited resources meet dietary guidelines and advance public health nutrition goals.

The reduction in blood glucose A1C levels underscores the potential of FVI programs to benefit individuals at risk for or living with diet-related health conditions, such as diabetes. Research indicates that increasing FV consumption is important for managing blood glucose levels.⁵⁵ By enhancing the accessibility and affordability of healthier food options, FVI programs support dietary changes that can improve blood glucose management and contribute to better health equity for underserved populations.

Three key evidence gaps exist for future research on FVI programs. First, most studies evaluated outcomes while incentives were still being provided, which limits insights into the long-term effects and sustainability of these changes after program completion. Future studies could explore the enduring impacts beyond the active program period. Second, while findings are broadly applicable to populations with lower incomes, there is limited information on specific groups, such as children in incentivized households. Since most studies focused on overall household consumption, future research could investigate how FVI programs affect children's consumption patterns and identify strategies to enhance program effectiveness for this demographic. Finally, more research is needed to understand how to tailor FVI programs for different groups to optimize incentive redemption.

Limitations

This review has several limitations. Over half of the included studies reported more than 20% attrition, and 15 studies had unclear sampling frames, screening criteria, or low participation rates. Additionally, FV consumption was assessed through self-reports, which may introduce potential recall and social desirability bias. The measurement of FV consumption and food insecurity varied across studies, limiting the ability to pool effect estimates. To address this issue, the team grouped measures by outcome type and pooled them when possible, providing narrative descriptions for results that could not be pooled. Furthermore, the review could not isolate the impacts of FVI programs that included nutritional education components, limiting the ability to determine the specific effects of the financial incentives alone. Finally, while the literature search was rigorous and comprehensive, it is important to acknowledge the potential for missed studies, which is a common limitation in systematic reviews.

Conclusions

Food and nutrition security is essential for health, as it helps to reduce chronic disease risks and prevent premature mortality. However, many households in the US continue to struggle to access affordable, healthy foods, including FV, which exacerbates health disparities. This review highlights the effectiveness of FVI programs in reducing household food insecurity, increasing FV consumption, and improving blood glucose levels among households with lower incomes. The findings can inform public health decision makers about effective strategies to enhance food and nutrition security and improve overall population health.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Denise Farley and Yolanda Strayhorn from the Centers for Disease Control and Prevention (CDC) Stephen B. Thacker Library for conducting the systematic literature search, as well as the Community Guide Program at CDC for scientific and dissemination assistance. The contributions of Chelsea Pritchard and Heather Vecsey were supported by the Virtual Student Federal Service Internship Program, a program run by the U.S. Department of State.

STUDY FUNDING

This review was partially funded by the National Institutes of Health, Office of Disease Prevention.

FINANCIAL DISCLOSURES

None of the following authors have financial disclosures: Renee Stein, Ramona K.C. Finnie, Stacy Harmon, Yinan Peng, Heather Vecsey, Karen M. Emmons, Stephen Hargarten, Melissa A. Simon, Heidi M. Blanck, Diane Harris, Laura Bellows, Alisha Coleman-Jensen, Sheila Fleischhacker, Mallory M. Koenings, Angela Odoms-Young, Clint Grant, and Amanda Powell. Hilary Seligman received support from the National Institute of Diabetes and Digestive and Kidney Diseases funded DREAMS Center for Diabetes Translation Research under award number P30DK092924.

Disclaimer statements:

The findings and conclusions in this publication are those of the authors and do not necessarily represent any official position or policy of CDC, USDA, or the U.S. Government. The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, DC 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer.

REFERENCES

1. U.S. Department of Agriculture. Food and nutrition security. 2024 Accessed 10/21/2024. Available from: <https://www.usda.gov/nutrition-security>.
2. Mozaffarian D, Blanck HM, Garfield KM, et al. A food is medicine approach to achieve nutrition security and improve health. *Nat Med*. 2022;28:2238–40. 10.1038/s41591-022-02027-3. [PubMed: 36202998]
3. Rabbitt MP, Hales LJ, Burke MP, Coleman-Jensen A. Household food security in the United States in 2022 (Report No. ERR-325). U.S. Department of Agriculture, Economic Research Service; 2023. 10.22004/ag.econ.338945.

4. Ma H, Wang X, Li X, et al. Food insecurity and premature mortality and life expectancy in the US. *JAMA Intern Med.* 2024. 10.1001/jamainternmed.2023.7968.
5. Rabbitt MP, Reed-Jones M, Hales LJ, Burke MP. Household food security in the United States in 2023 (Report No. ERR-337). U.S. Department of Agriculture, Economic Research Service. 2024. 10.32747/2024.8583175.ers.
6. Hales LJ, Coleman-Jensen A. Household food insecurity across race and ethnicity in the United States, 2016-21(Report No. EIB-269). U.S. Department of Agriculture, Economic Research Service. 2024.
7. Hanson KL, Connor LM. Food insecurity and dietary quality in US adults and children: a systematic review. *Am J Clin Nutr.* 2014;100(2):684–92. 10.3945/ajcn.114.084525. [PubMed: 24944059]
8. U.S. Department of Agriculture Food and Nutrition Service. How the HEI is scored 2023 Accessed 10/20/2024. Available from: <https://www.fns.usda.gov/cnpp/how-hei-scored>.
9. Arnotti K, Bamber M. Fruit and vegetable consumption in overweight or obese individuals: a meta-analysis. *West J Nurs Res.* 2019;42(4). 10.1177/0193945919858699.
10. Dagfinn A, Giovannucci E, Boffetta P, et al. Fruit and vegetable intake and the risk of cardiovascular disease, total cancer and all-cause mortality—a systematic review and dose-response meta-analysis of prospective studies. *Int J Epidemiol.* 2017. 46(3):1029–56. 10.1093/ije/dyw319. [PubMed: 28338764]
11. Wang P, Fang J, Gao Z, et al. Higher intake of fruits, vegetables or their fiber reduces the risk of type 2 diabetes: a meta-analysis. *J Diabetes Investig.* 2016;7:56–9. 10.1111/jdi.12376.
12. Lee SH, Moore LV, Park S, et al. Adults meeting fruit and vegetable intake recommendations—United States, 2019. *MMWR Morb Mortal Wkly Rep.* 2022;71:1–9. 10.15585/mmwr.mm7101a1. [PubMed: 34990439]
13. Odoms-Young A, Brown AGM, Agurs-Collins T, Glanz K. Food insecurity, neighborhood food environment, and health disparities: state of the science, research gaps and opportunities. *Am J Clin Nutr.* 2024;119(3):850–61. 10.1016/j.ajcnut.2023.12.019. [PubMed: 38160801]
14. Engel K, Ruder EH. Fruit and vegetable incentive programs for Supplemental Nutrition Assistance Program (SNAP) participants: a scoping review of program structure. *Nutrients.* 2020;12(6). 10.3390/nu12061676.
15. Briss P, Zaza S, Pappaioanou M, Fielding J, Wright-De Agüero L, Truman B, et al. Developing an evidence-based guide to Community Preventive Services—methods. The Task Force on Community Preventive Services. *Am J Prev Med.* 2000;18(15):35–43. 10.1016/s0749-3797(99)00119-1. [PubMed: 10806978]
16. Zaza S, Wright-De Agüero LK, Briss PA, Truman BI, Hopkins DP, Hennessy MH, et al. Data collection instrument and procedure for systematic reviews in the Guide to Community Preventive Services. Task Force on Community Preventive Services. *Am J Prev Med.* 2000;18(Suppl 1):44–74. 10.1016/s0749-3797(99)00122-1. [PubMed: 10806979]
17. Guide to Community Preventive Services. Community Guide Methodology. 2023. Accessed February 9, 2024. Available from: <https://www.thecommunityguide.org/pages/methods-manual.html>. Page last updated: September 2, 2021.
18. DistillerSR. Version 2.35 DistillerSR Inc.; 2021. Accessed October 21, 2024. Available from: <https://www.distillersr.com/>.
19. U.S. Department of Agriculture. Definitions of Food Security. Accessed 10/21/2024. Available from: <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/definitions-of-food-security/>.
20. Anliker JA, Winne M, Drake LT. An evaluation of the Connecticut Farmers' Market coupon program. *J Nutr Educ Behav.* 1992;24(4):185–91. 10.1016/S0022-3182(12)81152-6.
21. Atoloye AT, Savoie-Roskos MR, Durward CM. Higher fruit and vegetable intake is associated with participation in the Double Up Food Bucks (DUFb) program. *Nutrients.* 2021;13(8):29. 10.3390/nu13082607.
22. Bartlett S, Klerman J, Olsho L, Logan C, Blocklin M, Beauregard M, et al. Evaluation of the Healthy Incentives Pilot (HIP): final report. Prepared by Abt Associates for the U.S. Department of Agriculture, Food and Nutrition Service. 2014. Accessed October 21, 2024. Available

from: <https://www.abtglobal.com/insights/publications/report/evaluation-of-the-healthy-incentives-pilot-hip-final-report>.

23. Basu S, Akers M, Berkowitz SA, Josey K, Schillinger D, Seligman H. Comparison of fruit and vegetable intake among urban low-income US adults receiving a produce voucher in 2 cities. *JAMA Network Open*. 2021;4(3):e211757. 10.1001/jamanetworkopen.2021.1757. [PubMed: 33749765]
24. Basu S, Gardner CD, White JS, Rigdon J, Carroll MM, Akers M, et al. Effects of alternative food voucher delivery strategies on nutrition among low-income adults. *Health Aff (Millwood)*. 2019;38(4):577–84. 10.1377/hlthaff.2018.05405. [PubMed: 30933599]
25. Bowling AB, Moretti M, Ringelheim K, Tran A, Davison K. Healthy Foods, Healthy Families: combining incentives and exposure interventions at urban farmers' markets to improve nutrition among recipients of US federal food assistance. *Health Promot*. 2016;6(1):10–6. 10.15171/hpp.2016.02.
26. Bryce R, Guajardo C, Ilarraza D, Milgrom N, Pike D, Savoie K, et al. Participation in a farmers' market fruit and vegetable prescription program at a federally qualified health center improves hemoglobin A1C in low income uncontrolled diabetics. *Prev Med Rep*. 2017;7:176–9. 10.1016/j.pmedr.2017.06.006. [PubMed: 28702315]
27. Bryce R, Wolfson Bryce JA, Cohen Bryce A, Milgrom N, Garcia D, Steele A, et al. A pilot randomized controlled trial of a fruit and vegetable prescription program at a federally qualified health center in low income uncontrolled diabetics. *Prev Med Rep*. 2021;23:101410. 10.1016/j.pmedr.2021.101410. [PubMed: 34150472]
28. Cavanagh M, Jurkowski J, Bozlak C, Hastings J, Klein A. Veggie Rx: an outcome evaluation of a healthy food incentive programme. *Public Health Nutr*. 2017;20(14):2636–41. 10.1017/S1368980016002081. [PubMed: 27539192]
29. Cook M, Ward R, Newman T, Berney S, Slagel N, Bussey-Jones J, et al. Food security and clinical outcomes of the 2017 Georgia Fruit and Vegetable Prescription Program. *J Nutr Educ Behav*. 2021;53(9):770–8. 10.1016/j.jneb.2021.06.010. [PubMed: 34509277]
30. Durward CM, Savoie-Roskos M, Atoloye A, Isabella P, Jewkes MD, Ralls B, et al. Double Up Food Bucks participation is associated with increased fruit and vegetable consumption and food security among low-income adults. *J Nutr Educ Behav*. 2019;51(3):342–7. 10.1016/j.jneb.2018.08.011. [PubMed: 30341007]
31. Fertig AR, Tang X, Dahlen HM. The effect of a fresh produce incentive paired with cooking and nutrition education on healthy eating in low-income households: a pilot study. *Public Health Nutr*. 2021;24(9):2704–14. 10.1017/S1368980021000094. [PubMed: 33431079]
32. Gordon B, Ridinger S, Krick R, Grosvenor L, Charron R. Fruit and vegetable prescription program for diabetes control among community health centers in rural Idaho and Oregon. *Am J Public Health*. 2022;112(7):975–9. 10.2105/AJPH.2022.306853. [PubMed: 35617654]
33. Harnack L, Oakes JM, Elbel B, Beatty T, Rydell S, French S. Effects of subsidies and prohibitions on nutrition in a food benefit program: a randomized clinical trial. *JAMA Intern Med*. 2016;176(11):1610–8. 10.1001/jamainternmed.2016.5633. [PubMed: 27653735]
34. Herman DR, Harrison GG, Afifi AA, Jenks E. Effect of a targeted subsidy on intake of fruits and vegetables among low-income women in the Special Supplemental Nutrition Program for Women, Infants, and Children. *Am J Public Health*. 2008;98(1):98–105. 10.2105/AJPH.2005.079418. [PubMed: 18048803]
35. Jones LJ, VanWassenhove-Paetzold J, Thomas K, Bancroft C, Ziatyk EQ, Kim LS, et al. Impact of a fruit and vegetable prescription program on health outcomes and behaviors in young Navajo children. *Curr Dev Nutr*. 2020;4(8):nzaa109. 10.1093/cdn/nzaa109. [PubMed: 32734135]
36. Lyonnais MJ, Kaur AP, Rafferty AP, Johnson NS, Jilcott Pitts S. A mixed-methods examination of the impact of the partnerships to improve community health produce prescription initiative in northeastern North Carolina. *J Public Health Manag Pract*. 2022;28(3):233–42. 10.1097/PHH.0000000000001490. [PubMed: 35121710]
37. Lyonnais MJ, Rafferty AP, Spratt S, Jilcott Pitts S. A produce prescription program in eastern North Carolina results in increased voucher redemption rates and increased fruit and vegetable intake among participants. *Nutrients*. 2022;14(12):11. 10.3390/nu14122431.

38. Moran A, Thorndike A, Franckle R, Boulos R, Doran H, Fulay A, et al. Financial incentives increase purchases of fruit and vegetables among lower-income households with children. *Health Aff (Millwood)*. 2019;38(9):1557–66. 10.1377/hlthaff.2018.05420. [PubMed: 31479362]
39. Gus Schumacher Nutrition Incentive Program (GusNIP) Nutrition Incentive Program Training TA, Evaluation and Information Center (NTAE). Gus Schumacher Nutrition Incentive Program (GusNIP): impact findings year 3: September 1, 2021 to August 31, 2022. Prepared for U.S. Department of Agriculture, National Institute of Food and Agriculture; 2023. Accessed October 21, 2024. Available from: <https://nutritionincentivehub.org/gusnip-ntae-y3-impact-findings>.
40. Ratigan AR, Lindsay S, Lemus H, Chambers CD, Anderson CA, Cronan TA, et al. Factors associated with continued participation in a matched monetary incentive programme at local farmers' markets in low-income neighbourhoods in San Diego, California. *Public Health Nutr* 2017;20(15):2786–95. 10.1017/S1368980017001549. [PubMed: 28756784]
41. Ridberg RA, Bell JF, Merritt KE, Harris DM, Young HM, Tancredi DJ. A pediatric fruit and vegetable prescription program increases food security in low-income households. *J Nutr Educ Behav*. 2018;51(2):224–30.e1. 10.1016/j.jneb.2018.08.003. [PubMed: 30224295]
42. Ridberg RA, Levi R, Marpadga S, Akers M, Tancredi DJ, Seligman HK. Additional fruit and vegetable vouchers for pregnant WIC clients: an equity-focused strategy to improve food security and diet quality. *Nutrients*. 2022;14(11):01. 10.3390/nu14112328.
43. Ridberg RA, Marpadga S, Akers MM, Bell JF, Seligman HK. Fruit and vegetable vouchers in pregnancy: preliminary impact on diet & food security. *J Hunger Environ Nutr*. 2021;16(2):149–63. 10.1080/19320248.2020.1778593.
44. Savoie-Roskos M, Durward C, Jeweks M, LeBlanc H. Reducing food insecurity and improving fruit and vegetable intake among farmers' market incentive program participants. *J Nutr Educ Behav*. 2016;48(1):70–6.e1. 10.1016/j.jneb.2015.10.003. [PubMed: 26598911]
45. Saxe-Custack A, LaChance J, Hanna-Attisha M. Child consumption of whole fruit and fruit juice following six months of exposure to a pediatric fruit and vegetable prescription program. *Nutrients*. 2019;12(1):20. 10.3390/nu12010025. [PubMed: 31861789]
46. Saxe-Custack A, LaChance J, Jess J, Hanna-Attisha M. Influence of a pediatric fruit and vegetable prescription program on child dietary patterns and food security. *Nutrients*. 2021;13(8):29. 10.3390/nu13082619.
47. Trapl ES, Smith S, Joshi K, Osborne A, Benko M, Matos AT, et al. Dietary impact of produce prescriptions for patients with hypertension. *Prev Chronic Dis*. 2018;15:E138. 10.5888/pcd15.180301. [PubMed: 30447106]
48. Veldheer S, Scartozzi C, Bordner CR, Opara C, Williams B, Weaver L, et al. Impact of a prescription produce program on diabetes and cardiovascular risk outcomes. *J Nutr Educ Behav*. 2021;53(12):1008–17. 10.1016/j.jneb.2021.07.005. [PubMed: 34426064]
49. Vericker T, Dixit-Joshi S, Taylor J, Giesen L, Gearing M, Baier K, et al. The evaluation of food insecurity nutrition incentives (FINI) interim report. Prepared by Westat, Inc. for the U.S. Department of Agriculture, Food and Nutrition Service. 2019. Accessed October 21, 2024. Available at https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwif2vPavsOJAxW4RjABHeSoK5EQFnoECBYQAQ&url=https%3A%2F%2Fwww.westat.com%2Fwp-content%2Fuploads%2Flegacy%2FFINI-Infgrphc-Overview-508.pdf&usg=AOvVaw0fphnBn83e_kN6wnhZEcVi&opi=89978449.
50. Weinstein E, Galindo RJ, Fried M, Rucker L, Davis NJ. Impact of a focused nutrition educational intervention coupled with improved access to fresh produce on purchasing behavior and consumption of fruits and vegetables in overweight patients with diabetes mellitus. *Diabetes Educ*. 2014;40(1):100–6. 10.1177/0145721713508823. [PubMed: 24159007]
51. U.S. Department of Agriculture Food and Nutrition Service. Healthy Eating Index. Accessed 10/21/2024. Available from: <https://www.fns.usda.gov/cnpp/healthy-eating-index-hei>.
52. Fleischhacker S, Bleich S. Addressing food insecurity in the United States during and after the COVID-19 pandemic: the role of the federal nutrition safety net. *J of Food Law and Policy*. 2021;17(1). Accessed October 21, 2024. Available from <https://scholarworks.uark.edu/Ujflp/vol17/iss1/8>.

53. Healthy People 2030. Nutrition and healthy eating objectives: fruit consumption 2024. Accessed October 21, 2024. Available from: <https://odphp.health.gov/healthypeople/objectives-and-data/browse-objectives/nutrition-and-healthy-eating/increase-fruit-consumption-people-aged-2-years-and-over-nws-06>.
54. Healthy People 2030. Nutrition and healthy eating objectives: vegetable consumption 2024. Accessed October 21, 2024. Available from: <https://odphp.health.gov/healthypeople/objectives-and-data/browse-objectives/nutrition-and-healthy-eating/increase-vegetable-consumption-people-aged-2-years-and-older-nws-07>.
55. Evert AB, Dennison M, Gardner CD, Garvey WT, Lau KHK, MacLeod J, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. *Diabetes Care*. 2019;42(5):731–54. 10.2337/dci19-0014 [PubMed: 31000505]

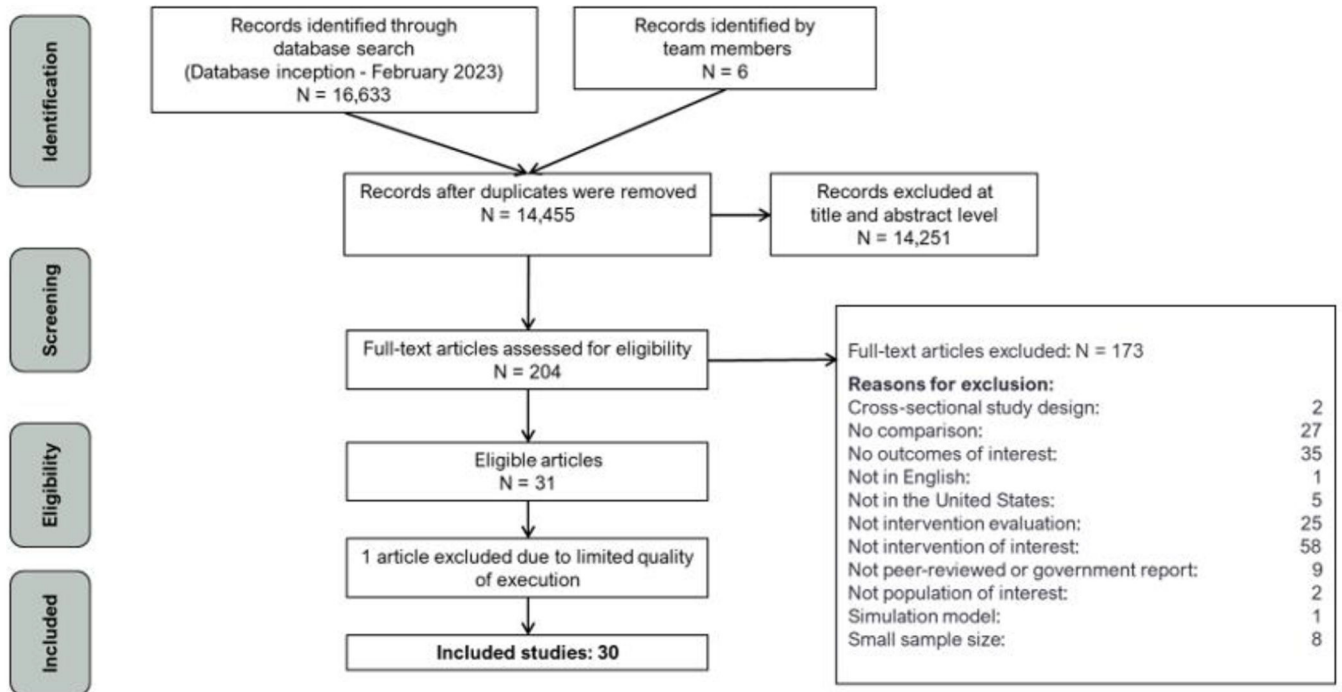


Figure 1.
PRISMA Flow Chart Search Process and Results for Fruit and Vegetable Incentive Program Studies

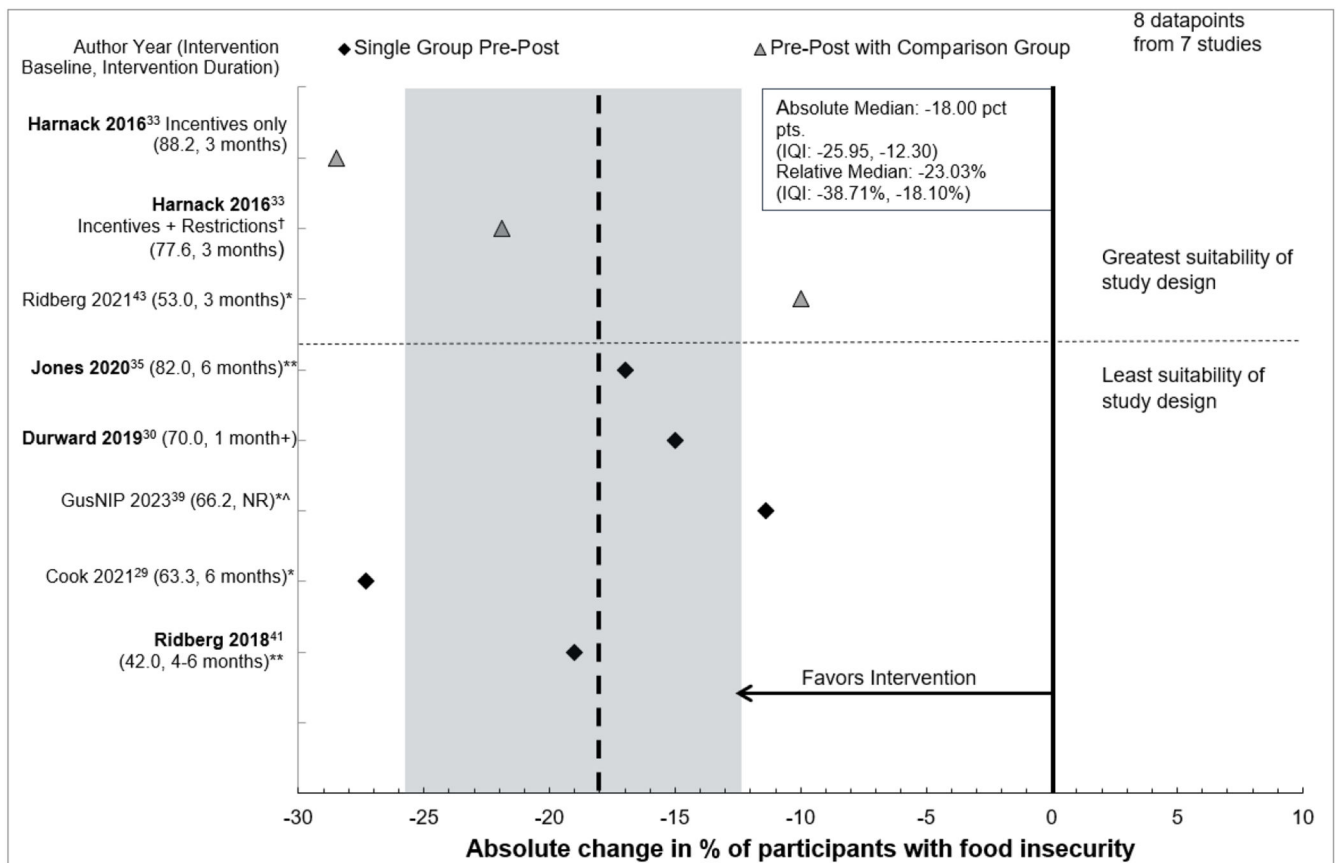


Figure 2.

Effects of Fruit and Vegetable Incentive Programs on Food Insecurity

Footnotes: NR, Not reported; Author names in bold indicate statistically significant changes; *significance was not reported; **indicate child population; ^intervention was implemented during COVID-19 pandemic; +: 1 month or more; † Restriction: sugar sweetened beverages, candies, and sweet baked goods were selected for restriction in the incentive plus restriction arm.

Table 1.
Demographic Characteristics of Fruit and Vegetable Incentive Program Study Participants

Characteristics	Number of Studies Reporting	Distribution Median (IQI)	Citations
Age			
Reported in years	22	42 years (29–53 years)	20–27, 30, 33–35, 38–40, 43–48, 50
Reported in ranges	7	Not applicable	29, 31, 32, 37, 41, 42, 49
Not reported	1	Not applicable	28
Sex			
Female	25	72% (66–82%)	21–27, 29–31, 33–35, 37–41, 44–50
Not reported	5	Not applicable	20, 28, 32, 42, 43
Race and ethnicity			
Hispanic/Latino	24	37% (11%–55%)	20–27, 29–34, 37, 39–44, 48–50
Black or African American	26	28% (9%–51%)	20–29, 31–34, 37, 39–50
White	25	27% (8%–52%)	20–22, 25–34, 37–44, 46, 48–50
Native Hawaiian or Other Pacific Islander	1	14% (Not applicable)	39
Asian American	7	9% (2%–21%)	25, 31, 34, 39, 40, 42, 44
Two or more races	4	3% (1%–11%)	29, 33, 39, 43
American Indian/Alaska Native	4 ^a	2% (0.40%–76%)	34, 35, 39, 42
Education			
Less than high school	9	18% (10%–43%)	20, 22–24, 29, 31, 37, 47, 50
High school graduate or GED	9	35% (23%–47%)	20, 22–24, 29, 31, 37, 47, 50
Greater than high school	11	30% (25%–62%)	20, 22–24, 29, 31, 37, 41, 46, 47, 50
Reported in ranges or mean education (years of education)	2	Not applicable	21, 34
Did not report education	15	Not applicable	25–28, 30, 32, 38, 40, 42–45, 48, 49
Participation in Federal Nutrition Assistance Programs			
SNAP	14	55% (37%–100%)	21–23, 25, 29–31, 35, 37, 38, 45, 47–49
WIC	11	16% (7%–100%)	20, 23, 25, 29, 31, 34, 35, 37, 42, 44, 45
FDPIR	1	84% (Not applicable)	35
No assistance received or not reported	12	Not applicable	24, 26–28, 32, 33, 39–41, 43, 46, 50

^aOne study conducted on Tribal Lands (Navajo Nation).

FDPIR, The Food Distribution Program on Indian Reservations; SNAP, Supplemental Nutrition Assistance Program; WIC, Special Supplemental Nutrition Program for Women, Infants, and Children.

Table 2.
Summary Measures of Findings for Fruit and Vegetable Incentive Programs

Outcome	Median change (IQI)	Citations
Food insecurity		
Percentage of participants with food insecurity (8 data pts from 7 studies)	−18.00 pct pts (−25.95 to −12.30)	29, 30, 33, 35, 39, 41, 43
Fruits and vegetables consumed per day		
Servings/d (7 data pts from 5 studies)	+1.10 servings/d (0.30 to 1.60)	31, 33–35, 47
Cups/d (10 data pts from 8 studies)	+ 0.13 cups/d (0.10 to 0.30)	22–24, 37, 39, 42, 45, 46
Number of times/d (5 data pts from 5 studies)	+ 0.49 times/d (−0.07 to 0.61)	21, 25, 30, 32, 48
HEI Score (6 datapoints from 3 studies)	+1.50 pts (0.93 to 4.88)	23, 24, 33
Blood Glucose (6 datapoints from 6 studies)	−0.64 pct pts in hemoglobin A1C levels (−1.33 to 0.08)	26, 27, 29, 32, 48, 50
Blood pressure		
Systolic (5 datapoints from 5 studies)	−0.49 mmHg (−2.49 to 3.45)	26, 27, 29, 48, 50
Diastolic (5 datapoints from 5 studies)	−0.40 mmHg (−1.19 to 0.83)	26, 27, 29, 48, 50
BMI (7 datapoints from 6 studies)	−0.05 kg/m ² (−0.57 to 0.10)	27–29, 33, 48, 50

Note: If there were fewer than 4 datapoints, or for studies that reported measures that could not be combined with other studies, the findings are described narratively in the text.

BMI, Body Mass Index; HEI, Healthy Eating Index; IQI, interquartile interval; kg/m², weight in kilograms (kg) divided by the square of the height in meters (m²); mmHG, millimeters of mercury; pct pts, percentage points; servings/d, servings per day; times/d, times per day.