

# Income, Cost, Time, and Convenience of Food: A Series of Rapid Reviews and Evidence Scans

Emily Callahan, MS,<sup>a</sup> Marlana Bates, MPH, RD,<sup>b</sup> Laural Kelly English, PhD,<sup>b</sup> Molly Higgins, MLIS,<sup>c</sup> Julia H Kim, PhD, MPH, RD,<sup>b</sup> Julie Nevins, PhD,<sup>b</sup> Sara Scinto-Madonich, MS<sup>b</sup>

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<sup>a</sup> Project Lead, NESR team, Nutrition Guidance and Analysis Division (NGAD), Center for Nutrition Policy and Promotion (CNPP), Food and Nutrition Service (FNS), U.S. Department of Agriculture (USDA)

<sup>b</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

<sup>c</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

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## Introduction

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The U.S. Department of Agriculture (USDA) develops four USDA Food Plans (the Thrifty, Low-Cost, Moderate-Cost, and Liberal Food Plans), each of which shows how a nutritious diet may be achieved at various cost levels. Each Food Plan includes a set of market baskets applicable to 1 of 15 age-sex groups. Each market basket is a selection of foods in purchasable food categories that together can be used in meals that reflect current dietary recommendations.

The Thrifty Food Plan (TFP) serves as the basis for the maximum allotment for the Supplemental Nutrition Assistance Program (SNAP), formerly known as the Food Stamp Program. The 2018 Farm Bill mandated an update to the TFP market baskets by 2022 and every five years thereafter to reflect “current prices, composition data, consumption patterns, and dietary guidance”. The importance of updating the TFP was further reiterated in Executive Order 14002 issued by President Joseph R. Biden on January 22, 2021.

To meet this mandate, the *Thrifty Food Plan, 2021* has been updated using a rigorous scientific process. USDA’s Center for Nutrition Policy and Promotion’s (CNPP) Nutrition Evidence Systematic Review (NESR) team completed a series of rapid reviews and an evidence scan as a source of information to support systematic and rigorous decisions throughout the process.

The staff at NESR specializes in conducting food- and nutrition-related systematic reviews and evidence syntheses. The NESR staff collaborated with USDA’s CNPP Nutrition and Economic Analysis Team (NEAT), who conduct the analyses to develop the USDA Food Plans, to complete a series of rapid reviews and evidence scans to address the following research questions:

1. Rapid Review: What is the relationship between income and prices for food items/baskets?
2. Rapid Review: What is the relationship between income or Federal Assistance participation/eligibility and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI)?
3. Rapid Review: What is the relationship between overall diet cost and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI)?
4. Rapid Review: What is the relationship between income and time spent on food-at-home-related activities?
5. Evidence Scan: What factors influence the purchase and/or consumption of at-home convenience foods? How are these foods described in the literature?

The methods for the rapid reviews and evidence scan are detailed below.

## Project methods

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Herein, we present an overview of the methods specific to the rapid reviews and evidence scans to inform the *Thrifty Food Plan, 2021*, including all deviations or modifications made to NESR standard systematic review methods.

Four rapid reviews were conducted to support the *Thrifty Food Plan, 2021* project. A rapid review is a type of evidence synthesis project in which the methods of a systematic review are modified or streamlined to produce

results in a timely and cost-effective manner.<sup>a</sup> Although systematic review methods are modified to expedite the process, a rapid review is still characterized by rigorous, transparent, and reproducible methods. The methodology utilized for each rapid review is informed by and tailored to the scientific question being answered and the specific needs of the requester (e.g., timeline, purpose, scope, circumstances, and stakeholders) while retaining scientific integrity. Best practices and recommendations from other research and health organizations, including the World Health Organization, Cochrane, the Agency for Healthcare Research and Quality, and the Center for Evidence-Based Medicine at the University of Oxford, inform the process by which NESR conducts rapid reviews.<sup>a,b,c,d</sup>

Three evidence scans were conducted for the Thrifty Food Plan, 2021 project. A NESR evidence scan is a systematic and exploratory process used to provide objective data on the volume and characteristics of research available on a topic or question. Evidence scans involve the following: development/refinement of the research question, evidence scan protocol development, search for and screen studies, minimal data extraction, and summarizing study characteristics. NESR evidence scans do not include: 1) data extraction of study results, 2) assessment of risk of bias, 3) synthesis of the evidence, 4) development of conclusion statements, 5) grading the strength of the evidence, or 6) recommend future research. Two of the evidence scans were conducted to inform protocol development for 2 of the rapid reviews and 1 to describe the volume and characteristics of studies available on a topic of interest related to the Thrifty Food Plan, 2021.

The process by which NESR developed rigorous *a priori* methods and protocols for this series of rapid reviews and evidence scans, and the type and extent of modifications made to NESR systematic review methods, are transparently documented and described below. Any additional methodological modifications made for individual reviews are acknowledged under their respective sections of the report. The summary statements in this series of rapid reviews should be interpreted in light of these modifications, and noted limitations.

## Develop a protocol

For each rapid review question or evidence scan, the NESR team collaborated with the NEAT team to develop a protocol. A rapid review or evidence scan protocol has the same elements as a systematic review protocol, and is a plan for how a specific review will be conducted. The protocol includes:

- Analytic framework
- Literature search and screening plan
  - Inclusion and exclusion criteria
  - Electronic databases and search terms
- Literature search and screening results

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<sup>a</sup> Tricco AC, Langlois EV, Straus SE, editors. Rapid reviews to strengthen health policy and systems: a practical guide. Geneva: World Health Organization. 2017. <https://apps.who.int/iris/handle/10665/258698>.

<sup>b</sup> Garrity C, Gartlehner G, Nussbaumer-Streit B, King VJ, Hamel C, Kamel C, Affengruber L, Stevens A. Cochrane Rapid Reviews Methods Group offers evidence-informed guidance to conduct rapid reviews. *J Clin Epi.* 2020;130:13-22.

<sup>c</sup> Hartling L, Guise J-M, Kato E, Anderson J, Aronson N, Belinson S, Berliner E, Dryden D, Featherstone R, Foisy M, Mitchell M, Motu'apuaka M, Noorani H, Paynter R, Robinson KA, Schoelles K, Umscheid CA, Whitlock E. EPC Methods: An Exploration of Methods and Context for the Production of Rapid Reviews. Research White Paper. (Prepared by the Scientific Resource Center under Contract No. 290-2012-00004-C.) AHRQ Publication No. 15-EHC008-EF. Rockville, MD: Agency for Healthcare Research and Quality; February 2015. [www.effectivehealthcare.ahrq.gov/reports/final.cfm](http://www.effectivehealthcare.ahrq.gov/reports/final.cfm).

<sup>d</sup> Plüddemann A, Aronson JK, Onakpoya I, Heneghan C, Mahtani KR. Redefining rapid reviews: a flexible framework for restricted systematic reviews. *BMJ Evid Based Med.* 2018;23(6):201-203. doi:10.1136/bmjebm-2018-110990



- Flow chart of literature search and screening results
- List of included articles
- List of excluded articles, with rationale

The protocols were established before any evidence was reviewed and synthesized. This allowed the establishment of protocols that would capture the most appropriate, relevant, and direct body of evidence to answer each question. Any revisions to protocols that occurred after the start of a specific review were documented and are noted in the below report.

A description of NESR's methodology for developing an analytic framework is below. NESR's methodology for developing inclusion and exclusion criteria and the search strategy, as well as processes related to screening and selecting studies for inclusion in a review, is described, below, in "Search for, screen, and select literature."

## Develop analytic frameworks

Analytic frameworks were developed for each rapid review and evidence scan question. An analytic framework defines the core elements of the review question, includes definitions for key terms, identifies key confounders and other factors that could affect the relationships examined, and helps to ensure that important contributing elements in the causal chain will be examined and evaluated. The analytic framework serves as the foundation for the rest of the review process, and informs the inclusion/exclusion criteria and literature search strategy, data extraction and risk of bias assessments, and the strategy for synthesizing the evidence to develop summary statements.

A standard framework, called the PICO framework, was used to define core elements of each review question. The elements of the PICO framework are the Population (for both the intervention/exposure and for the outcome), Intervention and/or exposure, Comparator (i.e., the alternative being compared to the intervention or exposure), and Outcomes. Key terms, key confounders, and other factors to be considered (i.e., mediators, moderators, covariates) were also identified and included in the analytic framework where appropriate. Key confounders are considered during review and evaluation of the evidence, particularly during risk of bias assessment (see "Assess risk of bias," below) and evidence synthesis.

## Search for, screen, and select literature

Systematic searching, screening, and selecting the scientific literature is a process through which NESR sought to identify the most complete and relevant body of evidence to answer the rapid review and evidence scan questions. The process started with defining inclusion and exclusion criteria *a priori*, followed by developing and implementing literature search strategies, and finally screening and identifying search results. The entire process was documented, including a complete list of articles that met criteria for inclusion in each rapid review or scan, and a list of excluded articles, with the rationale for exclusion.

## Define inclusion and exclusion criteria

Inclusion and exclusion criteria provide an objective, consistent, and transparent framework for determining which articles to include in each review. These criteria were developed before any studies were reviewed to guide selection of the most relevant and appropriate body of evidence for each review question. Additionally, these criteria were framed to increase the utility for *Thrifty Food Plan, 2021*. To minimize bias, revisions to the criteria after studies had been reviewed were discouraged. Any revisions to the criteria that occurred after studies were reviewed are documented in the individual reviews in this report.

NESR analysts worked jointly with the NEAT staff to establish inclusion and exclusion criteria that were tailored to the specific review question addressed.

Criteria were established for a number of study characteristics, and although criteria were tailored to the unique characteristics of each review question being addressed, NESR also applied several standard criteria across this project. Deviations from the standard criteria that were appropriate for individual questions are documented in the report section for that question. The following is a description of criteria applied across this project:

- **Study Design:** Any study design that was not a narrative review, systematic review, or meta-analysis was included.
- **Language:** Articles published in English were included. Articles published in languages other than English were excluded.
- **Publication status:** Articles that had been peer-reviewed or grey literature in the form of reports that had not been peer reviewed, but were available from government and nongovernmental organizations were included.
- **Publication date and data years:** Studies published between January 2008 to present and had data collected inclusive of 2008 (e.g., 2000-2012; 2008-2009) were included. Articles published before January 2008 or articles with data collected prior to 2008 (e.g., 2000-2007; 1999-2005), regardless of publication date, were excluded. NESR and NEAT chose 2008 because of national and policy-relevant changes. The Food, Conservation, Energy Act of 2008 (which was a continuation of the 2002 Farm Bill that restored food and nutrition program eligibility of legal immigrants) increased benefits and eligibility for the Food Stamp Program (FSP), and increased funding and eligibility for free/reduced-price lunch and other food-assistance programs. In 2009, the FSP was renamed to the Supplemental Nutrition Assistance Program (SNAP). Therefore, the NEAT and NESR teams determined that the preponderance of the evidence most relevant to factors such as income, price, cost and Federal assistance would be captured by searching literature starting in the year 2008. For consistency, a starting date of 2008 was selected for multiple questions addressed in this project.
- **Country:** Studies were only included if they were conducted in the U.S.
- **Study participants:** Human participants/populations were included and all non-human participants (i.e., animal studies, in-vitro) were excluded.

## Developing and implementing the literature search strategy

Once the inclusion and exclusion criteria were set, the NESR librarian used the analytic framework and inclusion/exclusion criteria to guide development of a comprehensive literature search strategy. The literature search strategy included selecting and using the appropriate bibliographic databases (e.g., PubMed/MEDLINE, Business Source Premier, Web of Science), identifying search terms appropriate for the databases being searched, and employing search refinements, such as search filters. The librarian worked in collaboration with NESR staff to construct a preliminary search strategy using PubMed operators and search terms. This was used to conduct a test search, preview the results, and correct any syntax, spelling, or grammatical errors. The search strategy underwent multiple revisions to refine and adjust the search before it was finalized for use. The search strategies are included in this report for all rapid reviews completed. Unlike NESR systematic reviews, the search strategies for these rapid reviews were not peer-reviewed by a 2<sup>nd</sup> librarian as a time-savings concession.

Literature search strategies for rapid reviews and evidence scans are developed with the same methods and were specific to each question. Evidence scans generally have broader questions and therefore broader search strategies. For the 2 questions where an evidence scan was conducted to inform the rapid review, the evidence scan confirmed that the scope of the question was adequate and the same search that was run for the evidence scan was used for the rapid review.

### Identify bibliographic databases

The NESR librarian selected electronic bibliographic databases based on the systematic review topic. A team of staff at Economic Research Service consulted on appropriate databases on the topic of income and prices of food/food baskets, including a grey literature approach. This insight was applied across the project for additional questions and topics. PubMed/MEDLINE, Business Source Premier, Web of Science were the primary databases used for the project, and AgEcon, Google Scholar, and Google were used for the grey literature search.

### Develop search terms and apply search filters

NESR analysts helped identify initial key terms and/or relevant articles to ensure that the NESR librarian had an understanding of the scope and intent of the systematic review question. The librarian was responsible for checking each bibliographic database's search features to ensure that all related search terms for a particular review question were captured.

For this project, filters that were used include: English language, human studies, date, study design, and publication type (e.g., to filter out news, editorials, and comments).

### Implement the literature search strategy

After finalizing the search strategies for each of the databases, the NESR librarian began the process of conducting all of the electronic searches. When searching multiple databases, overlap in the literature identified is common; the librarian electronically eliminated duplicate records at the search level using a citation management program (EndNote X9; Clarivate Analytics, Philadelphia, PA). Additional duplicates were identified by NESR analysts during the course of screening, and were removed from the search results. In addition, because some journals publish articles electronically, in advance of the print journal, the search captured these articles, and they were eligible for inclusion in the review, even though there was a possibility that they would be assigned an official publication date outside the window of the search date range.

In addition to the peer-reviewed primary studies retrieved from major biomedical databases, a complementary search of the grey literature was conducted in order to ensure that published and unpublished studies and reports relevant to the research questions were included in the search process. The grey literature search strategy included a broad search using similar key terms. More information about the sources selected and the searches conducted are included in each individual review. To determine which results to select for screening, the librarian limited the export of results to  $n$  pages where  $n = [\text{pages with relevant results}] + 1$ . Relevant results were determined by the result's title.

Once the electronic searches were done, the librarian documented the total number of unique articles identified, indicating how many were identified from each database searched. This documentation included the total, raw search results, as well as search results after removal of duplicates.

## Screen and select studies

The screening of search results was facilitated by the use of a web-based tool (i.e., DistillerSR) and screening forms that were developed based on the inclusion and exclusion criteria identified for each systemic review. For the rapid reviews and evidence scan included in this project, generally, 1 NESR analyst screened 100% of records and a 2<sup>nd</sup> analyst screened 20% of records. In some cases, 1 analyst screened 100% of records, and a 2<sup>nd</sup> analyst verified the decisions. A re-ranking function was utilized in DistillerSR to reorder the most relevant articles first. The goal of screening was to review the search results and exclude those that did not meet the inclusion criteria. Screening is generally completed at 3 levels. The first level of screening was completed using only the title of each article. If an article was not excluded at this level, it moved forward to the 2<sup>nd</sup> level, where the abstract was screened. Finally, if an article passed the first 2 levels, it moved to the third level, where the full text of the article was screened. In this project, title and abstract screening were sometimes combined into 1 level. Any disagreements between analysts were reconciled between the 2 screenings. If necessary, a third analyst was consulted to resolve differences. These screening distinctions are noted in each individual review section of this report.

If multiple articles were identified that presented effectively the same data from the same study or cohort, the article that most directly addressed the review question was included to avoid duplicative data. However, if the articles addressed unique data related to the question, or were needed to comprehensively present information from a study or cohort, then all articles were included. Included articles from the same study or cohort were noted in the review, and this was taken in consideration when weighing the amount of evidence to answer a question.

Screening for rapid reviews and evidence scans for this project used consistent methods in order to ensure that the screening completed for the scan could also be applied to the rapid review. In cases where the focus of the rapid review question was narrowed after the evidence scan, additional screening was completed to exclude any studies that would no longer be included when the rapid review protocol elements were applied to the body of evidence.

## Conduct manual searches

NESR analysts also completed manual searches on the rapid reviews in this project. Manual searching was done to find articles not identified through the electronic database search. This was typically due to inadequate indexing or filtering limitations of a database. The primary approach used for the manual search was hand searching, in which an analyst systematically searched the reference sections of included articles and related systematic reviews and meta-analyses. Potential articles also may have been suggested by others engaged in the process. Any identified citations were then screened for inclusion or exclusion as outlined above.

## Document the search results

After the electronic and manual searches were completed, NESR analysts and the librarian documented the literature search and screening results by compiling lists of the included and excluded citations, along with the rationale for exclusion at the full-text level.

## Extract data and assess risk of bias

NESR analysts extracted and summarized data from each included article to objectively describe the body of evidence available to answer a rapid review question or inform an evidence scan. For rapid reviews, NESR analysts assessed the risk of bias for each included article. Risk of bias assessments were not completed for

evidence scans. The extracted data and assessment of risk of bias were used to populate evidence tables to present the key data used in the synthesis for the review.

## Extract data

To expedite data extraction, only the most essential data for answering the question were extracted. For the rapid reviews, information on the following elements were generally extracted: Study design, analytic N, geographic location and/or population description, intervention/exposure, outcomes, results, key confounders, and data source. For evidence scans, only minimal descriptive information was extracted, and no results were included.

Once the types of data to be extracted were determined, a data extraction form was developed and used to facilitate accurate, consistent, and efficient data extraction. This form ensured that the same information from each article was formatted consistently, which made the content easier to compare and contrast during synthesis. NESR analysts used DistillerSR to extract data.

One NESR analyst extracted data from each included article using the data extraction form. In some cases, the required data were not reported in the article. In those situations, the data were recorded as “not reported.” However, if the required data were reported in an article’s protocol or related publication, the analyst extracted the data and noted the publication from which it was extracted. Next, a 2<sup>nd</sup> analyst reviewed only the extracted results for completeness, accuracy, and consistent presentation and formatting. Evidence tables were created by NESR analysts using the extracted data.

## Assess risk of bias

Each article included in a rapid review underwent a formal risk of bias assessment. Risk of bias assessments were not completed for evidence scans. Risk of bias is the likelihood of a systematic error or deviation from the truth, in results or inferences, which can lead to underestimation or overestimation of either the true effect of an intervention on an outcome or the true association between an exposure and outcome.

NESR assessed the risk of bias of RCTs, including parallel group trials, cluster-randomized trials, and cross-over trials, using the “Cochrane risk-of-bias tool for randomized trials” (RoB 2.0; August 2016 version).<sup>a</sup> NESR assessed the risk of bias of non-RCTs using the “Risk of Bias in Non-randomized Studies.”<sup>b</sup> NESR assessed the risk of bias of observational studies using the Risk of Bias for Nutrition Observational Studies tool (RoB-NObs) (**Appendix 0-b**).

For each article included in a rapid review, 1 NESR analyst completed the risk of bias tool appropriate for the study’s design and the assessment was verified by a 2<sup>nd</sup> analyst. Analysts answered the signaling questions based only on the data that was extracted for the rapid review for a specific result, and determined domain-level risk of bias judgements (e.g., Low, Moderate, Serious, Critical). If necessary, analysts referred to previous and/or related publications to obtain information to complete items in the tool. The analysts’ reconciled disagreements and if a disagreement could not be resolved by the 2 analysts, an additional member of the NESR staff was asked to provide a third-party consultation.

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<sup>a</sup> Higgins JPT, Sterne JAC, Savović J, et al. A revised tool for assessing risk of bias in randomized trials. In: Chandler J, Clarke M, McKenzie J, Boutron I, Welch V, eds. *Cochrane Methods*. Vol 10(Suppl 1): *Cochrane Database of Syst Rev.*; 2016. doi: 10.1002/14651858.CD201601.

<sup>b</sup> Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in nonrandomised studies of interventions. *BMJ*. 2016;355:i4919. doi:10.1136/bmj.i4919.

The results of each risk of bias assessment were displayed in a risk of bias table. This table provides transparency to the domain-level risk of bias judgements for each included article using a color-coded system. Limitations identified during risk of bias assessments were also described and considered.

## Synthesize evidence, assessment of evidence, develop summary statements, and identify research recommendations

### Synthesize evidence

Evidence synthesis was conducted for each rapid review, which is the process by which evidence from multiple studies is described, compared and contrasted, and combined qualitatively, or narratively, to answer the review question. This synthesis of the body of evidence involves identifying overarching themes or key concepts from the findings, identifying and explaining similarities and differences between studies, and determining whether certain factors may have affected the relationships being examined. Evidence synthesis conducted as part of the rapid reviews in this project align with that of NESR systematic reviews, but are more concise.

NESR analysts drafted a description of the studies included in the review to begin the process of synthesizing the evidence using the analytic framework and review protocol to guide how the evidence was organized and described.

Next, NESR analysts reviewed the included articles individually, and the body of evidence collectively. The following were considered in each review: study design, key associations between the intervention/exposure and outcome(s) of interest in the review question, along with considerations of key factors for assessing the body of evidence (risk of bias, consistency, directness, precision, and generalizability). Patterns of agreement and disagreement among the findings were examined, and methodological differences between the studies were assessed to potentially help explain disagreement. Gaps in the body of evidence also were identified.

Synthesis, assessment of evidence, and developing summary statements were not completed for evidence scans because no results were extracted nor was risk of bias assessed. However, research recommendations were developed based on the type and amount of literature included in the scan.

### Develop summary statements

NESR analysts developed summary statements outlining the main themes from the synthesis. Because modifications were made to NESR's standard systematic review methods and these reviews included limited expert involvement, conclusion statements and grades were not developed to answer the research questions. However, the grading elements (i.e., risk of bias, consistency, precision, directness, generalizability) were referenced to assess the evidence, determine limitations, and inform the development of summary statements.

### Identify research recommendations

Research gaps and methodological limitations identified during data extraction, synthesis, and discussions with the NEAT team are documented and included in this report for each question. They are framed as research recommendations that detail areas where further research is needed to strengthen the body of evidence on the research question of interest.



# Chapter 1 - What is the relationship between income and prices for food items/baskets?

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Julie Nevins, PhD,<sup>a</sup> Julia H Kim, PhD, MPH, RD,<sup>a</sup> Molly Higgins, MLIS,<sup>b</sup> Marlana Bates, MPH, RD,<sup>a</sup> Laural Kelly English, PhD,<sup>a</sup> Sara Scinto-Madonich, MS,<sup>a</sup> Emily Callahan, MS<sup>c</sup>

## Specific methods to conduct this rapid review

### Develop a protocol

The research question, “What is the relationship between income and the price of food items/baskets?”, was answered using a rapid review that was informed by an evidence scan.

The analytic framework for the rapid review examining the relationship between income and prices for food items/baskets is presented in **Figure 1-a**. This analytic framework visually represents the overall scope of the rapid review question and depicts the contributing elements that were examined and evaluated. The intervention or exposure of interest is income (e.g., household, city, regional income) and socioeconomic and geographic proxies for income in U.S. households or populations. The comparators are different levels/categories of income or socioeconomic factor proxy or different geographic areas. The outcomes are the difference in prices of similar food items/baskets of similar items (e.g., jar of spaghetti sauce, unit of banana) in U.S. households or populations. The key confounders are seasonal differences, urban versus rural areas, and cultural/racial diversity or disparities. The other factors to be considered are cultural food choices and neighborhood characteristics (access to healthy foods/distance to store/access to car/type of store). The confounders and other factors to be considered may impact the relationships of interest.

An evidence scan was conducted before the rapid review, and it included any paper that described socioeconomic status (SES) or geographic region for the intervention/exposure. The evidence scan also included education, time (e.g., cooking time), and neighborhood characteristics as key confounders. Based on the evidence scan, the following updates were made to the analytic framework for the rapid review:

- SES and geographic region had to relate directly to income to meet the inclusion criteria for the intervention/exposure.
- Because education is so closely linked to SES, and often included in indices of SES, it was not included as a key confounder in the present rapid review.
- While time (e.g., cooking time) may relate to income and/or food price, it was addressed in a separate rapid review presented in -. Therefore, time was not included as a key confounder in the present rapid review.
- Neighborhood characteristics, including access to foods, were determined to relate to income and/or food price, but were beyond the scope of the present rapid review. Therefore, neighborhood characteristics were not included as a key confounder in the present rapid review.

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<sup>a</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

<sup>b</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

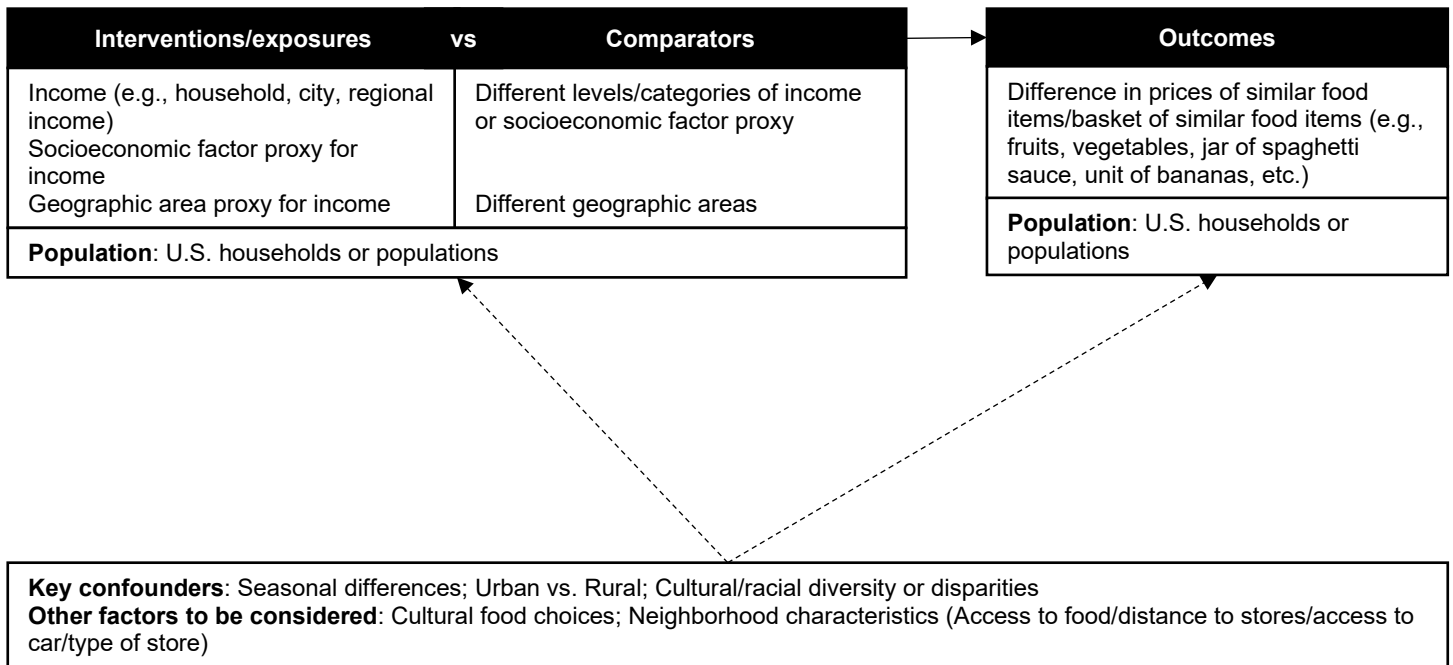
<sup>c</sup> Project Lead, NESR team, NGAD, CNPP, FNS, USDA

Further clarifications were made for the rapid review based on the evidence scan, although this did not change the analytic framework or inclusion/exclusion criteria:

- The price of alcoholic beverages does not meet the outcome criterion of “food price” because SNAP funds cannot be spent on alcohol.
- The Nutrition Environment Measures Survey in stores (NEMS-S) tool did not meet the outcome criteria because the price subscore compares price of “regular” foods versus healthy alternatives but does not include food prices.



**Figure 1-a. Analytic Framework**



**Key definitions**

Low income: before-tax income at or below 130 percent of the U.S. poverty guidelines

Higher income: before-tax income above 130 percent of the U.S. poverty guidelines

**Legend**

- > Relationship(s) of interest
- > Factors that may impact the relationship(s) of interest

## Search for and select studies

NESR analysts worked jointly with NEAT staff to establish the final inclusion and exclusion criteria, which are detailed in **Table 1-a**.

**Table 1-a. Inclusion and exclusion criteria**

Category	Inclusion Criteria	Exclusion Criteria
Study design	<ul style="list-style-type: none"> <li>Any study design that is not a narrative review, systematic review, or meta-analysis</li> </ul>	<ul style="list-style-type: none"> <li>Narrative reviews</li> <li>Systematic reviews</li> <li>Meta-analyses</li> </ul>
Intervention/exposure	<ul style="list-style-type: none"> <li>Income (e.g., household, city, regional income); socioeconomic factor proxy for income (e.g., education); geographic area proxy for income</li> </ul>	<ul style="list-style-type: none"> <li>Socioeconomic factors or geographic areas that are not a direct proxy for income determined by the author</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>Different levels or categories of income or SES factor proxy for income</li> <li>Higher vs. lower geographic areas</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> <li>Comparison of geographic areas without a proxy for income</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>Difference in price of similar food item/basket of similar food items (food items include food item or food category)</li> <li>Difference in price of basket of similar food items</li> </ul>	<ul style="list-style-type: none"> <li>Total food/grocery expenditures</li> </ul>
Publication date	<ul style="list-style-type: none"> <li>Published January 1995 – February 2021 with data from January 1995 – February 2021</li> </ul>	<ul style="list-style-type: none"> <li>Before January 1995, after February 2021</li> <li>Data prior to January 1995</li> </ul>
Publication status	<ul style="list-style-type: none"> <li>Articles that have been peer-reviewed</li> <li>Grey literature: reports that have not been peer-reviewed but are reports available from government and nongovernmental organizations (e.g., National Bureau of Economic Research)</li> </ul>	<ul style="list-style-type: none"> <li>Articles that have not been peer-reviewed and are not published in peer-reviewed journals, other than reports from government and nongovernmental organizations</li> </ul>
Language	<ul style="list-style-type: none"> <li>Articles published in English</li> </ul>	<ul style="list-style-type: none"> <li>Articles published in languages other than English</li> </ul>
Country	<ul style="list-style-type: none"> <li>Studies conducted in the U.S.</li> </ul>	<ul style="list-style-type: none"> <li>Studies conducted outside the U.S.</li> </ul>
Study participants	<ul style="list-style-type: none"> <li>Human participants</li> </ul>	<ul style="list-style-type: none"> <li>Non-human participants (e.g., animal studies, in-vitro models)</li> </ul>

The final search terms for all databases as well as documentation included in the total, raw search results from each database, as well as search results after removal of duplicates are included in **Appendix 1-a. Literature search strategy**.

The following outlines any departures from the screen and select studies project methods for this specific rapid review.

- Screening was done at 2 levels. The first level of screening was done using only the title and abstract of each article. If an article was not excluded, it moved forward to the 2<sup>nd</sup> level, where the full text of the

article was screened. After NESR analysts completed screening of both levels, the analysts reconciled any discrepancies between the 2 screenings for the 20 percent of articles which were dual screened. If necessary, a third analyst was consulted to resolve differences.

- Based on the literature, NESR analysts updated the analytic framework to include “type of store” as a commonly-reported measure of the other factor to be considered, “access to healthy foods.”

The compiled list of the included citations, can be found in the **References** section.

## Extract data and assess the risk of bias

NESR analysts extracted and summarized data from each included article to objectively describe the body of evidence available to answer a rapid review question or inform an evidence scan. The following outlines any departures from the project methods for this specific rapid review:

- Data extraction by single analyst, with quality control conducted by a 2<sup>nd</sup> analyst. Reconciliation was completed as needed
- Data extracted in Distiller, including author, year of data collection and data source for exposure and outcome, study design, analytic N, geographic location, population description, intervention/exposure and comparator descriptions, outcome description, results, key confounders
- Standard NESR risk of bias forms used in Distiller (dual, independent risk of bias)

## Synthesize the evidence

Evidence synthesis was completed by describing the evidence and evaluating the included studies individually and collectively as previously described in the project methods.

## Summary statements

NESR analysts formed summary statements, as previously described in the project methods, outlining the themes observed during the data synthesis of studies examining income and price of food.

## Recommend future research

Recommendations for future research evaluating the relationship between income and the price of food were determined based on the gaps and limitations observed during data extraction and synthesis, as previously described in the project methods. Future work addressing these gaps and limitations may contribute to the body of evidence available to answer this research question.

# Results

## Literature search and screening results

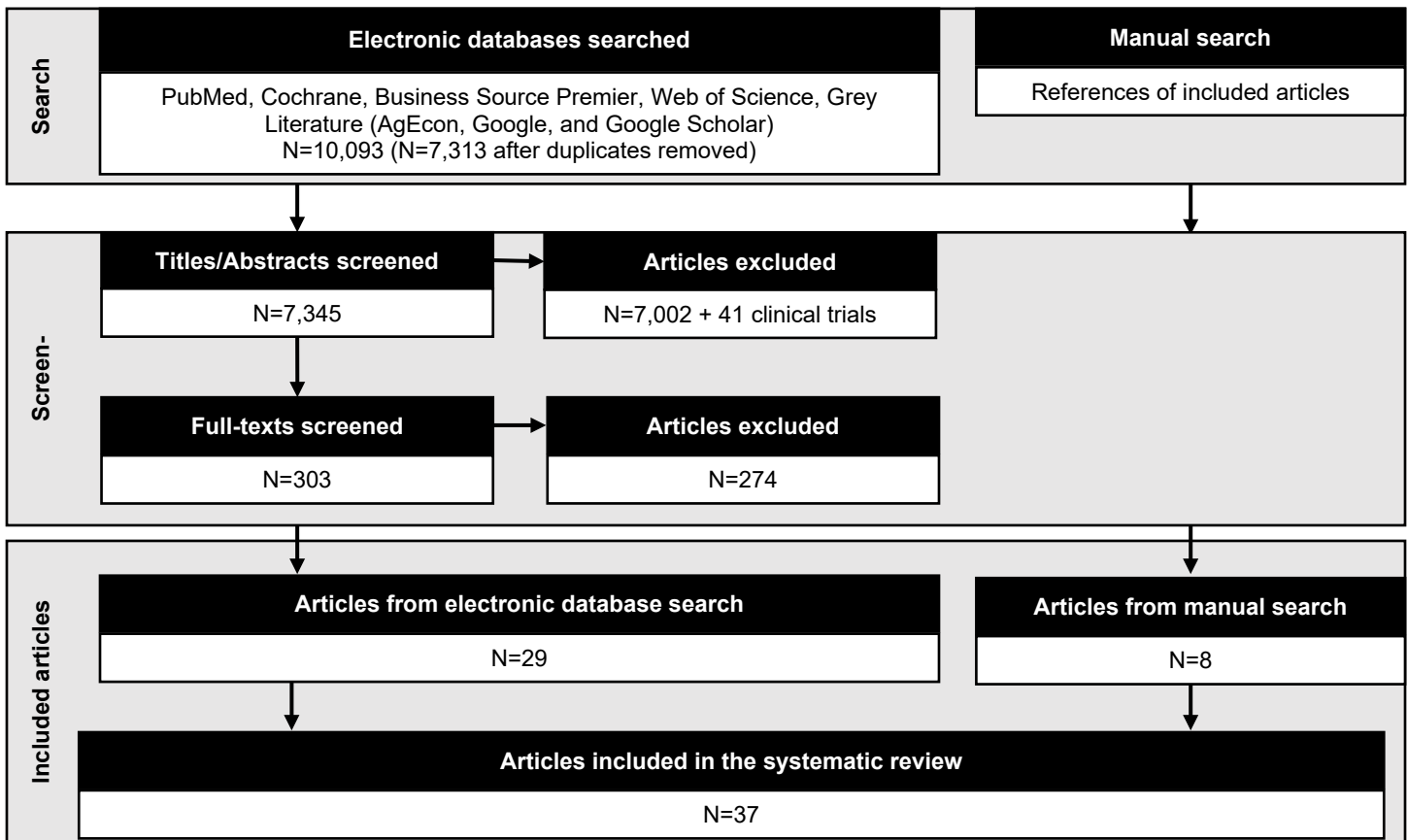
The literature search yielded 7,313 search results after the removal of duplicates (**see Figure 1-b**). Dual-screening resulted in the exclusion of 7,043 titles/abstracts and 274 full-texts articles. Reasons for full-text exclusion are in **Appendix 1-b**. Eight additional articles were identified from the manual search. The body of evidence included 37 articles from 32 studies (31 cross-sectional studies<sup>1-36</sup> and 1 prospective cohort study<sup>37</sup>). The included articles are listed in **Table 1-b**.

Evidence was provided for each food group, and most studies evaluated price data from multiple food groups:

- Fruits and Vegetables: 23 studies<sup>1-5,7,9,12-19,22,23,25,27,29,30,32,33,35,36</sup>
- Market Baskets: 11 studies<sup>2,6,8,9,11,18,20,22-24,27,34,37</sup>
- Dairy: 11 studies<sup>1,7,10,14,18,22,23,26,27,29-32</sup>
- Grains: 8 studies<sup>1,7,14,18,22,23,29,30,32</sup>
- Proteins: 2 studies<sup>14,23</sup>

Studies also reported prices of beverages (e.g., energy drinks, sports drinks, ready-to-drink tea and coffee), salty snacks, and sweets (e.g., sugar-sweetened beverages, ice cream), but were not specifically examined in this rapid review.

**Figure 1-b. Literature search and screen flowchart**



## Fruits and vegetables

### Description of the evidence

#### *Population*

Twenty-three cross-sectional studies reported fruit and/or vegetable outcomes as individual foods or food group(s), including 19 studies examining price in stores<sup>1-3,7,9,12,13,15,16,18,19,22,23,25,27,29,30,32,35,36</sup> (N=6<sup>1</sup> to 1953<sup>27</sup> stores), and 4 examining prices purchased by households<sup>4,5,14,17,33</sup> (N=90<sup>17</sup> to 43,000<sup>14</sup> households). The body

of evidence included samples from across the U.S. and 3 household studies had nationally representative samples.<sup>4,5,14,33</sup> Five studies that examined prices in stores included small or convenience stores.<sup>7,13,15,32,35</sup>

Thirteen of the studies<sup>3,7,9,12,15,16,18,19,22,23,30,32,35,36</sup> examined the price of fruit alone as individual foods or food group(s) in stores. No studies examined the price of fruit alone in households.

Twelve of the studies<sup>1,3,9,12,13,16,18,19,22,30,32,35,36</sup> reported the price of vegetables alone as individual foods or food group(s) in stores and two<sup>14,33</sup> in households.

### *Intervention/exposure*

Thirteen studies<sup>1,4,5,9,13-18,22,23,29,33,36</sup> measured income, 7 studies<sup>2,3,7,19,25,30,32</sup> measured geographic location as a proxy for income, and 3 studies<sup>12,26,27,35</sup> measured a socioeconomic proxy for income.

Of the 13 studies of fruit, 6 studies<sup>9,15,16,18,22,23,36</sup> measured income, 5 studies<sup>3,7,19,30,32</sup> measured geographic proxies of income, and 2 studies<sup>12,35</sup> measured socioeconomic proxies of income.

Of the 14 studies of vegetables, 8 studies<sup>1,9,13,14,16,18,22,33,36</sup> measured income, 4 studies<sup>3,19,30,32</sup> measured geographic proxies of income, and 2 studies<sup>12,35</sup> measured socioeconomic proxies of income.

### *Outcome*

Outcomes included prices of fruit (apples, bananas, berries, fruit juice, grapefruit, grapes, lemons, limes, mangoes, melons, oranges, peaches, pears, pineapple, plums, strawberries, total fruit), prices of vegetables (asparagus, avocados, beans, broccoli, cabbage, carrots, cauliflower, celery, corn, cruciferous vegetables, cucumbers, eggplant, green beans, greens, lettuce, mushrooms, okra, onions, peppers, potatoes, squash, tomatoes, frozen vegetables, total vegetables), prices of fruits and vegetables combined, and prices of produce.

## Synthesis of the evidence

### *Higher income related to higher prices of fruits and vegetables*

Among the studies of income and prices paid by households, 3 studies<sup>4,17,33</sup> of households found a statistically significant relationship between income and price of fruits and vegetables: households with higher incomes tended to pay higher prices for fruits and vegetables compared to households with lower incomes. The effect size ranged from less than 1 cent price index difference between poverty groups to 2 to 3 cents per ounce or cup.

Of the 19 studies examining prices of fruits and vegetables in stores, 14 studies<sup>1,3,7,9,12,13,16,22,23,25,27,32,35,36</sup> found a statistically significant relationship between income and price: prices of fruits and vegetables were higher in stores located in neighborhoods with higher incomes compared to stores located in neighborhoods with lower incomes. The evidence included samples from states across the U.S. and 4 studies in stores explicitly included small or convenience stores.<sup>7,13,32,35</sup> Two studies<sup>12,32</sup> were relatively small (less than 50 stores) and had critical ratings for risk of bias due to exposure classification (**Table 1-c**); thus the studies could not provide useful information on the relationship between income and price.

Seven studies that examined prices in stores<sup>3,7,9,12,22,23,32</sup> (N = 25<sup>9</sup> to 65 stores<sup>7</sup>) reported a statistically significant relationship between income and the prices of fruits alone: prices were higher in stores located in neighborhoods with higher incomes compared to stores located in neighborhoods with lower incomes. All but 1 study<sup>32</sup> included groceries or supermarkets and 2 studies<sup>7,32</sup> included convenience stores. Stores were located in the southern and eastern U.S.

One<sup>33</sup> of the two studies of income and prices paid by households for vegetables found statistically significant relationship, such that households with higher incomes paid higher prices for vegetables compared to households with lower incomes. The study was nationally representative and included 7,143 households. Eight studies in stores<sup>1,9,12,13,16,32,35,36</sup> (N = 6<sup>1</sup> to 364 stores<sup>36</sup>) reported a statistically significant finding that stores in higher income neighborhoods had higher vegetable prices than stores in lower income neighborhoods. Three studies<sup>13,32,35</sup> included convenience stores, and all others included groceries or supermarkets. Stores were primarily located in New York and in the southern and midwestern U.S.

#### *Higher income related to lower prices of fruits and vegetables*

One study of households<sup>5</sup> found a small, but statistically significant, relationship between income and price of fruits and vegetables: households with higher incomes paid lower prices for fruits and vegetables.

Five studies<sup>12,16,19,30,35</sup> found a statistically significant relationship between income and price of fruits and vegetables in stores. Stores located in neighborhoods with higher incomes had lower prices of fruits and vegetables than stores located in neighborhoods with lower incomes. One study<sup>19</sup> took place exclusively in low-income neighborhoods and another<sup>35</sup> included only small or non-traditional stores. Two studies<sup>12,19</sup> had critical ratings for risk of bias due to exposure classification (**Table 1-c**) and thus could not provide useful information on the relationship between income and price.

Two studies in stores (N = 32<sup>30</sup> to 1,474 stores<sup>19</sup>) reported a statistically significant relationship between income and the prices of fruits alone, such that stores in higher income neighborhoods had lower fruit prices than stores in lower income neighborhoods. Additionally, four studies in stores (N = 23<sup>16</sup> to 1,474 stores<sup>19</sup>) reported a statistically significant finding that stores in higher income neighborhoods had lower prices of vegetables compared to stores in lower income neighborhoods. Store types were mixed and were located in California, New York, and Texas.

#### *Non-significant associations between income and prices of fruits and vegetables*

Two studies<sup>4,14</sup> found no relationship between income and the price households paid for fruits and vegetables among adolescents (not children)<sup>4</sup> or for dried beans/peas.<sup>14</sup>

Fifteen studies<sup>2,3,7,9,12,13,15,16,18,19,22,29,30,32,35,36</sup> found no relationship between income and the price of fruits and vegetables in stores. Although none of the studies were nationally representative, results overall cover much of the country. Six studies<sup>2,7,13,15,32,35</sup> included convenience or small stores explicitly. Three studies<sup>12,19,32</sup> had critical ratings for risk of bias due to exposure classification (Table 1c) and thus could not provide useful information on the relationship between income and price.

Nine studies in stores<sup>7,12,15,16,18,30,32,35,36</sup> (N = 23<sup>16</sup> to 364 stores<sup>36</sup>) found no relationship between income and the prices of fruits alone. Four studies<sup>7,15,32,35</sup> included small or convenience stores. Stores were located in the southern and eastern U.S.

One<sup>14</sup> of the two studies of income and prices paid by households for vegetables found no relationship. The study was nationally representative and included 43,000 households. Seven studies in stores<sup>3,13,16,18,19,22,30,35</sup> (N = 23<sup>16</sup> to 1,474 stores<sup>19</sup>) reported no relationship between income and the prices of vegetables alone. Two studies<sup>13,35</sup> included convenience stores, and overall the studies were distributed across the U.S.

### Assessment of the evidence

#### *Risk of bias*

The body of evidence was comprised of cross-sectional studies, with moderate to serious concerns of risk of bias. While the studies generally had low risk of bias related to selection of participants into the study, deviations from intended exposures, and measurement of the outcomes, other domains had generally higher risk of bias. The major concerns are listed below, which limited the ability to draw clear summary statements:

- Most of the studies<sup>1-5,7,9,12,14-19,22,23,25,27,29,30,32,33,35,36</sup> did not account for all key confounders, resulting in a serious risk of bias.
- The studies of stores had risk of bias related to the exposure classification because each study examined the exposure of income levels of neighborhoods near the stores, but could not provide evidence that residents of those neighborhoods in fact shopped at the study stores and thus may not have faced the food prices in those stores. The risk of bias was critical in 3 studies<sup>12,19,32</sup>.
- Concerns emerged regarding risk of bias due to potential selection of reported results because none of the studies had pre-registered data analysis plans. However, given that the reported domains were generally consistent with reported methods and that most of the studies reported at least 1 non-statistically significant result, the risk was judged to be moderate.
- Several studies<sup>12,15,25,29,30,32,35</sup> had missing data that differed between exposure groups, often due to a lack of availability of certain foods or food groups in 1 exposure group, resulting in risk of bias due to missing data. Another 3 studies<sup>1,14,33</sup> did not provide sufficient information to evaluate risk of bias due to missing data.

### *Consistency*

Results were inconsistent for the relationship between income and the price of fruits, vegetables, and fruits and vegetables combined, but overall suggest a direct relationship. Results were less clear when examining individual foods, but this may be due to the variety of individual foods examined which did not necessarily overlap across studies. Within studies of households or stores, the methods were generally similar across studies.

Some studies noted that access to larger stores and/or purchasing behaviors explained prices more than income; more of the studies that adjusted for key confounders and store type/access seemed to find no relationship between income and price.

### *Precision*

There was an adequate number of studies to investigate the relationship between income and prices of fruits and vegetables, and the studies generally had medium to large sample sizes.

### *Directness*

Although multiple studies were designed to examine a different outcome (e.g., diet quality, obesity, or differences in access to stores), they directly examined the relationship between income and price of fruits and vegetables. Some studies reported that store size and/or shopping behavior may explain pricing more than income. Further, most of the studies evaluated prices in stores, which made it difficult to answer the review question because the studies could not prove that neighborhood income was measured in the same individuals who purchased food at the study stores.

### *Generalizability*

Overall the body of evidence was geographically diverse, particularly for the results of vegetables and fruits and vegetables combined, and thus the results were generalizable to the U.S. population. This was most clear



in the household studies, which were nationally representative; and, the studies in stores were also conducted across the U.S. For the results of fruits there were no nationally representative studies but results overall cover much of the country. There was some racial, ethnic, and socioeconomic diversity across the body of evidence.

## Market baskets

### Description of the evidence

#### *Population*

Ten cross-sectional studies<sup>2,6,8,9,11,18,20-24,26,27,34</sup> and 1 prospective cohort study<sup>37</sup> reported market basket outcomes. These included 2 studies examining prices purchased by households (N=3,473<sup>37</sup> to 40,000<sup>8</sup>) and 9 studies examining price<sup>2,6,9,11,18,20-24,26,27,34</sup> in stores (N=4<sup>20</sup> to 1,953<sup>27</sup>). The body of evidence included samples from across the U.S. One study explicitly included small or convenience stores.<sup>2</sup>

#### *Intervention/exposure*

Four studies<sup>8,9,18,22-24</sup> measured income, 6 studies<sup>2,6,11,20,21,34,37</sup> measured geographic location as a proxy for income, and 1 study<sup>26,27</sup> measured a socioeconomic proxy for income.

#### *Outcome*

All market baskets included foods from multiple food groups. Two studies<sup>8,23</sup> measured the cost of all foods purchased, 4<sup>9,20-22</sup> measured the cost of a USDA Market Basket meeting the Dietary Guidelines for Americans, and 4<sup>6,9,11,22,24</sup> measured the cost of a diet based on the Thrift Food Plan. Three studies<sup>2,18,26,27</sup> reported the prices of regular and healthier food options of market baskets and two studies<sup>34,37</sup> simply reported foods across multiple food categories.

### Synthesis of the evidence

#### *Higher income related to higher prices of market baskets*

Both studies of households<sup>8,37</sup> found a statistically significant relationship between income and price of market baskets: higher income households paid more for market baskets than lower income households. The data were from households across the country, with large sample sizes (N=3,473 to 43,000). Five studies<sup>2,6,9,18,24</sup> reported a statistically significant relationship between income and price of market baskets in stores (N=25<sup>9,24</sup> to 110 stores<sup>6</sup>), such that stores in higher income neighborhoods had higher prices than stores in lower income neighborhoods. The studies took place primarily in California and in southern, eastern, and midwestern states. One study<sup>2</sup> explicitly included convenience stores.

#### *Higher income related to lower prices of market baskets*

Three studies of stores<sup>20,21,27,34</sup> found a statistically significant finding that price of market baskets was lower in stores from higher versus lower income neighborhoods (N=4<sup>20</sup> to 1,953<sup>27</sup>). The data were collected from across the U.S. None of the studies explicitly included small or convenience stores.

#### *Non-significant associations between income and prices of market baskets*

Six studies of stores<sup>2,11,18,22,23,27,34</sup> reported no relationship between income and the prices (N=55<sup>11</sup> to 1,953<sup>27</sup>). The data were collected from across the U.S., and 1 study<sup>2</sup> explicitly included convenience stores.



## Assessment of the evidence

### *Risk of bias*

The body of evidence was comprised primarily of cross-sectional studies with moderate to serious concerns of risk of bias. The studies generally had low risk of bias related to selection of participants into the study, deviations from intended exposures, and measurement of the outcomes. The major concerns in other domains are listed below, which limited the ability to draw clear summary statements:

- Two studies had serious<sup>21,37</sup> ratings for deviations from intended exposures due to unbalanced co-exposures between exposure groups.
- Most of the studies<sup>2,6,9,11,20,21,23,24,34</sup> did not account for all key confounders, resulting in a serious risk of bias.
- The studies of stores had risk of bias related to the exposure classification because each study examined the exposure of income levels of neighborhoods near the stores, but could not provide evidence that residents of those neighborhoods in fact shopped at the study stores and thus may not have faced the food prices in those stores. The risk of bias was critical in 2 studies.<sup>21,32</sup>
- Concerns emerged regarding risk of bias due to potential selection of reported results because none of the studies had pre-registered data analysis plans. However, given that the reported domains were generally consistent with reported methods and that most of the studies reported at least 1 non-statistically significant result, the risk was judged to be moderate.
- One study<sup>8</sup> did not provide sufficient information to evaluate risk of bias due to missing data.

### *Consistency*

Results were inconsistent, but generally suggested a relationship between higher income and higher price of market baskets. Methods were generally similar across studies. Many studies noted that access to larger stores and/or purchasing behaviors explained prices more than income.

### *Precision*

There was an adequate number of studies to investigate the relationship between income and prices of market baskets, with mostly medium or large sample sizes.

### *Directness*

Multiple studies were designed to examine a different outcome (e.g., diet quality, obesity, or differences in access to stores), but still directly examined the relationship between income and price of market baskets. Some studies reported that store size and/or shopping behavior may explain pricing more than income. Further, most of the studies evaluated prices in stores, which made it difficult to answer the review question because the studies could not prove that neighborhood income was measured in the same individuals who purchased food at the study stores.

### *Generalizability*

Overall, the body of evidence was geographically diverse, with more studies in urban than in rural areas, and included large, nationally representative studies. There was some racial, ethnic, and socioeconomic diversity across the body of evidence. Therefore, these studies were generalizable to the U.S. population.

## Dairy

### Description of the evidence

#### *Population*

Eleven cross-sectional studies reported dairy outcomes, including 10 studies examining price in stores<sup>1,7,10,18,22,23,26,27,29-32</sup> (N=6<sup>1</sup> to 8,793<sup>31</sup> stores), and 1 examining prices purchased by 43,000 households<sup>14</sup> (households). The body of evidence included samples from across the U.S., including two studies with nationally representative data.<sup>26,27,31</sup>

#### *Intervention/exposure*

Six studies<sup>1,14,18,22,23,29,31</sup> measured income, 4<sup>7,10,30,32</sup> measured geographic location as a proxy for income, and 1 study<sup>26,27</sup> measured a socioeconomic proxy for income.

#### *Outcome*

Outcomes included milk, cheese, and total dairy.

### Synthesis of the evidence

#### *Higher income related to higher prices of dairy*

Four studies found a statistically significant relationship between income and the price of milk<sup>1,10,26</sup> or low-fat dairy<sup>22</sup> in grocery stores, such that prices were higher in stores in higher income neighborhoods than in lower income neighborhoods. Study sample sizes ranged from small (N=6)<sup>1,10</sup> to large (N=1,743).<sup>26</sup> The study by Kern et al.<sup>26</sup> was nationally representative.

#### *Higher income related to lower prices of dairy*

Three studies<sup>10,27,31</sup> including 2 nationally representative studies,<sup>27,31</sup> reported a statistically significant between income and price of milk or dairy measured at grocery stores: prices of milk and dairy were higher in stores in higher income neighborhoods than stores in lower income neighborhoods. Study sample sizes ranged from small (N=6)<sup>10</sup> to large (N=8,793).<sup>31</sup>

#### *Non-significant associations between income and prices of dairy*

The study of households<sup>14</sup> found no relationship between income and the price of milk or cheese. Six studies<sup>7,18,22,23,29,30,32</sup> found no relationship between income and the price of dairy, specifically milk, measured in stores. Study sample sizes ranged from 28<sup>32</sup> to 73<sup>29</sup> stores, mostly from New York and the southern U.S. Two studies<sup>7,32</sup> included convenience stores, and 1 of those<sup>32</sup> had a critical rating for risk of bias due to exposure classification (**Table 1-c**) and thus could not provide useful information on the relationship between income and price of milk or cheese.

### Assessment of the evidence

#### *Risk of bias*

The body of evidence was comprised of cross-sectional studies with generally moderate to serious concerns of risk of bias. The studies generally had low risk of bias related to selection of participants into the study, deviations from intended exposures, and measurement of the outcomes. The major concerns in other domains are listed below, which limited the ability to draw clear summary statements:

- Most of the studies<sup>1,7,10,14,23,29-32</sup> did not account for all key confounders, resulting in a serious risk of bias.
- The studies of stores had risk of bias related to the exposure classification because each study examined the exposure of income levels of neighborhoods near the stores, but could not provide evidence that residents of those neighborhoods shopped at the study stores and thus may not have faced the food prices in those stores. The risk of bias was critical in 1 study.<sup>32</sup>
- Concerns emerged regarding risk of bias due to potential selection of reported results because none of the studies had pre-registered data analysis plans. However, given that the reported domains were generally consistent with reported methods and that most of the studies reported at least 1 non-statistically significant result, the risk was judged to be moderate.
- Three studies<sup>29,30,32</sup> had missing data that differed between exposure groups, often due to a lack of availability of certain foods or food groups in 1 exposure group, resulting in risk of bias due to missing data. Another 2 studies<sup>1,14</sup> did not provide sufficient information to evaluate risk of bias due to missing data.

### *Consistency*

Results were inconsistent for the relationship between income and the price of dairy, with generally similar methods across studies. Specific food items studies varied across studies. Many studies noted that access to larger stores and/or purchasing behaviors explained prices more than income.

### *Precision*

There were an adequate number of studies to investigate the relationship between income and prices of dairy, with varied sample sizes.

### *Directness*

Multiple studies were really designed to examine a different outcome (e.g., diet quality, obesity, or differences in access to stores), but still directly examined the relationship between income and price of dairy. Some studies reported that store size and/or shopping behavior may explain pricing more than income. Further, most of the studies evaluated prices in stores, which made it difficult to answer the review question because the studies could not provide evidence that neighborhood income was measured in the same individuals who faced food prices at the study stores.

### *Generalizability*

Overall the body of evidence was fairly geographically diverse, and included large, nationally representative studies. There was some racial, ethnic, and socioeconomic diversity across the body of evidence. Therefore, these studies were generalizable to the U.S. population.

## Grains

### Description of the evidence

#### *Population*

Eight cross-sectional studies reported grains as individual foods or food group(s), including 7 studies examining price in stores<sup>1,7,18,22,23,29,30,32</sup> (N=6<sup>1</sup> to 73<sup>29</sup> stores), and 1 examining prices purchased by 43,000

households.<sup>14</sup> The body of evidence included samples from across the U.S. Two studies in stores included small or convenience stores.<sup>7,32</sup>

### *Intervention/exposure*

Five studies<sup>1,14,18,22,23,29</sup> measured income and 3<sup>7,30,32</sup> measured geographic location as a proxy for income. No studies measured a socioeconomic proxy for income.

### *Outcome*

Outcomes included bread, breakfast cereals, flour, oatmeal, pasta, rice, and whole grains.

## Synthesis of the evidence

### *Higher income related to higher prices of grains*

Three studies<sup>1,18,32</sup> found a statistically significant relationship suggesting that higher income was related to higher grains prices, but the results were difficult to interpret. In 1 study,<sup>1</sup> prices did not differ between neighborhoods, shoppers in higher income neighborhoods purchased more expensive grains than shoppers in lower-income neighborhoods, suggesting that the effects reflected consumer behavior rather than prices faced. In a 2<sup>nd</sup> study,<sup>18</sup> prices of more nutrient dense grains were reported in comparison to less nutrient dense grains, and the size of the store was a stronger determinant of relative price than income. Further, the third study<sup>32</sup> had critical ratings for risk of bias due to exposure classification (**Table 1-c**) and thus could not provide useful information on the relationship between income and price of grains.

### *Higher income related to lower prices of grains*

Two studies of stores reported a statistically significant relationship between income and the price of bread<sup>30</sup> and cereal<sup>23</sup>: stores in higher income neighborhoods had higher prices than stores in lower neighborhoods.

### *Non-significant associations between income and prices of grains*

One study of 43,000 households across the U.S.<sup>14</sup> found no relationship between income and the price of grains, specifically the price of ready-to-eat breakfast cereal. Six studies in stores<sup>1,7,18,22,23,29,32</sup> found no relationship between income and the price of grains, specifically the price of whole grain bread.<sup>7,18,23,29,32</sup> Sample sizes ranged from 6<sup>1</sup> to 73<sup>29</sup> stores, and 2 of the studies<sup>7,32</sup> included data from convenience stores. Stores were primarily located in the southern and eastern U.S.

## Assessment of the evidence

### *Risk of bias*

The body of evidence was comprised of cross-sectional studies with generally moderate to serious concerns of risk of bias. While the studies generally had low risk of bias related to selection of participants into the study, deviations from intended exposures, and measurement of the outcomes, other domains had generally higher risk of bias. The major concerns are listed below, which limited the ability to draw clear summary statements:

- Most of the studies<sup>1,7,14,23,29,30,32</sup> did not account for all key confounders, resulting in a serious risk of bias.
- The studies of stores had serious risk of bias related to the exposure classification because each study examined the exposure of income levels in neighborhoods near the stores but did not provide evidence that residents of those neighborhoods shopped at the study stores. The risk of bias was critical in 1 study because the exposure was not clearly defined.<sup>32</sup>

- Risk of bias due to potential selection of reported results was possible because none of the studies had pre-registered data analysis plans. However, the risk was judged to be moderate because the reported domains were generally consistent with reported methods and that most of the studies reported at least 1 non-statistically significant result.
- Three studies<sup>29,30,32</sup> had missing data that differed between exposure groups, often due to a lack of availability of certain foods or food groups in 1 exposure group, resulting in risk of bias due to missing data. Two additional studies<sup>1,14</sup> did not provide sufficient information to evaluate risk of bias due to missing data.

### *Consistency*

Results were inconsistent for the relationship between income and the price of grains, with little overlap in the specific foods studied. Within studies of households or stores, respectively, the methods were generally similar across studies. Some studies noted that access to larger stores and/or purchasing behaviors explained prices more than income; more of the higher-quality studies reported no relationship between income and price.

### *Precision*

There were a somewhat small number of studies to investigate the relationship between income and grain prices, and the studies generally had small to medium sample sizes.

### *Directness*

Most of the studies reported that store size and/or shopping behavior may explain pricing more than income. Further, most of the studies evaluated prices in stores, which made it difficult to answer the review question because the studies could not prove that neighborhood income was measured in the same people who purchased food at the study stores.

### *Generalizability*

There were concerns with generalizability of the evidence as most studies were conducted in the eastern and midwestern regions of the U.S., and studies did not report sufficient information to evaluate the racial, ethnic, and socioeconomic diversity across the body of evidence.

## Proteins

### Description of the evidence

#### *Population*

Two cross-sectional studies reported protein food outcomes, including 1 study examining price in stores<sup>23</sup> (N=57 stores), and 1 examining prices purchased by households<sup>14</sup> (N=43,000 households). Hayes et al.<sup>23</sup> was conducted in New York City and Davis et al.<sup>14</sup> had a nationally representative sample.

#### *Intervention/exposure*

Both studies<sup>14,23</sup> measured income. No studies measured either geographic or socioeconomic proxies for income.

#### *Outcome*

Outcomes included chicken, eggs, ground beef, peanut butter, and tuna.

### *Synthesis of the evidence*

There was insufficient evidence to examine the relationship between income and price of protein foods.

## Summary statements and research recommendations

### Summary statements

The findings of the rapid review are presented in the following summary statements.

#### Fruits and vegetables

Evidence suggests that a higher income may be associated with a higher price of vegetables and fruits and vegetables combined, but shopping behavior may be an important factor in interpreting the data.

Evidence suggests no relationship between income and price of fruit, although higher income may be associated with a higher price of fruit. Store size and/or shopping behavior may explain pricing more than income.

All studies were cross-sectional, resulting in risk of bias concerns common in that study design. Most of the studies did not account for all key confounders and had risk of bias related to the exposure classification because most studies did not measure the exposure and outcome for the same individuals.

#### Market baskets

Evidence indicates that a higher income is associated with a higher price of market baskets. Income was more strongly associated with shopping behaviors and store size/access than the actual prices faced, although shopping behavior may be in response to prices.

Most of the studies did not account for all key confounders and had risk of bias related to the exposure classification because most studies did not measure the exposure and outcome for the same individuals.

#### Dairy

Evidence suggests that a higher income may be weakly associated with a lower price of dairy products, although studies were not consistent. Income was more strongly associated with shopping behaviors and store size/access than the actual prices faced, although shopping behavior may be in response to prices.

All studies were cross-sectional, resulting in risk of bias concerns common in that study design. Most of the studies did not account for all key confounders and had risk of bias related to the exposure classification because most studies did not measure the exposure and outcome for the same individuals.

#### Grains

Evidence suggests no relationship between income and price of grains, particularly whole-grain breads. There was not enough evidence to examine the relationship with other types of grains. Store size and or shopping behavior may explain pricing more than income.

All studies were cross-sectional, resulting in risk of bias concerns common in that study design. Most of the studies did not account for all key confounders and had risk of bias related to the exposure classification because most studies did not measure the exposure and outcome for the same individuals.

#### Protein foods

There was not enough evidence to examine the relationship between income and price of protein foods.

## Research recommendations

1. Conduct well-designed, longitudinal studies that examine the relationship between income and food price over time. In particular, these studies should directly examine the relationship between household-level income and actual prices at stores where household members shop for food.

2. Assess income exposures using standard definitions and categories to improve comparability across studies.
3. Assess food group prices using standard definitions and categories to improve comparability across studies.
4. Differentiate between participants in Federal assistance programs who are income-eligible, income-eligible nonparticipants, and income-ineligible nonparticipants.
5. Account for store size/type, access to stores, as well as other potential confounders including urban versus rural setting and cultural/racial diversity or disparities, to better determine the response to income on food price as a function of these factors.

Table 1-b. Evidence examining the relationship between income and price<sup>a</sup>

Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
<b>Prospective cohort study</b>				
Colabianchi, 2021 <sup>37</sup>	<p><b>N=3473</b></p> <p>All participants lived in public housing or project-based assisted housing located centrally in 1 of the five cities in a census tract with high poverty rates (i.e., 40% or more persons in the census tract had incomes &lt; federal poverty threshold) in 1995-1998.</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Treatment</li> <li>• Section 8</li> <li>• Control</li> </ul>	Market basket	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (log transformed), SE price per unit averaged across 13 categories, weighted linear regression, F-statistic: 16.50, p&lt;0.001</p> <p>Treatment (n=1428): 0.30, 0.026</p> <p>Section 8 (n=982): 0.24, 0.030</p> <p>Control (n=1063): 0.07, 0.031</p>
<b>Cross-sectional studies</b>				
Akбай, 2005 <sup>1</sup>	<p><b>N=6</b></p> <p>Analytic N is stores (supermarkets); Columbus, Ohio metropolitan area</p>	<p><b>Income</b></p> <ul style="list-style-type: none"> <li>• Lower</li> <li>• Higher</li> </ul>	Breakfast cereals	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean price paid for food products, cents per ounce</p> <p>Breakfast cereals, t-test</p> <p>Private brand price</p> <p>Lower income: 14.16</p> <p>Higher income: 14.73</p> <p>t: -4.72; p&lt;0.01</p> <p>National brand price</p> <p>Lower income: 20.02</p> <p>Higher income: 21.29</p> <p>t: -11.60; p&lt;0.01</p>





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Cooking oil	<b>Direct relationship, Statistically significant</b>  Mean price paid for food products, cents per ounce Cooking oil, t-test Private brand price Lower income: 6.99 Higher income: 11.98 t: -25.44; p<0.01  National brand Lower income: 7.89 Higher income: 15.34 t: -27.88; p<0.01
			Ice cream	<b>Direct relationship, Statistically significant</b>  Mean price paid for food products, cents per ounce Ice cream, t-test Private brand price Lower income: 3.50 Higher income: 3.98 t: -11.49; p<0.01  National brand Lower income: 6.66 Higher income: 9.28 t: -20.95; p<0.01
			Mayonnaise	<b>No relationship, Statistically non-significant</b>  Mayonnaise, t-test Private brand price Lower income: 6.18 Higher income: 6.28 t: -1.69; p<0.10  National brand Lower income: 11.29 Higher income: 11.27 t: -0.17; p>0.10



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Milk	<b>Direct relationship (National brand), Statistically significant</b>  Mean price paid for food products, cents per ounce Fluid milk, t-test Private brand price Lower income: 1.81 Higher income: 1.85 t: -1.47; p>0.10  National brand Lower income: 3.33 Higher income: 4.37 t: -22.6; p<0.01
			Pasta	<b>Direct relationship (National brand), Statistically significant</b>  Mean price paid for food products, cents per ounce Pasta, t-test Private brand price Lower income: 5.50 Higher income: 5.52 t: -0.72; p>0.10  National brand Lower income: 8.06 Higher income: 9.14 t: -13.75; p<0.01
			Salad dressing	<b>Direct relationship, Statistically significant</b>  Mean price paid for food products, cents per ounce Salad dressing, t-test Private brand price Lower income: 9.67 Higher income: 10.62 t: -8.70; p<0.01  National brand Lower income: 13.41 Higher income: 17.22 t: -16.51; p<0.01



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Salty Snacks	<p><b>Direct relationship (National brand)</b>  <b>Inverse relationship (Private brand), Statistically significant</b></p> <p>Mean price paid for food products, cents per ounce            Salty snacks, t-test            Private brand price            Lower income: 13.06            Higher income: 12.65            t: 3.02; p&lt;0.01</p> <p>National brand            Lower income: 19.60            Higher income: 20.22            t: -5.83; p&lt;0.01</p>
			Vegetables	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean price paid for food products, cents per ounce            Frozen vegetables, t-test            Private brand price            Lower income: 8.60            Higher income: 11.61            t: -9.47; p&lt;0.01</p> <p>National brand            Lower income: 12.51            Higher income: 13.06            t: -4.97; p&lt;0.01</p>
Andreyeva, 2008 <sup>2</sup>	<p><b>N=48, 75</b></p> <p>Study 1: Analytic N=48 stores            Supermarkets within a three-mile            distance from neighborhoods</p> <p>Study 2: Analytic N=75 stores (19            small and large grocery stores; 56            convenience stores)</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Lower</li> <li>• Higher</li> </ul>	Produce	<p><b>No relationship, Statistically non-significant</b></p> <p>Study 1: Average prices were not significantly different between            lower- and higher-income neighborhoods</p>
			Healthier Market Basket	<p><b>Direct relationship, Statistically significant</b></p> <p>Study 2: Average prices of healthful food basket, t-test            Low-income area: \$26.10            High-income area: \$27.20            p&lt;0.05</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Market basket	<p><b>Direct relationship, Statistically significant</b></p> <p>Study 2: Average prices of all-foods basket, t-test            Low-income area: \$46.70            High-income area: \$48.50            p&lt;0.05</p>
			Unhealthy food price	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Study 2: Average prices of regular food basket, t-test            Low-income area: \$20.60            High-income area: \$21.30            p&gt;0.05</p>
Ard, 2010 <sup>3</sup>	<p><b>N=44</b></p> <p>Analytic N is grocery stores in Jefferson and Shelby counties</p> <p>Neighborhood median characteristics:            29% African American            80% ≥high school diploma            12% HH &lt;poverty level</p>	<p><b>Geographic location</b></p> <p>% HH below poverty level</p>	<p>Potatoes</p>	<p><b>Direct relationship (t-test), Statistically significant</b>  <b>No relationship (multiple linear regression), Statistically non-significant</b></p> <p>Price/serving of white potatoes during spring months, multiple linear regression (adjusted for % African American and % ≥ high school diploma)            Beta coefficient (SE),            % HH below poverty level: 0.000 (0.001), p=0.92            F (35,3): 4.073, Adjusted R<sup>2</sup>: 0.195            Mean prices for potatoes, t-test, p=0.004            Highest tertile for % below poverty level: \$0.09            Lowest tertile for % below poverty level: \$0.13</p>
			Strawberries	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean price of strawberries, t-test, p=0.048            Middle tertile for % below poverty level: \$0.16            Top tertile for % below poverty level: NR but lower than middle tertile</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
<b>Beydoun, 2008<sup>5</sup></b>	<b>N=7331</b>  Analytic N is nationally representative sample of 7331 adults from USDA Continuing Survey of Food Intakes by Individuals (CSFII) 1994–1996. Mean age of 39.8 (SD: 0.25); 13.3 (SD: 1.0) years of education, 51% female, 74% non-Hispanic White; highest proportion lived in the South (36%); 47% lived in suburban areas	<b>Income</b> <ul style="list-style-type: none"> <li>• PIR ≤130%</li> <li>• PIR 131-299%</li> <li>• PIR ≥300%</li> </ul>	Fruits and Vegetables	<b>Inverse relationship, Statistically significant</b>  FV-PI Weighted Mean (SEM), ANOVA, p<0.05 ≤130% (n=1616): \$0.728 (0.009) 131-299% (n=2713): \$0.722 (0.007) ≥300% (n=3002): \$0.727 (0.007)  FV-PI Weighted Mean (SEM), ANOVA, p<0.05 ≤130%: \$0.728 (0.009) 131-299%: \$0.722 (0.007) ≥300%: \$0.727 (0.007)
<b>Beydoun, 2011<sup>4</sup></b>	<b>N=8438</b>  Analytic N is nationally representative sample of 6759 children aged 2-9 y and 1679 adolescents age 10-18 y from USDA Continuing Survey of Food Intakes by Individuals (CSFII) 1994–1996 and additional data collected from children aged 2–9 y in 1998.	<b>Income</b> <ul style="list-style-type: none"> <li>• PIR ≤185%</li> <li>• PIR &gt;185%</li> </ul>	Fruits and Vegetables	<b>Direct relationship (Children), Statistically significant</b> <b>No relationship (Adolescents), Statistically non-significant</b>  FV-PI among children (2-9 y) Weighted Mean (SE), ANOVA, p<0.05 ≤185%: \$0.72 (0.01) >185%: \$0.73 (0.01)  FV-PI among adolescents (10-18 y) Weighted Mean (SE), ANOVA, p≥0.05 ≤185%: \$0.72 (0.01) >185%: \$0.72 (0.01)
<b>Block, 2006<sup>6</sup></b>	<b>N=110</b>  Analytic N is stores; Austin: population 117,527, 42% of the HH lived in homes for ≥10 years. 24% HH<poverty level; primarily African American population with averages lower middle income Oak Park: population 52,500. Upper-middle-income suburb with a mixed profile	<b>Geographic location</b> <ul style="list-style-type: none"> <li>• Austin</li> <li>• Oak Park</li> </ul>	USDA Market Basket	<b>Direct relationship, Statistically significant</b>  Difference of means t-test: Austin \$110 vs. Oak Park \$122; P<0.001



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Borja, 2019 <sup>7</sup>	<p><b>N=65</b></p> <p>Analytic N is stores, including 25 grocery stores and 40 convenience stores</p> <p>County population of 1,408,566, 75% White, 18% African American, 29% Hispanic or Latino</p> <p>Median household income of \$51,681</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• low-income areas</li> <li>• not-low-income areas</li> </ul>	Apples	<p><b>Direct relationship (regression), Statistically significant</b></p> <p><b>No relationship (t-test), Statistically non-significant</b></p> <p>Mean prices of apples per unit</p> <p>T-test, P=NS</p> <p>Low-income areas: \$0.78</p> <p>Not-low-income areas: \$0.79</p> <p>Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type)</p> <p>Apple: 0.31 (0.13), p&lt;0.05</p>
			Bananas	<p><b>Direct relationship (regression), Statistically significant</b></p> <p><b>No relationship (t-test), Statistically non-significant</b></p> <p>Mean prices of bananas per unit</p> <p>T-test, P=NS</p> <p>Low-income areas: \$0.39</p> <p>Not-low-income areas: \$0.38</p> <p>Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type)</p> <p>Banana: 0.22 (0.11), p&lt;0.05</p>
			Bread	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean prices for white bread</p> <p>T-test, P=NS</p> <p>Low-income areas: \$2.73</p> <p>Not-low-income group: \$2.89</p> <p>Mean prices for whole wheat bread</p> <p>T-test, P=NS</p> <p>Low-income areas: \$2.85</p> <p>Not-low-income group: \$2.87</p> <p>Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type)</p> <p>White bread: -0.02 (0.39), NS</p> <p>Wheat bread: 0.05 (0.43), NS</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Breakfast cereals	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean prices of high sugar content cereal per 17/18 oz box T-test, P=NS Low-income areas: \$4.44 Not-low-income areas: \$4.03</p> <p>Mean prices of low sugar content cereal per 17/18 oz box T-test, P=NS Low-income areas: \$3.96 Not-low-income areas: \$3.85</p> <p>Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type) High sugar content cereal: -0.24 (0.39), NS Low sugar content cereal: -0.23 (0.34), NS</p>
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean price of whole milk (1 gallon) T-test, P=NS Low-income areas: \$4.28 Not-low-income areas: \$4.02</p> <p>Mean price of 2%-fat milk (1 gallon) T-test, P=NS Low-income areas: \$4.21 Not-low-income areas: \$3.96</p> <p>Mean price of 1%-fat milk (1 gallon) T-test, P=NS Low-income areas: \$3.79 Not-low-income areas: \$3.69</p> <p>Mean price of skim milk (1 gallon) T-test, P=NS Low-income areas: \$3.73 Not-low-income areas: \$3.59</p> <p>Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type) Whole milk: 0.05 (0.27), NS 1% milk: 0.28 (0.28), NS 2% milk: 0.26 (0.27), NS</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Oranges	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean prices of oranges per unit T-test, P=NS Low-income areas: \$0.88 Not-low-income areas: \$0.92 Beta coefficient (SE), Income and price regression (adjusted for distance, no car, density, and store type) Orange: 0.14 (0.16), NS</p>
<b>Broda, 2009<sup>8</sup></b>	<p><b>N=40,000</b></p> <p>Analytic N is demographically representative households Analytic N is demographically representative household and 452 stores across the U.S</p>	<p><b>Income</b> continuous</p>	Food	<p><b>Direct relationship, Statistically significant</b></p> <p>Ln (Price), Regression, within R<sup>2</sup>: 0.0638 Coefficient (SE), (adjusted for log income in household's zipcode, log income income in store's zipcode, household size, age, race, marital status, city of residence, and retail chain controls) Log HH Income: 0.0088 (0.0001), p&lt;0.01</p> <p>Food, produce not included Ln (Price), Regression, R<sup>2</sup>: 0.0304 Coefficient (SE), (adjusted for log income in household's zipcode, log income income in store's zipcode, race, store type, household size, age, marital status, and city of residence) Log HH Income: 0.0117 (0.0001), p&lt;0.01</p> <p>Non-random weight foods Ln (Price), Regression, R<sup>2</sup>: 0.0764 Coefficient (SE), (adjusted for log income in household's zipcode, log income income in store's zipcode, household size, age, race, marital status, and city of residence, retail chain controls) Log HH Income: 0.0079 (0.0001), p&lt;0.01</p> <p>Random weight foods Ln (Price), Regression, R<sup>2</sup>: 0.0474 Coefficient (SE), (adjusted for log income in household's zipcode, log income income in store's zipcode, household size, age, race, marital status, and city of residence, retail chain controls) Log HH Income: 0.0408 (0.0021), p&lt;0.01</p>





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Cassady, 2007 <sup>9</sup>	<b>N=75</b>  N=75 observations across 25 stores and 3 timepoints Number of observations by store type (N): Bulk (12), Independent (9), Chain (54)	<b>Income</b> <ul style="list-style-type: none"> <li>• Very low</li> <li>• Low</li> <li>• Middle</li> <li>• High</li> </ul>	2005 DGA Market Basket	<b>Direct relationship, Statistically significant</b>  2005 DGA Market Basket Mean total cost of F&V, t-test Very Low : \$64.94 Low: \$66.67 Middle: \$77.82, vs. Very Low p<0.05, vs. Low p<0.05 High: \$73.07, vs. Very Low p<0.05, vs. Low p<0.05
			TFP Food Basket	<b>Direct relationship, Statistically significant</b>  TFP market basket Mean total cost of F&V, t-test Very Low and Low: \$65 Middle and High: \$78, vs. Very Low and Low p≤0.05
			Fruit	<b>Direct relationship (Middle vs. lower), Statistically significant</b> <b>No relationship (High vs. lower), Statistically non-significant</b>  2005 DGA Market Basket Mean cost of fruit, t-test Very Low: \$31.60 Low: \$32.84 Middle: \$37.62, vs. Very Low p<0.05, vs. Low p<0.05 High: \$35.60



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
				<b>Direct relationship, Statistically significant</b>
				<p>Vegetables</p> <p>2005 DGA Market Basket Mean cost of vegetables, t-test Very Low: \$33.34 Low: \$34.28 Middle: \$40.19, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05 High: \$37.47, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05, vs. Middle p&lt;0.05</p> <p>Mean cost of dark green vegetables, t-test, p&gt;0.05 Very Low: \$4.41 Low: \$4.70 Middle: \$4.89 High: \$4.63</p> <p>Mean cost of orange vegetables, t-test Very Low: \$1.60 Low: \$1.76 Middle: \$2.33, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05 High: \$2.17, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05</p> <p>Mean cost of legumes, t-test, p&gt;0.05 Very Low: \$9.05 Low: \$8.58 Middle: \$9.66 High: \$9.82</p> <p>Mean cost of starchy vegetables, t-test Very Low: \$2.81 Low: \$2.94 Middle: \$4.22, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05 High: \$3.38</p> <p>Mean cost of other vegetables, t-test Very Low: \$15.77 Low: \$15.84 Middle: \$19.09, vs. Very Low p&lt;0.05, vs. Low p&lt;0.05 High: \$17.47</p>
				<b>Direct relationship, Statistically significant</b>
				<p>Fruit</p> <p>TFP market basket Mean cost of fruit, t-test, Data NR</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Vegetables	<p><b>Direct relationship, Statistically significant</b></p> <p>TFP market basket (Prices NR) Mean cost of vegetables High more than Very Low and Low, <math>p &gt; 0.05</math></p> <p>Mean cost of orange vegetables Middle more than Very Low and Low, <math>p \leq 0.05</math> High more than Very Low and Low, <math>p \leq 0.05</math></p> <p>Mean cost of starchy vegetables Middle more than Very Low and Low, <math>p \leq 0.05</math></p> <p>Mean cost of other vegetables Middle more than Very Low and Low, <math>p \leq 0.05</math></p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Chang, 2011 <sup>10</sup>	<p><b>N=6</b> Analytic N is stores</p> <p><u>Race:</u> Inner-city: White: 76.2%, Black: 21.7%, Other: 2.0% Suburban: White: 93.6%, Black: 3.5%, Other: 3.0%</p> <p><u>Education:</u> Inner-city: 30.4% at least some college, 33.7% did not graduate from high school Suburban: 65% at least some college, 11.3% did not graduate from high school</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Low Income</li> <li>• High Income</li> </ul>	Milk	<p><b>Direct relationship (organic milk), Statistically significant</b> <b>Inverse relationship (conventional skim milk), Statistically significant</b></p> <p>Price per half gallon Mean conventional whole milk prices, t-test, p=0.50 Inner-city: \$1.297 Suburban: \$1.305</p> <p>Mean conventional 2% milk prices, t-test, p=0.38 Inner-city: \$1.297 Suburban: \$1.308</p> <p>Mean conventional 1% milk prices, t-test, p=0.24 Inner-city: \$1.284 Suburban: \$1.269</p> <p>Mean conventional skim milk prices, t-test, p=0.00 Inner-city: \$1.363 Suburban: \$1.324</p> <p>Mean organic whole milk prices, t-test, p=0.00 Inner-city: \$2.980 Suburban: \$3.251</p> <p>Mean organic 2% milk prices, t-test, p=0.00 Inner-city: \$3.117 Suburban: \$3.267</p> <p>Mean organic 1% milk prices, t-test, p=0.00 Inner-city: \$3.210 Suburban: \$3.411</p> <p>Mean organic skim milk prices, t-test, p=0.00 Inner-city: \$2.877 Suburban: \$3.271</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Chung, 1999 <sup>11</sup>	<p><b>N=55</b>            N is stores            Nonpoor (n=31): zip codes with &lt;10% below poverty level; 87% of chain stores and 60% of nonchain stores in these ZIP            Poor (n=24): zip codes with ≥10% below poverty level; 13% of chain stores and 40% of nonchain stores in these ZIP</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• Non-poor</li> </ul>	TFP Food Basket	<p><b>Inverse relationship, Statistically significant</b></p> <p>Mean basket price, t-test            Poor: \$110.36            Non-poor: \$105.21            Difference: \$5.15            Difference (adjusted for chains and availability): \$3.41            t-value: 1.3076, p&gt;0.10            Recursive model, Adj R<sup>2</sup>=0.2535, p=0.0009            Coefficient, t-value            Poor: -1.5223, -0.329 (NS)            Adjusted for chain supermarket, % stores in ZIP chains, availability index</p>
Cole, 2010 <sup>12</sup>	<p><b>N=45</b></p> <p>Analytic N is census tracts two Brooklyn Community Districts (BCD). BCD 6 included Carroll Gardens, Cobble Hill, Park Slope, Gowanus, and Red Hook. BCD 9 included Crown Heights South, Prospect Lefferts Gardens, and Wingate.</p>	<p><b>SES proxy</b></p> <ul style="list-style-type: none"> <li>• &gt;80% Black (low income)</li> <li>• 20-80% Black (middle)</li> <li>• &lt;20% Black (high income)</li> </ul>	Apples	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of apples, statistical method NR, p=significant            Predominantly Black, low-income (n=3): \$0.44 (n/a)            Mixed race, middle income (n=7): \$0.52 (0.11)            Predominantly White, high-income (n=17): \$0.70 (0.24)</p>
			Asparagus	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of asparagus, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$2.39 (n/a)            Mixed race, middle income (n=1): \$n/a (n/a)            Predominantly White, high-income (n=5): \$3.06 (1.01)</p>
			Avocados	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of avocados, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$n/a (n/a)            Mixed race, middle income (n=6): \$1.31 (0.41)            Predominantly White, high-income (n=11): \$1.79 (0.38)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Bananas	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of yellow bananas, statistical method NR, p=significant            Predominantly Black, low-income (n=0): \$n/a (n/a)            Mixed race, middle income (n=10): \$0.24 (0.06)            Predominantly White, high-income (n=18): \$0.29 (0.09)</p>
			Berries	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of berries, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$3.33 (n/a)            Mixed race, middle income (n=5): \$3.24 (1.75)            Predominantly White, high-income (n=11): \$4.10 (1.39)</p>
			Broccoli	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of broccoli, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$1.49 (n/a)            Mixed race, middle income (n=2): \$0.99 (n/a)            Predominantly White, high-income (n=7): \$2.32 (0.71)</p>
			Corn	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of corn, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$n/a (n/a)            Mixed race, middle income (n=4): \$0.33 (n/a)            Predominantly White, high-income (n=8): \$0.89 (0.44)</p>
			Cucumbers	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of cucumbers, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$0.50 (n/a)            Mixed race, middle income (n=6): \$0.34 (0.15)            Predominantly White, high-income (n=11): \$0.55 (0.42)</p>
			Eggplant	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of eggplants, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$n/a (n/a)            Mixed race, middle income (n=5): \$0.63 (0.11)            Predominantly White, high-income (n=6): \$1.09 (0.36)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Grapefruit	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of grapefruit, statistical method NR, p=significant Predominantly Black, low-income (n=1): \$0.65 (n/a) Mixed race, middle income (n=5): \$0.60 (0.24) Predominantly White, high-income (n=12): \$1.24 (0.75)
			Green beans	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of green beans (lb), statistical method NR, p=significant Predominantly Black, low-income (n=2): \$0.99 (n/a) Mixed race, middle income (n=5): \$2.94 (n/a) Predominantly White, high-income (n=9): \$2.31 (0.58)
			Lemons	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of lemons, statistical method NR, p=significant Predominantly Black, low-income (n=4): \$0.25 (n/a) Mixed race, middle income (n=6): \$0.27 (0.04) Predominantly White, high-income (n=15): \$0.42 (0.22)
			Lettuce	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of greens, lettuce, statistical method NR, p=significant Predominantly Black, low-income (n=3): \$0.99 (n/a) Mixed race, middle income (n=6): \$1.35 (0.51) Predominantly White, high-income (n=11): \$1.43 (0.96)
			Limes	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of limes, statistical method NR, p=significant Predominantly Black, low-income (n=1): \$0.15 (n/a) Mixed race, middle income (n=4): \$0.17 (0.05) Predominantly White, high-income (n=14): \$0.42 (0.23)
			Mangoes	<b>No relationship, Statistically non-significant</b>  Mean (SD) price of mangoes, statistical method NR, p=NS Predominantly Black, low-income (n=1): \$1.50 (n/a) Mixed race, middle income (n=5): \$1.47 (0.35) Predominantly White, high-income (n=14): \$1.39 (0.47)



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Melons	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of melons, statistical method NR, p=significant Predominantly Black, low-income (n=1): \$1.50 (n/a) Mixed race, middle income (n=6): \$1.60 (1.12) Predominantly White, high-income (n=10): \$3.12 (1.39)
			Mushrooms	<b>Direct relationship, Statistically non-significant</b>  Mean (SD) price of mushrooms (lb), statistical method NR, p=NR Predominantly Black, low-income (n=1): \$n/a (n/a) Mixed race, middle income (n=2): \$3.39 (n/a) Predominantly White, high-income (n=7): \$6.24 (3.20)
			Okra	<b>Inverse relationship, Statistically significant</b>  Mean (SD) price of okra (lb), statistical method NR, p=significant Predominantly Black, low-income (n=1): \$3.99 (n/a) Mixed race, middle income (n=2): \$2.00 (n/a) Predominantly White, high-income (n=2): \$1.54 (1.34)
			Oranges	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of oranges, statistical method NR, p=significant Predominantly Black, low-income (n=3): \$0.33 (n/a) Mixed race, middle income (n=6): \$0.44 (0.07) Predominantly White, high-income (n=15): \$0.56 (0.24)
			Pears	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of pears, statistical method NR, p=significant Predominantly Black, low-income (n=0): \$n/a (n/a) Mixed race, middle income (n=5): \$0.49 (0.05) Predominantly White, high-income (n=9): \$0.76 (0.22)
			Peppers	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of peppers, statistical method NR, p=significant Predominantly Black, low-income (n=1): \$0.33 (n/a) Mixed race, middle income (n=7): \$0.56 (0.08) Predominantly White, high-income (n=11): \$0.94 (0.49)
			Pineapple	<b>Direct relationship, Statistically significant</b>  Mean (SD) price of pineapples, statistical method NR, p=significant Predominantly Black, low-income (n=0): \$n/a (n/a) Mixed race, middle income (n=4): \$1.99 (n/a) Predominantly White, high-income (n=9): \$4.42 (1.13)





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Plums	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of plums, statistical method NR, p=significant            Predominantly Black, low-income (n=0): \$n/a (n/a)            Mixed race, middle income (n=5): \$0.34 (0.20)            Predominantly White, high-income (n=11): \$0.67 (0.30)</p>
			Potatoes	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of potatoes, statistical method NR, p=significant            Predominantly Black, low-income (n=6): \$0.33 (n/a)            Mixed race, middle income (n=9): \$0.41 (0.36)            Predominantly White, high-income (n=17): \$1.01 (1.63)</p>
			Squash	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of squash, statistical method NR, p=significant            Predominantly Black, low-income (n=1): \$1.00 (n/a)            Mixed race, middle income (n=6): \$1.00 (0.49)            Predominantly White, high-income (n=8): \$1.61 (1.30)</p>
			Tomatoes	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SD) price of , statistical method NR, p=significant            Predominantly Black, low-income (n=3): \$0.54 (n/a)            Mixed race, middle income (n=7): \$0.51 (0.07)            Predominantly White, high-income (n=17): \$0.77 (0.33)</p>
<b>Daep, 2015<sup>13</sup></b>	<p><b>N=40</b></p> <p>Analytic N = stores</p>	<p><b>Income</b></p> <ul style="list-style-type: none"> <li>• Low</li> <li>• High</li> </ul>	Broccoli	<p><b>No relationship, Statistically non-significant</b></p> <p>Broccoli (bunch) in grocery stores            High vs. Low income            Kruskal Wallis Chi-square: 3.7817, p=0.0518</p>
			Cabbage	<p><b>No relationship, Statistically non-significant</b></p> <p>Cabbage (1 lb) in grocery stores            High vs. Low income            Kruskal Wallis Chi-square: 0.9724, p=0.3241</p>
			Carrots	<p><b>No relationship, Statistically non-significant</b></p> <p>Carrots (1 lb) in grocery stores            High vs. Low income            Kruskal Wallis Chi-square: 0.3628, p=0.547</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Cauliflower	<b>Direct relationship, Statistically significant</b>  Cauliflower (pc) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 5.2067, p=0.0225
			Celery	<b>No relationship, Statistically non-significant</b>  Celery (stalk) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 0.2384, p=0.6254
			Corn	<b>No relationship, Statistically non-significant</b>  Corn (3 pc) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 2.1, p=0.1473
			Cucumbers	<b>No relationship, Statistically non-significant</b>  Cucumber (pc) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 0, p=1.0000
			Lettuce	<b>No relationship, Statistically non-significant</b>  Lettuce in grocery stores High vs. Low income Kruskall Wallis Chi-square: 1.1126, p=0.2915
			Peppers	<b>No relationship, Statistically non-significant</b>  Peppers (pc) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 0.7445, p=0.3882
			Tomatoes	<b>No relationship, Statistically non-significant</b>  Tomatoes (1 lb) in grocery stores High vs. Low income Kruskall Wallis Chi-square: 0.5038, p=0.4778



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Davis, 2005 <sup>14</sup>	<p><b>N=43000</b></p> <p>Analytic N = about 43,000 households from 24 cities in 17 States California (San Francisco/Oakland, Los Angeles, Visalia), Colorado (Denver, Grand Junction), Florida (Tampa/St. Petersburg), Georgia (Atlanta, Rome); Illinois (Chicago), Iowa (Cedar Rapids)</p>	<p><b>Income</b></p> <ul style="list-style-type: none"> <li>• Low income; WIC eligible</li> <li>• High income</li> </ul>	Beans	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for dried beans/peas did not differ between income classes. (Statistical test NR)</p>
			Breakfast cereals	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for baby cereals and ready-to-eat breakfast cereals did not differ between income classes. (Statistical test NR)</p>
			Cheese	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for cheese did not differ between income classes. (Statistical test NR)</p>
			Eggs	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for eggs did not differ between income classes. (Statistical test NR)</p>
			Juice	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for fruit and vegetable juice did not differ between income classes. (Statistical test NR)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean milk price (1 gal), Statistical test NR            Low income, WIC eligible, High income, p=non-significant            CA: \$2.61, \$2.57, \$2.70            CO: \$2.49, \$2.52, \$2.43            FL: \$2.98, \$3.00, \$3.00            GA: \$2.55, \$2.61, \$2.69            IA: \$2.33, \$2.36, \$2.30            IL: \$2.52, \$2.46, \$2.54            KS: \$2.66, \$2.64, \$2.64            MA: \$2.62, \$2.65, \$2.61            MI: \$2.57, \$2.55, \$2.57            MN: \$2.89, \$2.88, \$2.88            MO: \$2.76, \$2.77, \$2.76            NY: \$2.92, \$2.87, \$2.90            PA: \$2.36, \$2.48, \$2.37            TN: \$2.82, \$2.81, \$2.85            TX: \$2.43, \$2.37, \$2.40            WA: \$2.52, \$2.52, \$2.62            WI: \$2.51, \$2.53, \$2.51</p>
			Peanut butter	<p><b>No relationship, Statistically non-significant</b></p> <p>Prices for peanut butter did not differ between income classes.            (Statistical test NR)</p>
DeWeese, 2017 <sup>15</sup>	<p><b>N=104</b></p> <p>Analytic N is New Jersey corner stores for metro areas of Camden, Newark, New Brunswick, and Trenton, NJ</p>	<p><b>Income</b></p> <ul style="list-style-type: none"> <li>• Low</li> <li>• Med</li> <li>• High</li> </ul>	Chips	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean price of chips, ANOVA, P=NS            Lowest income (≥54%): \$0.45            Medium income (34-&lt;54%): \$0.49            Highest income (&lt;34%): \$0.45</p>
			Fruit	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean price of fruit, ANOVA, P=NS            Lowest income (≥54%): \$0.49            Medium income (34-&lt;54%): \$0.50            Highest income (&lt;34%): \$0.47</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Dunn, 2011 <sup>16</sup>	<p><b>N=23</b></p> <p>Analytic N = 23 stores from 6 rural counties in the Brazos Valley, located between Dallas and Houston.</p> <p>Census block group characteristics of the included stores, Mean (SD): Median family income: \$30,083 (\$7,290)</p> <p>Proportion Black: 21.2% (16.1%)</p> <p>Proportion Hispanic: 16.5% (9.7%)</p>	<p><b>Income</b></p> <p>Median family income</p>	Fruit	<p><b>Direct relationship (High variety), Statistically non-significant</b></p> <p><b>No relationship (Basic variety), Statistically non-significant</b></p> <p>Fruit Price Index--High Variety</p> <p>Multivariate regression, R<sup>2</sup>=0.19, N=21</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=10.15 (5.99), p&gt;0.05</p> <p>Fruit Price Index--Basic Variety</p> <p>Multivariate regression, R<sup>2</sup>=0.02, N=22</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=-0.12 (3.49), p&gt;0.05</p>
			Vegetables	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Vegetable Price Index--High Variety</p> <p>Multivariate regression, R<sup>2</sup>=0.14, N=23</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=13.87 (6.94), p&gt;0.05</p> <p>Vegetable Price Index--Basic Variety</p> <p>Multivariate regression, R<sup>2</sup>=0.15, N=23</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=16.12 (8.11), p&gt;0.05</p>
			Apples	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of apples (\$/lb)</p> <p>Multivariate regression, R<sup>2</sup>=0.09, N=21</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=0.50 (0.45), p&gt;0.05</p>
			Avocados	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of avocados (\$/lb)</p> <p>Multivariate regression, R<sup>2</sup>=0.48, N=21</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=3.78 (1.37), p&lt;0.01</p>
			Bananas	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of bananas (\$/lb)</p> <p>Multivariate regression, R<sup>2</sup>=0.17, N=21</p> <p>Coefficient estimates (robust SE), adjusted for race</p> <p>Median family income (ln): B=-0.16 (0.10), p&gt;0.05</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Beans	<b>Inverse relationship, Statistically significant</b>  Price of green beans (\$/lb) Multivariate regression, R <sup>2</sup> =0.22, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-2.05 (1.03), p<0.05
			Berries	<b>No relationship, Statistically non-significant</b>  Price of berries (\$/lb) Multivariate regression, R <sup>2</sup> =0.11, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.21 (1.04), p>0.05
			Carrots	<b>No relationship, Statistically non-significant</b>  Price of carrots (\$/lb) Multivariate regression, R <sup>2</sup> =0.15, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-0.16 (0.44), p>0.05
			Corn	<b>No relationship, Statistically non-significant</b>  Price of corn (\$/lb) Multivariate regression, R <sup>2</sup> =0.16, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.03 (0.53), p>0.05
			Cruciferous vegetables	<b>No relationship, Statistically non-significant</b>  Price of cruciferous vegetables (\$/lb) Multivariate regression, R <sup>2</sup> =0.15, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.26 (0.30), p>0.05
			Grapes	<b>No relationship, Statistically non-significant</b>  Price of grapes (\$/lb) Multivariate regression, R <sup>2</sup> =0.04, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.54 (0.60), p>0.05
			Greens	<b>No relationship, Statistically non-significant</b>  Price of greens (\$/lb) Multivariate regression, R <sup>2</sup> =0.11, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-0.30 (0.33)



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Lettuce	<b>No relationship, Statistically non-significant</b>  Price of lettuce (\$/lb) Multivariate regression, R <sup>2</sup> =0.31, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=1.11 (0.67), p>0.05
			Melons	<b>No relationship, Statistically non-significant</b>  Price of melons (\$/lb) Multivariate regression, R <sup>2</sup> =0.01, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.09 (0.38), p>0.05
			Onions	<b>No relationship, Statistically non-significant</b>  Price of onions (\$/lb) Multivariate regression, R <sup>2</sup> =0.06, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.51 (0.54), p>0.05
			Oranges	<b>No relationship, Statistically non-significant</b>  Price of oranges (\$/lb) Multivariate regression, R <sup>2</sup> =0.02, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-0.03 (0.40), p>0.05
			Peaches	<b>No relationship, Statistically non-significant</b>  Price of peaches (\$/lb) Multivariate regression, R <sup>2</sup> =0.08, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-0.30 (0.49), p>0.05
			Pears	<b>No relationship, Statistically non-significant</b>  Price of pears (\$/lb) Multivariate regression, R <sup>2</sup> =0.02, N=21 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=-0.06 (0.55), p>0.05
			Potatoes	<b>No relationship, Statistically non-significant</b>  Price of potatoes (\$/lb) Multivariate regression, R <sup>2</sup> =0.13, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.48 (0.39), p>0.05



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Squash	<b>Direct relationship, Statistically significant</b>  Price of squash (\$/lb) Multivariate regression, R <sup>2</sup> =0.26, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=1.08 (0.41), p<0.01
			Tomatoes	<b>No relationship, Statistically non-significant</b>  Price of tomatoes (\$/lb) Multivariate regression, R <sup>2</sup> =0.07, N=23 Coefficient estimates (robust SE), adjusted for race Median family income (ln): B=0.62 (0.49), p>0.05
<b>French, 2010<sup>17</sup></b>	<b>N=90</b>  Analytic N is households Mean of four people per household. Primary shoppers were 93% female; 78% White; Mean age 40.8 y (SD=7.3); 64% married or living with significant other; 25.8% had more than a college degree; mean BMI: 29.7 (SD=7.2)	<b>Income</b> • Low • Med • High	Fruits and Vegetables	<b>Direct relationship, Statistically significant</b>  Monthly median price per person per ounce of fruits/vegetables eaten at home, Jonckheere-Terpstra test, p=0.007 Low: \$0.08 Med: \$0.08 High: \$0.10
<b>Gillespie, 2015<sup>18</sup></b>	<b>N=60</b>  Analytic N = full-service grocery stores across 9 parishes Median HH income: \$45,392 African American population: 39%	<b>Income</b>	Healthier Market Basket	<b>No relationship, Statistically non-significant</b>  Price(Ln) of Nutrient-dense foods Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=50, R <sup>2</sup> : 0.184, Prob>F: 0.070 Coefficient (SE) Income(Ln): 0.143 (0.138), p>0.10
			Unhealthy food price	<b>Direct relationship, Statistically significant</b>  Price(Ln) of Energy-dense foods, Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=40, R <sup>2</sup> : 0.596, Prob>F: 0.000 Coefficient (SE) Income(Ln): -0.237 (0.131), p≤0.10 [10% increase in income was associated with a 2.37% decrease in price of energy-dense foods]





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Healthy to unhealthy ratio	<p><b>Direct relationship (bread:cakes, potatoes:cakes, oatmeal:cakes, oatmeal:cola)</b>  <b>Inverse relationship (milk:cola, bananas:cola, bananas:chips)</b></p> <p>Income was significant (<math>p \leq 0.10</math>) for 7 (26%) of the 45 regressions for nutrient-dense/energy-dense pricing ratios. Models adjusted for Black, High or Low real estate value, urban, chain, supercenter, services, store size, and competition.</p> <p>4 regressions (15%) indicated that higher income resulted in relatively higher prices for nutrient-dense foods relative to energy-dense foods: whole-wheat bread, potatoes, and oatmeal, all relative to snack cakes, and oatmeal relative to cola.</p> <p>3 regressions (11%) indicated that higher income resulted in relatively lower prices for nutrient-dense foods relative to energy-dense foods: skim milk and bananas relative to cola and bananas relative to potato chips.</p> <p>When the nutrient-dense market basket /energy-dense market basket cost ratio was analyzed, income was non-significant.</p>
			Bananas	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of bananas (1 lb)  Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), <math>N=59</math>, <math>R^2: 0.128</math>, <math>\text{Prob}&gt;F: 0.008</math>  Coefficient (SE)  Income(Ln): <math>-0.212 (0.237)</math>, <math>p &gt; 0.10</math></p>
			Bread	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of whole wheat bread (20 oz)  Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), <math>N=58</math>, <math>R^2: 0.220</math>, <math>\text{Prob}&gt;F: 0.036</math>  Coefficient (SE)  Income(Ln): <math>0.167 (0.257)</math>, <math>p &gt; 0.10</math></p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Broccoli	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of broccoli (1 lb) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=59, R<sup>2</sup>: 0.424, Prob&gt;F: 0.000 Coefficient (SE) Income(Ln): 0.207 (0.185), p&gt;0.10</p>
			Chips	<p><b>Direct relationship, Statistically significant</b></p> <p>Price(Ln) of potato chips (12 oz) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=57, R<sup>2</sup>: 0.486, Prob&gt;F: 0.000 Coefficient (SE) Income(Ln): 0.543 (0.215), p&lt;0.05 [10% increase in income was associated with a 5.43% increase in price of potato chips]</p>
			Ice cream	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of ice cream (0.5 gal) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=59, R<sup>2</sup>: 0.217, Prob&gt;F: 0.018 Coefficient (SE) Income(Ln): 0.121 (0.186), p&gt;0.10</p>
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of skim milk (1 gal) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=59, R<sup>2</sup>: 0.326, Prob&gt;F: 0.001 Coefficient (SE) Income(Ln): 0.117 (0.087), p&gt;0.10</p>
			Oatmeal	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of oatmeal (18 oz) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=58, R<sup>2</sup>: 0.206, Prob&gt;F: 0.006 Coefficient (SE) Income(Ln): 0.401 (0.307), p&gt;0.10</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Oranges	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of oranges (1 lb) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=58, R<sup>2</sup>: 0.358, Prob&gt;F: 0.000 Coefficient (SE) Income(Ln): 0.225 (0.204), p&gt;0.10</p>
			Soda	<p><b>No relationship, Statistically non-significant</b></p> <p>Price(Ln) of cola (2 L) Regression (adjusted for Black, real estate value, urban, chain, supercenter, services, store size, competition), N=58, R<sup>2</sup>: 0.488, Prob&gt;F: 0.000 Coefficient (SE) Income(Ln): 0.082 (0.225), p&gt;0.10</p>
<b>Gosliner, 2018<sup>19</sup></b>	<p><b>N=1474</b></p> <p>Analytic N=1474 stores in 470 unique census tracts within 225 low-income neighborhoods in cities and towns across 44 California counties.</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Low-income neighborhoods</li> <li>• County average</li> </ul>	Apples	<p><b>Inverse relationship, Statistically significant</b></p> <p>Average lowest price of apples (\$/lb) by store type Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR Large groceries (n=218): \$1.17 (0.39, 0.66-2.99), 44% Small markets (n=312): \$1.18 (0.37, 0.63-2.59), 53% Convenience stores (n=130): \$1.58 (0.50, 0.69-2.80), 110%</p>
			Bananas	<p><b>Inverse relationship, Statistically significant</b></p> <p>Average lowest price of bananas (\$/lb) by store type Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR Large groceries (n=218): \$0.70 (0.16, 0.49-1.49), 15% Small markets (n=336): \$0.85 (0.31, 0.49-2.19), 39% Convenience stores (n=150): \$1.30 (0.46, 0.49-2.19), 115%</p>
			Broccoli	<p><b>No relationship, Statistically non-significant</b></p> <p>Average lowest price of broccoli (\$/lb) by store type Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR Large groceries (n=199): \$1.30 (0.49, 0.68-3.19), 1% Small markets (n=142): \$1.33 (0.56, 0.68-3.18), 6% Convenience stores: Available in too few stores for inclusion</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Cabbage	<p><b>No relationship, Statistically non-significant</b></p> <p>Average lowest price of cabbage (\$/lb) by store type  Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR  Large groceries (n=172): \$0.74 (0.27, 0.38-1.59) 0%  Small markets (n=261): \$0.66 (0.26, 0.34-1.50), -1%  Convenience stores: Available in too few stores for inclusion</p>
			Carrots	<p><b>Inverse relationship, Statistically significant</b></p> <p>Average lowest price of carrots (\$/lb) by store type  Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR  Large groceries (n=179): \$0.84 (0.33, 0.50-2.14), 33%  Small markets (n=242): \$0.91 (0.37, 0.50-2.20), 43%  Convenience stores (n=24): \$1.22 (0.58, 0.50-2.00), 102%</p>
			Oranges	<p><b>Inverse relationship, Statistically significant</b></p> <p>Average lowest price of oranges (\$/lb) by store type  Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR  Large groceries (n=200): \$0.95 (0.40, 0.48-1.49), 35%  Small markets (n=249): \$0.88 (0.41, 0.47-2.20), 27%  Convenience stores (n=88): \$1.36 (0.59, 0.50-2.20), 107%</p>
			Tomatoes	<p><b>Inverse relationship, Statistically significant</b></p> <p>Average lowest price of tomatoes (\$/lb) by store type  Mean (SD, range), Relative price difference from county chain supermarket average, Statistical test NR  Large groceries (n=197): \$1.21 (0.45, 0.59-2.66), 13%  Small markets (n=311): \$1.12 (0.41, 0.59-2.79), 6%  Convenience stores (n=57): \$1.21 (0.38, 0.69-2.19), 23%</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Hardin-Fanning, 2015 <sup>20</sup>	<p><b>N=4</b></p> <p>Analytic N is number of counties 4 counties compared with 1 store/county All groceries were regional or national chain stores of similar size and food product variety</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• FD-HP</li> <li>• U-MP</li> <li>• U-LP</li> <li>• HP</li> </ul>	USDA Market Basket	<p><b>Inverse relationship (healthier foods), Statistically significant</b></p> <p>Mean price/serving, repeated measures ANOVA (adjusted for month and ONQI score (fixed effects) and food item identifier (random effect)) County: <math>F(3,1365) = 22.9, p &lt; 0.0001</math> County x Month: <math>p = 0.4</math></p> <p>Mean price/serving, repeated measures ANOVA (adjusted for month and quartile x month (fixed effects) and food item identifier (random effect)) County: <math>F(3,1347) = 24.5, p &lt; 0.0001</math> County x Month: <math>p &gt; 0.0005</math> ONQI quartile x County: <math>F(9,1347) = 6.7, p &lt; 0.0001</math></p> <p>Mean price/serving, Post-hoc analysis FD-HP (lower per capita income): \$0.40 vs. U-MP and U-LP, <math>p &lt; 0.0001</math>; vs. HP, <math>p = 0.0002</math> U-MP and U-LP (higher per capita income; average): \$0.36 HP (higher per capita income): \$0.38 vs. U-LP <math>p = 0.003</math></p>
Hardin-Fanning, 2017 <sup>21</sup>	<p><b>N=15</b></p> <p>Analytic N is number of counties 15 counties compared with 1 store/county All groceries were regional or national chain stores of similar size and food product variety</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Least healthy counties (highest average poverty rates)</li> <li>• Moderately healthy counties (lower average poverty rates)</li> <li>• Most healthy counties (lower average poverty rates)</li> </ul>	USDA Market Basket	<p><b>Inverse relationship, Statistically significant</b></p> <p>GEE Model, Price per serving across health ranking groups, adjusted for ONQI quartile, county population, Appalachian status, and multiple measurements per county. Chi-squared: 12, <math>P = 0.003</math></p> <p>Post-hoc analysis of pairwise differences, mean price/serving: Least healthy (highest poverty) \$0.58 Moderately healthy (lower poverty) \$0.53 Most healthy (lower poverty) \$0.50</p> <p>Relative price per serving (\$) by health tertiles: Least healthy (highest poverty) vs. Most healthy (lower poverty): <math>B = 0.08, SE = 0.02, Z = 3.8, P &lt; 0.001</math> Least healthy (highest poverty) vs. Moderately healthy (lower poverty): <math>B = 0.05, SE = 0.02, Z = 2.3, P = 0.024</math> Moderately healthy vs. Most healthy, <math>P = NS</math></p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Hatzenbuehler, 2012 <sup>22</sup>	<p>N=59</p> <p>Analytic N is supermarkets in Baton Rouge, Louisiana, metropolitan area</p> <p>Mean income: \$40,704 (range: \$17,170-77,668)</p> <p>Mean household size: 2.61 (range: 1.87-3.08)</p> <p>Mean % Black: 32.53% (0.50-97.00%)</p> <p>Mean % other minority: 4.55% (1.06-11.96%)</p>	Income continuous	TFP Food Basket	<p><b>No relationship, Statistically non-significant</b></p> <p>TFP market basket, Ordinary least squares</p> <p>Income: B: 0.29, t-value: 0.76, p&gt;0.05</p> <p>R<sup>2</sup>: 0.3250, Model F-value: 4.10, p&lt;0.01</p> <p>Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>
			2005 DGA Market Basket	<p><b>No relationship, Statistically non-significant</b></p> <p>Stewart DGA market basket, Ordinary least squares</p> <p>Income: B: 0.52, t-value: 1.50, p&gt;0.05</p> <p>R<sup>2</sup>: 0.3655, Model F-value: 4.71, p&lt;0.01</p> <p>Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>
			Dairy	<p><b>Direct relationship (2005 DGA), Statistically significant</b></p> <p><b>No relationship (TFP), Statistically non-significant</b></p> <p>Low-fat dairy products for the Stewart 2005 DGA market basket</p> <p>Ordinary least squares</p> <p>Income: B: 0.17, t-value: 2.19, p&lt;0.05</p> <p>R<sup>2</sup>: 0.2407, Model F-value: 3.04, p&lt;0.01</p> <p>Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p> <p>Low-fat dairy products for the TFP market basket</p> <p>Ordinary least squares</p> <p>Income: B: 0.06, t-value: 1.43, p&gt;0.05</p> <p>R<sup>2</sup>: 0.1491, Model F-value: 2.13, p&lt;0.05</p> <p>Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Fruit	<p><b>Direct relationship (2005 DGA), Statistically significant</b>  <b>No relationship (TFP), Statistically non-significant</b></p> <p>Fruit for the Stewart 2005 DGA market basket            Ordinary least squares            Income: B: 0.13, t-value: 2.55, p&lt;0.05            R<sup>2</sup>: 0.3778, Model F-value: 4.91, p&lt;0.01            Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p> <p>Fruit for the TFP market basket            Ordinary least squares            Income: B: 0.23, t-value: 1.52, p&gt;0.05            R<sup>2</sup>: 0.2893, Model F-value: 3.62, p&lt;0.01            Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>
			Greens	<p><b>No relationship, Statistically non-significant</b></p> <p>Dark green vegetables for the Stewart 2005 DGA market basket            Ordinary least squares            Income: B: 0.02, t-value: 1.00, p&gt;0.05            R<sup>2</sup>: 0.1433, Model F-value: 2.08, p&lt;0.05            Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p> <p>Dark green vegetables for the TFP market basket            Ordinary least squares            Income: B: 0.00, t-value: 0.87, p&gt;0.05            R<sup>2</sup>: 0.1135, Model F-value: 1.83, p&gt;0.05            Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Whole grains	<p><b>No relationship, Statistically non-significant</b></p> <p>Whole grains for the Stewart 2005 DGA market basket Ordinary least squares Income: B: -0.01, t-value: -0.17, p&gt;0.05 R<sup>2</sup>: 0.1784, Model F-value: 2.40, p&lt;0.05 Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p> <p>Whole grains for the TFP market basket Ordinary least squares Income: B: 0.00, t-value: 0.35, p&gt;0.05 R<sup>2</sup>: 0.1524, Model F-value: 2.16, p&lt;0.05 Adjusted for population density, household size, chain, supercenter, services, store size, Black, other minority</p>
<b>Hayes, 2000<sup>23</sup></b>	<p><b>N=57</b></p> <p>Analytic N is supermarkets identified by the Food and Safety Inspection Report: Poor: n=21 stores, 10 zip codes Middle: n=14 stores, 7 zip codes Upper: n=22 stores, 11 zip codes NYC consists of New York, Bronx, Kings, Queens, Richmond, and Westchester co</p>	<p><b>Income</b></p> <ul style="list-style-type: none"> <li>• Poor</li> <li>• Middle</li> <li>• Upper</li> </ul>	Market basket	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) total cost in logarithms of market basket, weighted by expenditure-shares, Mean difference Poor: 3.955 (0.008) or \$52.20 Middle: 3.968 (0.013) or \$52.88 Upper: 3.971 (0.014) or \$53.04 Poor-upper difference: -0.016 (0.016) or -\$0.84 P=NS</p> <p>Mean (SE) total cost of market basket in logarithms, unweighted Poor: 3.925 (0.008) or \$50.65 Middle: 3.938 (0.014) or \$51.32 Upper: 3.942 (0.015) or \$51.52 Poor-upper difference: -0.016 (0.017) or -\$0.87 P=NS</p>
			Apples	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SE) price in logarithms of Apples, Mean difference Poor: -0.120 (0.032) or \$0.89 Middle: 0.058 (0.032) or \$1.06 Upper: 0.082 (0.028) or \$1.09 Poor-upper difference: -0.202 (0.043) or -\$0.20 Significantly different</p>





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Bananas	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SE) price in logarithms of Bananas, Mean difference            Poor: -0.799 (0.038) or \$0.45            Middle: -0.854 (0.067) or \$0.43            Upper: -0.636 (0.049) or \$0.53            Poor-upper difference: -0.163 (0.062) or \$0.08            Significantly different</p>
			Bread	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Bread, Mean difference            Poor: 0.468 (0.023) or \$1.60            Middle: 0.538 (0.12) or \$1.71            Upper: 0.504 (0.014) or \$1.66            Poor-upper difference: -0.036 (0.027) or -\$0.06            P=NS</p>
			Breakfast cereals	<p><b>Inverse relationship, Statistically significant</b></p> <p>Mean (SE) price in logarithms of Cereal, Mean difference            Poor: 0.927 (0.005) or \$2.53            Middle: 0.926 (0.016) or \$2.52            Upper: 0.876 (0.009) or \$2.40            Poor-upper difference: 0.052 (0.010) or \$0.13            Significantly different</p>
			Butter	<p><b>Inverse relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Butter, Mean difference            Poor: 1.106 (0.009) or \$3.02            Middle: 1.060 (0.030) or \$2.89            Upper: 1.068 (0.027) or \$2.91            Poor-upper difference: 0.037 (0.028) or \$0.11            P=NS</p>
			Cheese	<p><b>Inverse relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Cheese, Mean difference            Poor: 1.180 (0.21) or \$3.25            Middle: 1.166 (0.046) or \$3.21            Upper: 1.152 (0.027) or \$3.16            Poor-upper difference: 0.028 (0.034) or \$0.09            P=NS</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Chicken	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean price in logarithms of Chicken, Mean difference            Poor: 0.788 (0.044) or \$2.20            Middle: 0.755 (0.069) or \$2.13            Upper: 0.862 (0.052) or \$2.37            Poor-upper difference: -0.074 (0.068) or -\$0.17            P=NS</p>
			Cooking oil	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Oil, Mean difference            Poor: 0.533 (0.005) or \$1.70            Middle: 0.570 (0.017) or \$1.77            Upper: 0.542 (0.009) or \$1.72            Poor-upper difference: -0.009 (0.011) or \$0.02            P=NS</p>
			Eggs	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Eggs, Mean difference            Poor: 0.192 (0.020) or \$1.21            Middle: 0.222 (0.035) or \$1.25            Upper: 0.285 (0.039) or \$1.33            Poor-upper difference: -0.074 (0.044) or -\$0.12            P=NS</p>
			Flour	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Flour, Mean difference            Poor: 0.648 (0.046) or \$1.91            Middle: 0.700 (0.024) or \$2.01            Upper: 0.676 (0.026) or \$1.97            Poor-upper difference: -0.029 (0.052) or -\$0.06            P=NS</p>
			Ground beef	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Ground beef, Mean difference            Poor: 1.444 (0.042) or \$4.24            Middle: 1.490 (0.077) or \$4.44            Upper: 1.530 (0.044) or \$4.62            Poor-upper difference: -0.086 (0.061) or \$0.38            P=NS</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Juice	<p><b>Direct relationship, Statistically significant</b></p> <p>Mean (SE) price in logarithms of Orange Juice, Mean difference            Poor: 0.919 (0.026) or \$2.51            Middle: 0.915 (0.031) or \$2.50            Upper: 1.011 (0.022) or \$2.75            Poor-upper difference: -0.092 (0.034) or -\$0.24            Significantly different</p>
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Milk, Mean difference            Poor: 0.932 (0.008) or \$2.54            Middle: 0.885 (0.029) or \$2.42            Upper: 0.948 (0.020) or \$2.58            Poor-upper difference: -0.015 (0.022) or -\$0.04            P=NS</p>
			Pasta	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Spaghetti, Mean difference            Poor: -0.025 (0.044) or \$0.98            Middle: 0.071 (0.039) or \$1.07            Upper: 0.002 (0.032) or \$1.00            Poor-upper difference: -0.027 (0.054) or \$0.02            P=NS</p>
			Rice	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Long-Grain Rice, Mean difference            Poor: 1.104 (0.017) or \$3.02            Middle: 1.116 (0.013) or \$3.05            Upper: 1.088 (0.018) or \$2.97            Poor-upper difference: 0.016 (0.025) or \$0.05            P=NS</p>
			Sugar	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Sugar, Mean difference            Poor: 0.957 (0.008) or \$2.60            Middle: 0.895 (0.025) or \$2.45            Upper: 0.990 (0.019) or \$2.69            Poor-upper difference: -0.033 (0.020) or -\$0.09            P=NS</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Tuna	<p><b>No relationship, Statistically non-significant</b></p> <p>Mean (SE) price in logarithms of Tuna, Mean difference            Poor: -0.059 (0.026) or \$0.94            Middle: 0.034 (0.058) or \$1.03            Upper: -0.051 (0.031) or \$0.95            Poor-upper difference: -0.008 (0.040) or \$0.01            P=NS</p>
Jetter, 2006 <sup>24</sup>	<p><b>N=25</b></p> <p>Analytic N = stores            12 stores in Los Angeles; 13 stores            in Sacramento</p>	<p><b>Income</b>            Continuous and            low vs. higher</p>	TFP Food Basket	<p><b>Direct relationship (continuous), Statistically significant</b>  <b>No relationship (lower vs. higher), Statistically non-significant</b></p> <p>Cost of a market basket (either TFP or Healthier)            Regression model (adjusted for: store type, fiber (ln), fat (ln),            store density, store access)            Coefficient            Low-income area: -0.001, p&gt;0.1            Income (ln; continuous): 0.079, p&lt;0.05</p>
Jewell, 2019 <sup>25</sup>	<p><b>N=21</b></p> <p>Analytic N is neighborhoods.            Stores: N=108 from 710 census            tracts</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• CX3</li> <li>• Adjacent</li> </ul>	Fruits and Vegetables	<p><b>Direct relationship, Statistically non-significant</b></p> <p>Median (IQR) produce price, Kruskal-Wallis, p=0.06            CX3 neighborhoods: \$1.05 (0.63)            Adjacent neighborhoods: \$1.50 (0.97)</p>
Kern, 2016 <sup>26</sup>	<p><b>N=1743</b></p> <p>Analytic N is stores (large chain            supermarkets and superstores)            across 41 states and 1694 census            blocks.</p>	<p><b>SES proxy</b>            Neighborhood SES            index</p>	Milk	<p><b>Direct relationship, Statistically significant</b></p> <p>Hierarchical model of price of milk (\$/12 fl. oz) per neighborhood            SES z-score            Estimate (95% CI)            Adjusted (race, age, region, urbanicity, supermarket density,            toilet paper price, soda price, county and state): 0.0149 (0.0104,            0.0193), p&lt;0.0001</p> <p>Bivariate regression model of price of milk (\$/12 fl. oz) per            neighborhood SES z-score, p&lt;0.0001            Mean (SD)            Lowest SES tertile (least advantaged, n=581): \$0.60 (0.11)            Middle SES tertile (n=582): \$0.61 (0.11)            Highest SES tertile (most advantaged, n=580): \$0.65 (0.10)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Soda	<p><b>Direct relationship, Statistically significant</b></p> <p>Hierarchical model of price of soda (\$/12 fl. oz) per neighborhood SES z-score Estimate (95% CI) Adjusted (race, age, region, urbanicity, supermarket density, toilet paper price, milk price, county and state): 0.0024 (0.0012, 0.0035), p&lt;0.0001</p> <p>Bivariate regression model of price of soda (\$/12 fl. oz) per neighborhood SES z-score, p&lt;0.0001 Mean (SD) Lowest SES tertile (least advantaged, n=581): \$0.23 (0.02) Middle SES tertile (n=582): \$0.22 (0.02) Highest SES tertile (most advantaged, n=580): \$0.23 (0.02)</p>
Kern, 2017 <sup>27</sup>	<p><b>N=1953</b></p> <p>Analytic N is stores</p>	<p><b>SES proxy</b> Neighborhood SES index</p>	<p>Healthy food price</p>	<p><b>Direct relationship (unadjusted), Statistically significant</b></p> <p>Estimate (95%): Unadjusted (county and state): 0.00452 (0.0034, 0.0056), p&lt;0.0001</p> <p>Partially adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, county and state): 0.00085 (-0.00027, 0.00198), p=0.1370</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, race, county and state): 0.00090 (-0.0007, 0.0025), p= 0.2836;</p> <p>Price of food by Neighborhood SES quintile, mean (SD): Lowest quintile (least advantaged): \$0.581 (0.047) Second quintile: \$0.581 (0.048) Middle quintile: \$0.589 (0.053) Fourth quintile: \$0.590 (0.057) Highest quintile (most advantaged): \$0.611 (0.068)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Unhealthy food price	<p><b>Direct relationship (unadjusted), Statistically significant</b>  <b>Inverse relationship (partially adjusted), Statistically significant</b></p> <p>Estimate (95% CI)            Unadjusted (county and state): 0.00057 (0.0001, 0.0011), p=0.0234</p> <p>Partially adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, county and state): -0.00102 (-0.00148, -0.00056), p&lt;0.0001</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, race, county and state): 0.00055 (-0.0001, 0.0012), p=0.1110</p> <p>Price of food by Neighborhood SES quintile, mean (SD):            Lowest quintile (least advantaged): \$0.299 (0.019)            Second quintile: \$0.295 (0.020)            Middle quintile: \$0.295 (0.017)            Fourth quintile: \$0.294 (0.016)            Highest quintile (most advantaged): \$0.306 (\$0.039)</p>
			Dairy	<p><b>Inverse relationship, Statistically significant</b></p> <p>Estimate (95% CI)            Unadjusted (county and state): -0.01323 (-0.0153, -0.0112), p&lt;0.0001</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, race, county and state): -0.01836 (-0.0215, -0.0152), p&lt;0.0001</p>
			Fruit Juice and Frozen Vegetables	<p><b>Direct relationship, Statistically significant</b></p> <p>Estimate (95% CI)            Unadjusted (county and state): 0.01386 (0.0126, 0.0151), p&lt;0.0001</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, and race, county and state): 0.01096 (0.0091, 0.0128), p&lt;0.0001</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Salty Snacks	<p><b>Inverse relationship, Statistically significant</b></p> <p>Estimate (95% CI) Unadjusted (county and state): -0.00216 (-0.0025, -0.0018), p&lt;0.0001</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, race, county and state): -0.00125 (-0.0018 -0.0007), p&lt;0.0001</p>
			Soda	<p><b>No relationship, Statistically non-significant</b></p> <p>Estimate (95% CI) Unadjusted (county and state): 0.00051 (-0.0001, 0.0011), p=0.0937</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, either race, county and state): 0.00065 (-0.0003, 0.0016), p=0.1682</p>
			Sweets	<p><b>Direct relationship, Statistically significant</b></p> <p>Estimate (95% CI) Unadjusted (county and state): 0.00267 (0.0018, 0.0035), p&lt;0.0001</p> <p>Fully adjusted (age, region, urbanicity, population density, supermarket density, toilet paper price, race, county and state): 0.00153 (0.0005, 0.0026), p=0.0054</p>
<b>Leider, 2019<sup>28</sup></b>	<p><b>N=11767</b></p> <p>Analytic N is product-level observations from 581 stores</p>	<p><b>Income</b> Continuous (units of \$10k)</p>	Energy drinks	<p><b>No relationship, Statistically non-significant</b></p> <p>Energy drinks (n=2,276) Beta coefficient (95% CI), Multiple linear regression Median HH income (units of \$10k): 0.02 (-0.05, 0.10), p&gt;0.05 % population &lt;125% poverty level: 0.02 (-0.00, 0.04), p&gt;0.05 Adjusted for beverage size, sale status, store type, race/ethnicity, site</p>
			Juice	<p><b>No relationship, Statistically non-significant</b></p> <p>Juice drinks (non-100% juice, n=886) Beta coefficient (95% CI), Multiple linear regression Median HH income (units of \$10k): 0.02 (-0.03, 0.07), p&gt;0.05 % population &lt;125% poverty level: 0.00 (-0.01, 0.02), p&gt;0.05 Adjusted for beverage size, sale status, store type, race/ethnicity, site</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Ready-to-drink tea and coffee	<b>No relationship, Statistically non-significant</b>  Ready-to-drink tea and coffee (n=1,454) Beta coefficient (95% CI), Multiple linear regression Median HH income (units of \$10k): 0.02 (-0.09, 0.12), p>0.05 % population <125% poverty level: -0.02 (-0.05, 0.00), p>0.05 Adjusted for beverage size, sale status, store type, race/ethnicity, site
			Soda	<b>Direct relationship, Statistically significant</b>  Soda (n=5,220) Beta coefficient (95% CI), Multivariable linear regression Median HH income (units of \$10k): 0.02 (0.00, 0.04), p<0.05 % population <125% poverty level: 0.00 (-0.01, 0.00), p>0.05 Adjusted for beverage size, sale status, store type, race/ethnicity, site
			Sports drinks	<b>No relationship, Statistically non-significant</b>  Sports drinks (n=1,931) Beta coefficient (95% CI), Multivariable linear regression Median HH income (units of \$10k): 0.00 (-0.03, 0.03), p>0.05 % population <125% poverty level: 0.00 (-0.00, 0.01), p>0.05 Adjusted for beverage size, sale status, store type, race/ethnicity, site
			Sugar-sweetened beverages	<b>No relationship, Statistically non-significant</b>  All sugar-sweetened beverages (N=11,767) Beta coefficient (95% CI), Multivariable linear regression Median HH income (units of \$10k): 0.02 (-0.01, 0.04), p>0.05 % population <125% poverty level: 0.00 (-0.01, 0.01), p>0.05 Adjusted for beverage category, beverage size, sale status, store type, race/ethnicity, site
<b>Leone, 2011<sup>29</sup></b>	<b>N=73</b>  Analytic N is stores County population was 239,452. Race: White 66.4%, Black 29.1%, other race 4.5% 18.2% lived below poverty	<b>Income</b> • Low • High	Fruits and Vegetables	<b>No relationship, Statistically non-significant</b>  Neighborhood characteristics (including income) were not significantly related to the price of more healthful foods.
			Bread	<b>No relationship, Statistically non-significant</b>  Neighborhood characteristics (including income) were not significantly related to the price of whole-wheat bread.





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Milk	<b>No relationship, Statistically non-significant</b>  Neighborhood characteristics (including income) were not significantly related to the price of low-fat milk.
<b>Lopez-Class, 2010<sup>30</sup></b>	<b>N=32</b>  Analytic N is stores Latino and surrounding neighborhoods in a city located in East Central New York, on the Mohawk River. Population of ~18,000 with 16% Latino, of those 72% are Puerto-Rican. City is divided into four geographic areas: Cork Hill, South Side, the Projects, and East End	<b>Geographic location</b> • Latino neighborhood • Non-Latino neighborhood	Apples	<b>Inverse relationship, Statistically significant</b>  Apple, medium Mean price (SD), range, t-test, p=0.038 Latino neighborhood: \$0.39 (0.07), 0.30-0.49 Non-Latino neighborhood: \$0.28 (0.08), 0.15-0.36
			Bread	<b>Inverse relationship, Statistically significant</b>  High-fiber bread (≥2g per slice), 24 oz Mean price (SD), range, t-test, p=0.028 Latino neighborhood: \$3.89 (only mean available) Non-Latino neighborhood: \$2.72 (0.94), 1.44-3.84
			Cucumbers	<b>Inverse relationship, Statistically significant</b>  Cucumber, medium Mean price (SD), range, t-test, p=0.041 Latino neighborhood: \$0.54 (0.05), 0.49-0.59 Non-Latino neighborhood: \$0.39 (0.09), 0.33-0.49



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Low-fat (<math>\leq 1\%</math> milk), quart Mean price (SD), range, t-test, <math>p=0.081</math> Latino neighborhood: \$1.08 (0.16), 0.95-1.29 Non-Latino neighborhood: \$0.93 (0.09), 0.80-0.99</p> <p>Low-fat (<math>\leq 1\%</math> milk), half gallon Mean price (SD), range, <math>p=0.746</math> Latino neighborhood: \$1.51 (0.19), 1.09-1.75 Non-Latino neighborhood: \$1.54 (0.20), 1.29-1.99</p> <p>Low-fat (<math>\leq 1\%</math> milk), gallon Mean price (SD), range, <math>p=0.888</math> Latino neighborhood: \$2.59 (0.40), 1.99-2.79 Non-Latino neighborhood: \$2.62 (0.31), 2.25-2.99</p>
			Oranges	<p><b>Inverse relationship, Statistically non-significant</b></p> <p>Orange, medium Mean price (SD), range, t-test, <math>p=0.267</math> Latino neighborhood: \$0.54 (0.18), 0.33-0.75 Non-Latino neighborhood: \$ 0.43 (0.09), 0.32-0.50</p>
			Tomatoes	<p><b>No relationship, Statistically non-significant</b></p> <p>Tomato, medium Mean price (SD), range, t-test, <math>p=0.315</math> Latino neighborhood: \$0.33 (0.11), 0.11-0.40 Non-Latino neighborhood: \$0.51 (0.29), 0.24-0.99</p>



Rimkus, 2015<sup>31</sup>

N=8793

Analytic N = food stores across 468 communities spanning 46 states. Communities observed were defined by school enrollment zones for students surveyed as part of the Monitoring the Future study and were nationally representative of where 8th, 10th, and 12th grade public school students reside.

**Income**

- High (ref)
- Medium
- Low

**Milk**

**Inverse relationship (various), Statistically significant  
No relationship, Statistically non-significant**

All stores  
Ordinary least squares regression, adjusted for: US Census Division, year of data collection, store type, race, ethnicity, urbanicity

Beta coefficient (SE) of whole milk prices  
High income: Reference  
Medium income: 0.067 (0.043), p>0.05  
Low income: 0.091 (0.042), p<0.05

Beta coefficient (SE) of 2% milk prices  
High income: Reference  
Medium income: 0.064 (0.041), p>0.05  
Low income: 0.075 (0.041), p>0.05

Beta coefficient (SE) of 1% milk prices  
High income: Reference  
Medium income: -0.017 (0.046), p>0.05  
Low income: -0.006 (0.055), p>0.05

Beta coefficient (SE) of skim milk prices  
High income: Reference  
Medium income: -0.008 (0.045), p>0.05  
Low income: -0.0034 (0.047), p>0.05

Supermarkets  
Ordinary least squares regression, adjusted for: US Census Division, year of data collection, race, ethnicity, urbanicity

Beta coefficient (SE) of whole milk prices  
High income: Reference  
Medium income: 0.091 (0.060), p>0.05  
Low income: 0.069 (0.067), p>0.05

Beta coefficient (SE) of 2% milk prices  
High income: Reference  
Medium income: 0.067 (0.063), p>0.05  
Low income: 0.032 (0.067), p>0.05

Beta coefficient (SE) of 1% milk prices  
High income: Reference  
Medium income: 0.084 (0.064), p>0.05



Low income: 0.036 (0.067),  $p > 0.05$

Beta coefficient (SE) of skim milk prices

High income: Reference

Medium income: 0.069 (0.068),  $p > 0.05$

Low income: 0.021 (0.070),  $p > 0.05$

Grocery stores

Ordinary least squares regression, adjusted for: US Census  
Division, year of data collection, race, ethnicity, urbanicity

Beta coefficient (SE) of whole milk prices

High income: Reference

Medium income: 0.058 (0.085),  $p > 0.05$

Low income: 0.117 (0.098),  $p > 0.05$

Beta coefficient (SE) of 2% milk prices

High income: Reference

Medium income: 0.073 (0.086),  $p > 0.05$

Low income: 0.122 (0.089),  $p > 0.05$

Beta coefficient (SE) of 1% milk prices

High income: Reference

Medium income: 0.217 (0.101),  $p < 0.05$

Low income: 0.212 (0.106),  $p < 0.05$

Beta coefficient (SE) of skim milk prices

High income: Reference

Medium income: 0.210 (0.108),  $p > 0.05$

Low income: 0.153 (0.111),  $p > 0.05$

Limited-service stores

Ordinary least squares regression, adjusted for: US Census  
Division, year of data collection, race, ethnicity, urbanicity

Beta coefficient (SE) of whole milk prices

High income: Reference

Medium income: 0.064 (0.045),  $p > 0.05$

Low income: 0.092 (0.041),  $p < 0.05$

Beta coefficient (SE) of 2% milk prices

High income: Reference

Medium income: 0.061 (0.044),  $p > 0.05$

Low income: 0.079 (0.043),  $p > 0.05$



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
				<p>Beta coefficient (SE) of 1% milk prices High income: Reference Medium income: -0.085 (0.051), p&gt;0.05 Low income: -0.033 (0.064), p&gt;0.05</p> <p>Beta coefficient (SE) of skim milk prices High income: Reference Medium income: -0.060 (0.046), p&gt;0.05 Low income: -0.075 (0.050), p&gt;0.05</p>
<b>Smith, 2013<sup>32</sup></b>	<b>N=28</b>  Analytic N = 28 convenience stores from 2 neighborhoods in Bexar County, TX. ZIP A and ZIP B has the highest and lowest city-levels of adults clinically diagnosed with diabetes.	<b>Geographic location</b> • Lower income • Higher income	Apples	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of apples Mean (SD), t-test, p=0.818 ZIP A (lower income, n=5): \$1.12 (0.94) ZIP B (higher income, n=5): \$1.24 (0.53)</p>
			Bananas	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of bananas Mean (SD), t-test, p=0.015 ZIP A (lower income, n=5): \$0.43 (0.15) ZIP B (higher income, n=6): \$1.13 (0.43)</p>
			Bread	<p><b>Direct relationship (White bread), Statistically significant</b> <b>No relationship (Whole grain bread), Statistically non-significant</b></p> <p>Price of whole grain bread Mean (SD), t-test, p=0.203 ZIP A (lower income, n=3): \$2.01 (0.77) ZIP B (higher income, n=7): \$2.83 (0.17)</p> <p>Price of white bread Mean (SD), t-test, p=0.001 ZIP A (n=15): \$2.06 (0.39) ZIP B (n=8): \$2.65 (0.32)</p>
			Broccoli	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of broccoli Mean (SD), t-test, p&lt;0.001 ZIP A (lower income, n=1): \$0.07 (0.30) ZIP B (higher income, n=1): \$2.99 (0.00)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Chips	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of baked potato chips Mean (SD), t-test, p=NR ZIP A (lower income, n=3): \$0.99 (0.00) ZIP B (higher income, n=8): \$0.99 (0.00)</p> <p>Price of regular potato chips Mean (SD), t-test, p=0.868 ZIP A (n=18): \$2.22 (1.43) ZIP B (n=9): \$2.32 (1.58)</p>
			Cucumbers	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of cucumbers Mean (SD), t-test, p&lt;0.001 ZIP A (lower income, n=3): \$0.14 (0.34) ZIP B (higher income, n=1): \$2.99 (0.00)</p>
			Juice	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of 100% juice (no sugar added; 15.2 oz) Mean (SD), t-test, p=0.071 ZIP A (lower income, n=13): \$1.66 (0.19) ZIP B (higher income, n=7): \$2.00 (0.58)</p> <p>Price of juice drink (sugar added: 15.2 oz) Mean (SD), t-test, p=0.487 ZIP A (n=6): \$1.55 (0.15) ZIP B (n=5): \$1.63 (0.23)</p>
			Melons	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of watermelon Mean (SD), t-test, p=0.873 ZIP A (lower income, n=2): \$1.99 (0.00) ZIP B (higher income, n=5): \$2.19 (1.09)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Milk	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of milk: low fat, skim, or 1% (half gallon) Mean (SD), t-test, p=0.130 ZIP A (lower income, n=2): \$3.19 (0.28) ZIP B (higher income, n=1): \$2.29 (0.42)</p> <p>Price of milk: 2% (half gallon) Mean (SD), t-test, p=0.852 ZIP A (n=5): \$3.29 (0.27) ZIP B (n=8): \$3.14 (1.30)</p>
			Oranges	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of oranges Mean (SD), t-test, p=0.018 ZIP A (lower income, n=3): \$0.45 (0.09) ZIP B (higher income, n=4): \$0.90 (0.21)</p>
			Soda	<p><b>Direct relationship (diet cola), Statistically significant</b> <b>No relationship (regular cola), Statistically non-significant</b></p> <p>Price of diet cola (20 oz) Mean (SD), t-test, p=0.044 ZIP A (lower income, n=19): \$1.35 (0.13) ZIP B (higher income, n=9): \$1.45 (0.05)</p> <p>Price of regular cola (20 oz) Mean (SD), t-test, p=0.060 ZIP A (n=19): \$1.37 (0.11) ZIP B (n=9): \$1.45 (0.05)</p>
			Tomatoes	<p><b>Direct relationship, Statistically significant</b></p> <p>Price of tomatoes Mean (SD), t-test, p=0.010 ZIP A (lower income, n=7): \$0.18 (0.27) ZIP B (higher income, n=1): \$0.99 (0.00)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Stewart, 2011 <sup>33</sup>	<p><b>N=7143</b></p> <p>N is households who participated in the Nielsen-run panel for all 12 months of 2006 Nielsen provides a sample weight to be nationally representative Mean household income: \$27,000; Mean age: 54.9 y; Mean household size: 2.32 people; Black: 13%, Hispanic</p>	Income continuous	Salty Snacks	<p><b>Direct relationship, Statistically significant</b></p> <p>Salty snacks Coefficient (SE), R<sup>2</sup>=0.05 Household income: 0.005 (0.0015), p&lt;0.01 Household income squared: -0.0003 (0.0002), p&gt;0.1 Poverty principal component: 0.0005 (0.0004), p&gt;0.1 Adjusted for household size, age, education, household includes child, homemaker in household, race/ethnicity, urbanicity, poverty, residential community, racial composition of community, geographic region (east, south, west)</p>
			Vegetables	<p><b>Direct relationship, Statistically significant</b></p> <p>Fresh vegetables Coefficient (SE), R<sup>2</sup>=0.14 Household income: 0.0293 (0.0372), p&lt;0.01 Household income squared: -0.0019 (0.0004), p&lt;0.01 Poverty principal component: -0.0009 (0.0011), p&gt;0.1 Adjusted for household size, age, education, household includes child, homemaker in household, race/ethnicity, urbanicity, poverty, residential community, racial composition of community, geographic region (east, south, west)</p>
Talukdar, 2008 <sup>34</sup>	<p><b>N=115</b></p> <p>Analytic N = 115 stores from 17 of the 27 zip codes in of Buffalo city and immediate surrounding suburbs. Homes with ≥Bachelor's degree: Richest zip codes: 28.0% Medium zip codes: 27.1% Poorest zip codes: 11.6%</p>	<p><b>Geographic location</b></p> <ul style="list-style-type: none"> <li>• Richest zip codes (ref)</li> <li>• Medium zip codes</li> <li>• Poorest zip codes</li> </ul>	Branded foods	<p><b>Inverse relationship (Richest vs. Poorest), Statistically significant</b></p> <p>Relative price index, regression model (adjusted for store type, and distance to competitive environment), Adj R<sup>2</sup> = 0.78 Estimates (SE) Richest: Reference Medium: 0.006 (0.008), p&gt;0.1 Poorest: 0.019 (0.008), p&lt;0.05</p>
			Non-branded foods	<p><b>No relationship, Statistically non-significant</b></p> <p>Relative price index, regression model (adjusted for store type, and distance to competitive environment), Adj R<sup>2</sup> = 0.75 Estimates (SE) Richest: Reference Medium: 0.006 (0.009), p&gt;0.1 Poorest: 0.008 (0.014), p&gt;0.1</p>





Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
Winkler, 2019 <sup>35</sup>	<p><b>N=140</b></p> <p>Analytic N = stores Small and non-traditional food stores were randomly selected from lists of licensed grocery retailers in both cities. Of 157 eligible stores, 140 agreed to participate</p>	<p><b>SES proxy</b></p> <ul style="list-style-type: none"> <li>• Lowest income</li> <li>• Middle income</li> <li>• Highest income</li> </ul>	Apples	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Apples (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=56, p&gt;0.05 POC dominant (Lowest income): \$0.83 (0.67, 1.00) Racially mixed (Middle income): \$0.84 (0.75, 0.93) White dominant (Highest income): \$0.92 (0.83, 1.01)</p>
			Bananas	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Bananas (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=64, p&gt;0.05 POC dominant (Lowest income): \$0.52 (0.44, 0.61) Racially mixed (Middle income): \$0.45 (0.41, 0.49) White dominant (Highest income): \$0.51 (0.46, 0.55)</p>
			Lettuce	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Lettuce (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=15, p&gt;0.05 POC dominant (Lowest income): \$3.21 (1.47, 4.94) Racially mixed (Middle income): \$3.37 (2.48, 4.27) White dominant (Highest income): \$3.31 (2.71, 3.90)</p>
			Onions	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Onions (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=25, p&gt;0.05 POC dominant (Lowest income): \$0.68 (0.13, 1.22) Racially mixed (Middle income): \$0.70 (0.41, 0.99) White dominant (Highest income): \$0.67 (0.38, 0.96)</p>
			Oranges	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Oranges (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=47, p&gt;0.05 POC dominant (Lowest income): \$1.25 (1.00, 1.52) Racially mixed (Middle income): \$0.84 (0.67, 1.01) White dominant (Highest income): \$0.94 (0.76, 1.11)</p>



Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Tomatoes	<p><b>No relationship, Statistically non-significant</b></p> <p>Price of Tomatoes (\$/item) Multivariate regression, adjusted for corporate status Adjusted Mean (95% CI), N=18, p&gt;0.05 POC dominant (Lowest income): \$0.79 (0.00, 1.60) Racially mixed (Middle income): \$1.30 (0.68, 1.93) White dominant (Highest income): \$1.06 (0.52, 1.60)</p>
Zenk, 2014 <sup>36</sup>	<p><b>N=364</b></p> <p>Analytic N = 364 WIC vendors in 7 seven northern Illinois counties (DeKalb, DuPage, Kane, Lee, Ogle, Winnebago, west suburban Cook [not including Chicago]). Data were collected annually from each vendor. Analysis included all WIC vendors authorized in 20</p>	Income	Fruit	<p><b>No relationship, Statistically non-significant</b></p> <p>Fresh fruit Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity), Adj R<sup>2</sup> =0.25 Coefficient (SE) Neighborhood median HH income (1000s): &lt;-0.01 (0.02), p=0.96</p> <p>Canned fruit Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity), Adj R<sup>2</sup> =0.17 Coefficient (SE) Neighborhood median HH income (1000s): 0.01 (0.02), p=0.36</p> <p>Frozen fruit Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity), Adj R<sup>2</sup> =0.29 Coefficient (SE) Neighborhood median HH income (1000s): 0.02 (0.02), p=0.17</p>

Article	Study and Participant Characteristics	Intervention	Outcome(s)	Results
			Vegetables	<p><b>Direct relationship (canned), Statistically significant</b>  <b>No relationship (fresh and frozen), Statistically non-significant</b></p> <p>Fresh vegetables            Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity, Adj R<sup>2</sup> = 0.35            Coefficient (SE)            Neighborhood median HH income (1000s): -0.02 (0.01), p=0.19</p> <p>Canned vegetables            Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity, Adj R<sup>2</sup> =0.61            Coefficient (SE)            Neighborhood median HH income (1000s): 0.03 (0.01), p=0.002</p> <p>Frozen vegetables            Multivariate regression, adjusted for vendor type, year of data collection, seasonality, population density, % other racial/ethnicity, Adj R<sup>2</sup> =0.26            Coefficient (SE)            Neighborhood median HH income (1000s): 0.02 (0.01), p=0.14</p>

<sup>a</sup> Abbreviations: ANOVA: Analysis of Variance; CSFII: USDA Continuing Survey of Food Intakes by Individuals; CX3: Communities of Excellence in Nutrition, Physical Activity and Obesity Prevention Project; DGA: Dietary Guidelines for Americans; F&V: Fruits and vegetables; FV-PI: Fruits and Vegetables Price Index; g: gram; gal: gallon; GEE: general estimation equation; HH: household; IQR: interquartile range; lb: pound; Ln: natural log; N: sample size; n/a: not applicable; NR: Not reported; NS: Statistically non-significant; ONQI: overall nutrition quality index; Oz: ounce; pc: piece; PIR: Poverty Income Ratio; POC: person of color; SD: standard deviation; SE: standard error; SEM: standard error of the mean; SES: Socioeconomic status; TFP: Thrifty Food Plan; USDA: United States Department of Agriculture; WIC: Special Supplemental Nutrition Program for Women, Infants, and Children; y: year

**Table 1-c. Risk of bias for observational studies examining income and food price<sup>a</sup>**

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Akbay, 2005 <sup>1</sup>	SERIOUS	NO INFORMATION	SERIOUS	LOW	NO INFORMATION	LOW	MODERATE
Andreyeva, 2008 <sup>2</sup>	SERIOUS	LOW	SERIOUS	MODERATE	LOW	LOW	MODERATE
Ard, 2010 <sup>3</sup>	MODERATE	LOW	SERIOUS	MODERATE	LOW	LOW	MODERATE
Beydoun, 2008 <sup>5</sup>	SERIOUS	MODERATE	LOW	LOW	LOW	MODERATE	SERIOUS
Beydoun, 2011 <sup>4</sup>	SERIOUS	MODERATE	LOW	LOW	LOW	MODERATE	SERIOUS
Block, 2006 <sup>6</sup>	SERIOUS	LOW	SERIOUS	LOW	MODERATE	LOW	MODERATE
Borja, 2019 <sup>7</sup>	SERIOUS	LOW	SERIOUS	MODERATE	LOW	LOW	MODERATE
Broda, 2009 <sup>8</sup>	MODERATE	LOW	LOW	LOW	NO INFORMATION	MODERATE	MODERATE
Cassady, 2007 <sup>9</sup>	SERIOUS	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS
Chang, 2011 <sup>10</sup>	SERIOUS	LOW	SERIOUS	LOW	LOW	LOW	MODERATE
Chung, 1999 <sup>11</sup>	SERIOUS	LOW	SERIOUS	LOW	LOW	LOW	MODERATE
Colabianchi, 2021 <sup>37</sup>	MODERATE	LOW	SERIOUS	SERIOUS	LOW	LOW	MODERATE
Cole, 2010 <sup>12</sup>	SERIOUS	LOW	CRITICAL	LOW	SERIOUS	LOW	CRITICAL
Daepf, 2015 <sup>13</sup>	SERIOUS	NO INFORMATION	SERIOUS	LOW	SERIOUS	LOW	SERIOUS

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Davis, 2005 <sup>14</sup>	SERIOUS	LOW	LOW	NO INFORMATION	NO INFORMATION	LOW	MODERATE
DeWeese, 2017 <sup>15</sup>	SERIOUS	LOW	SERIOUS	LOW	SERIOUS	LOW	MODERATE
Dunn, 2011 <sup>16</sup>	MODERATE	LOW	SERIOUS	LOW	MODERATE	LOW	MODERATE
French, 2010 <sup>17</sup>	SERIOUS	LOW	MODERATE	LOW	LOW	MODERATE	MODERATE
Gillespie, 2015 <sup>18</sup>	MODERATE	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS
Gosliner, 2018 <sup>19</sup>	SERIOUS	SERIOUS	CRITICAL	LOW	MODERATE	MODERATE	MODERATE
Hardin-Fanning, 2015 <sup>20</sup>	SERIOUS	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS
Hardin-Fanning, 2017 <sup>21</sup>	SERIOUS	LOW	CRITICAL	SERIOUS	LOW	LOW	MODERATE
Hatzenbuehler, 2012 <sup>22</sup>	MODERATE	LOW	SERIOUS	LOW	MODERATE	LOW	MODERATE
Hayes, 2000 <sup>23</sup>	SERIOUS	LOW	SERIOUS	LOW	MODERATE	LOW	MODERATE
Jetter, 2006 <sup>24</sup>	SERIOUS	LOW	SERIOUS	MODERATE	LOW	LOW	MODERATE
Jewell, 2019 <sup>25</sup>	MODERATE	LOW	SERIOUS	LOW	SERIOUS	LOW	SERIOUS
Kern, 2016 <sup>26</sup>	MODERATE	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS
Kern, 2017 <sup>27</sup>	MODERATE	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS
Leider, 2019 <sup>28</sup>	MODERATE	LOW	SERIOUS	LOW	MODERATE	LOW	SERIOUS

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Leone, 2011 <sup>29</sup>	SERIOUS	LOW	SERIOUS	MODERATE	SERIOUS	LOW	MODERATE
Lopez-Class, 2010 <sup>30</sup>	SERIOUS	LOW	SERIOUS	LOW	SERIOUS	LOW	SERIOUS
Rimkus, 2015 <sup>31</sup>	SERIOUS	LOW	SERIOUS	LOW	MODERATE	LOW	SERIOUS
Smith, 2013 <sup>32</sup>	SERIOUS	LOW	CRITICAL	MODERATE	SERIOUS	LOW	MODERATE
Stewart, 2011 <sup>33</sup>	MODERATE	LOW	LOW	LOW	NO INFORMATION	MODERATE	MODERATE
Talukdar, 2008 <sup>34</sup>	SERIOUS	LOW	SERIOUS	MODERATE	LOW	LOW	MODERATE
Winkler, 2019 <sup>35</sup>	SERIOUS	LOW	SERIOUS	MODERATE	SERIOUS	LOW	SERIOUS
Zenk, 2014 <sup>36</sup>	MODERATE	MODERATE	SERIOUS	LOW	MODERATE	LOW	MODERATE

<sup>a</sup> Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias for Nutrition Observational Studies" tool (RoB-NObs) (Dietary Guidelines Advisory Committee. 2020. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services*. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC.)

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## Chapter 2 - What is the relationship between income or Federal Assistance participation/eligibility and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI)?

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Laural Kelly English, PhD,<sup>a</sup> Sara Scinto-Madonich, MS,<sup>a</sup> Molly Higgins, MLIS,<sup>b</sup> Marlana Bates, MPH, RD,<sup>a</sup> Julie Nevins, PhD,<sup>a</sup> Julia H Kim, PhD, MPH, RD,<sup>a</sup> Emily Callahan, MS<sup>c</sup>

### Specific methods to conduct this rapid review

#### Develop a protocol

The research question, “What is the relationship between income and HEI?”, was answered using a rapid review that was informed by an evidence scan.

The analytic framework for the rapid review examining the relationship between income and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI), is presented in **Figure 2-a**. This analytic framework visually represents the overall scope of the rapid review question and depicts the contributing elements that were examined and evaluated. The intervention or exposure of interest is income or Federal assistance participation/eligibility in Americans. The comparators are different levels or categories of income or participation/eligibility status. The outcomes are HEI scores in Americans. The key confounders are urban versus rural settings, cultural/racial diversity or disparities, sex, age, food security status. The other factors to be considered are cultural food choices, neighborhood characteristics (e.g., access to food/distance to stores/access to car/type of store), smoking, weight status, chronic disease status, convenience level, and processing level. The confounders and other factors to be considered may impact the relationships of interest.

An evidence scan was conducted before the rapid review, and it included additional intervention/exposures of income proxies including socioeconomic status (SES) factors such as education, marital status, or household assets, food security status, and geographical areas. Based on the evidence scan, the intervention/exposure for the rapid review was narrowed to include only income or Federal assistance participation/eligibility in Americans to produce the strongest body of evidence that would be of most utility for the Thrifty Food Plan, 2021. The evidence scan also included outcomes of either consumption or purchasing of dietary patterns, diet diversity, and other diet quality indicators/scores as the outcomes, regardless of approach or measure used to study the dietary pattern. The outcome for the rapid review was narrowed to include only HEI scores based on consumption as these were by far the most common outcome studied across the evidence scan and the NEAT staff recognized that additional information would not be useful for the Thrifty Food Plan, 2012 by the inclusion of other types of dietary patterns that were not in direct alignment with the *Dietary Guidelines for Americans*. Comparisons of Federal assistance benefits between states were considered in the scan, but excluded from the rapid review for lack of applicability to the entire U.S. population. Similarly, comparisons of temporality within receipt month of Federal assistance benefits (e.g., 15 days past receipt v. 30 days past receipt) were

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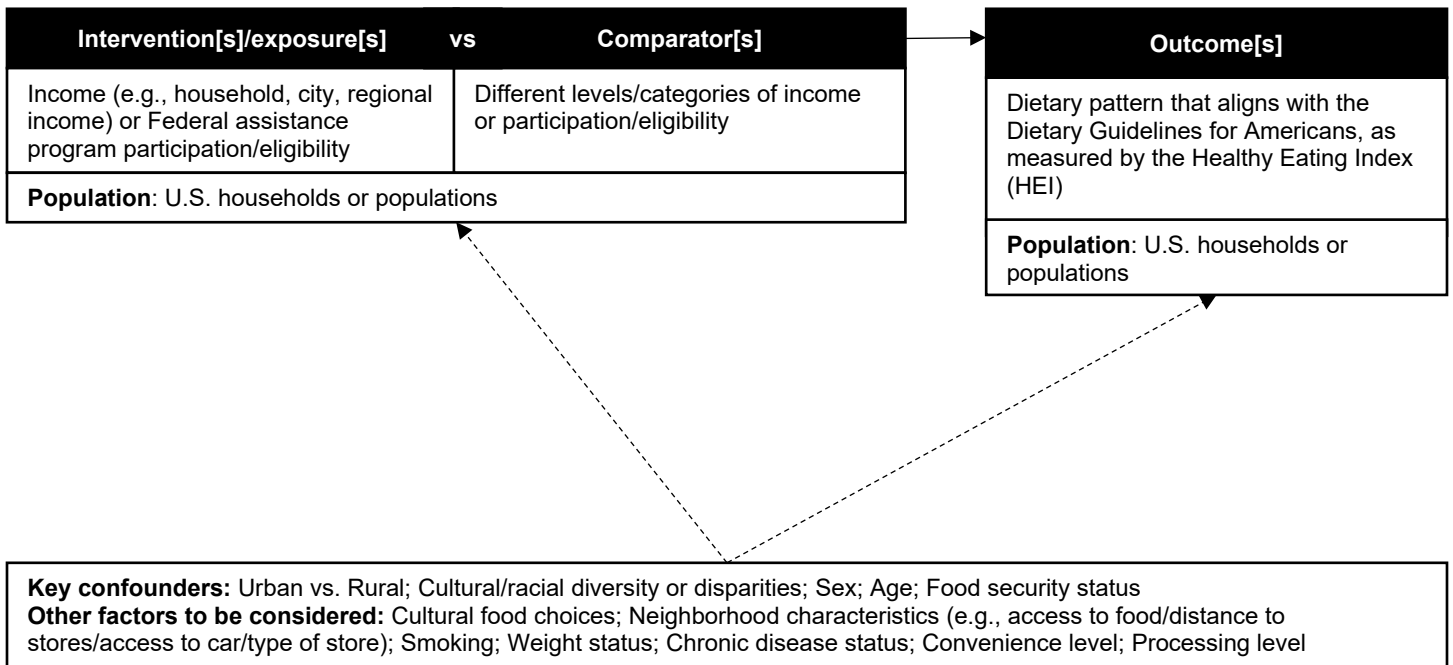
<sup>a</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

<sup>b</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

<sup>c</sup> Project Lead, NESR team, NGAD, CNPP, FNS, USDA

considered in the scan, but excluded from the rapid review for lack of directness to the intended exposure of income.

**Figure 2-a. Analytic Framework**



**Key definitions**

Low income: before-tax income at or below 130 percent of the U.S. poverty guidelines

Higher income: before-tax income above 130 percent of the U.S. poverty guidelines

Dietary pattern: The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

**Legend**

- > Relationship(s) of interest
- > Factors that may impact the relationship(s) of interest

## Search for and select studies

The following outlines any departures from the search and select studies project methods for this specific rapid review:

- 80% of all records were single-screened at title, abstract, and full-text levels and 20% of all records were dual-screened, independently at each of these levels.

NESR analysts worked jointly with NEAT staff to establish the final inclusion and exclusion criteria and literature search strategy, which are detailed in **Table 2-a** and **Appendix 2-a**, respectively.

**Table 2-a. Inclusion and exclusion criteria**

Category	Inclusion Criteria	Exclusion Criteria
Study design	<ul style="list-style-type: none"> <li>• Any study design that is not a narrative review, systematic review, or meta-analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Narrative reviews</li> <li>• Systematic reviews</li> <li>• Meta-analyses</li> </ul>
Intervention/exposure	<ul style="list-style-type: none"> <li>• Income (e.g., household, city, regional income)</li> <li>• Income-based Federal assistance program participation/eligibility</li> </ul>	<ul style="list-style-type: none"> <li>• Other proxies used for income</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>• Different levels or categories of income</li> <li>• Different participation/eligibility status in income-based Federal assistance program(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Comparison of geographic areas without a proxy for income</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>• Dietary patterns that specifically align with the Dietary Guidelines for Americans, as measured by the total Healthy Eating Index (HEI)</li> <li>• All versions or variations of HEI (e.g. HEI-2005, HEI-2010, HEI-2015)</li> <li>• Change in total HEI over time</li> </ul>	<ul style="list-style-type: none"> <li>• Studies that examine any other dietary pattern or diet quality indicator that include only individual or select foods and beverages and do not reflect the totality of the diet nor the Dietary Guidelines for Americans.</li> <li>• Studies that only examine component scores of the HEI</li> </ul>
Publication date	<ul style="list-style-type: none"> <li>• Jan 2008 - May 2021 and data inclusive of 2008 (e.g., 2000-2012; 2008-2009)</li> </ul>	<ul style="list-style-type: none"> <li>• Articles published prior to Jan 2008</li> <li>• Data prior to 2008 (e.g., 2000-2007; 1999-2005)</li> </ul>
Publication status	<ul style="list-style-type: none"> <li>• Articles that have been peer-reviewed</li> <li>• Grey literature: reports that have not been peer reviewed but are available from government and nongovernmental organizations</li> </ul>	<ul style="list-style-type: none"> <li>• Articles that have not been peer reviewed and are not published in peer-reviewed journals (e.g., unpublished data, manuscripts, pre-prints, reports, abstracts, and conference proceedings), other than reports from government and nongovernmental organizations</li> </ul>
Language	<ul style="list-style-type: none"> <li>• Articles published in English</li> </ul>	<ul style="list-style-type: none"> <li>• Articles published in languages other than English</li> </ul>
Country	<ul style="list-style-type: none"> <li>• Studies conducted in the U.S.</li> </ul>	<ul style="list-style-type: none"> <li>• Studies conducted outside the U.S.</li> </ul>
Study participants	<ul style="list-style-type: none"> <li>• Human participants/populations</li> </ul>	<ul style="list-style-type: none"> <li>• Non-human participants (e.g., animal studies, in-vitro models)</li> </ul>



Category	Inclusion Criteria	Exclusion Criteria
Age of study participants	<ul style="list-style-type: none"> <li>• Age at intervention or exposure:               <ul style="list-style-type: none"> <li>○ Infants and toddlers (birth to 24 months)</li> <li>○ Children and adolescents (2-18 years)</li> <li>○ Adults (19-64 years)</li> <li>○ Older adults (65 years and older)</li> </ul> </li> <li>• Age at outcome:               <ul style="list-style-type: none"> <li>○ Infants and toddlers (birth to 24 months)</li> <li>○ Children and adolescents (2-18 years)</li> <li>○ Adults (19-64 years)</li> <li>○ Older adults (65 years and older)</li> </ul> </li> </ul>	

## Extract data and assess the risk of bias

NESR analysts extracted and summarized data from each included article to objectively describe the body of evidence available to answer a rapid review question. The following outlines any departures from the extract data and assesses risk of bias project methods for this specific rapid review:

- Data extraction and risk of bias assessment was completed on all included articles and verified by a 2<sup>nd</sup> analyst

## Synthesize the evidence

Evidence synthesis was completed by describing the evidence and evaluating the included studies individually and collectively as previously described in the project methods.

## Summary statements

NESR analysts formed summary statements, as previously described in the project methods, outlining the themes observed during the data synthesis of studies examining income and HEI.

## Recommend future research

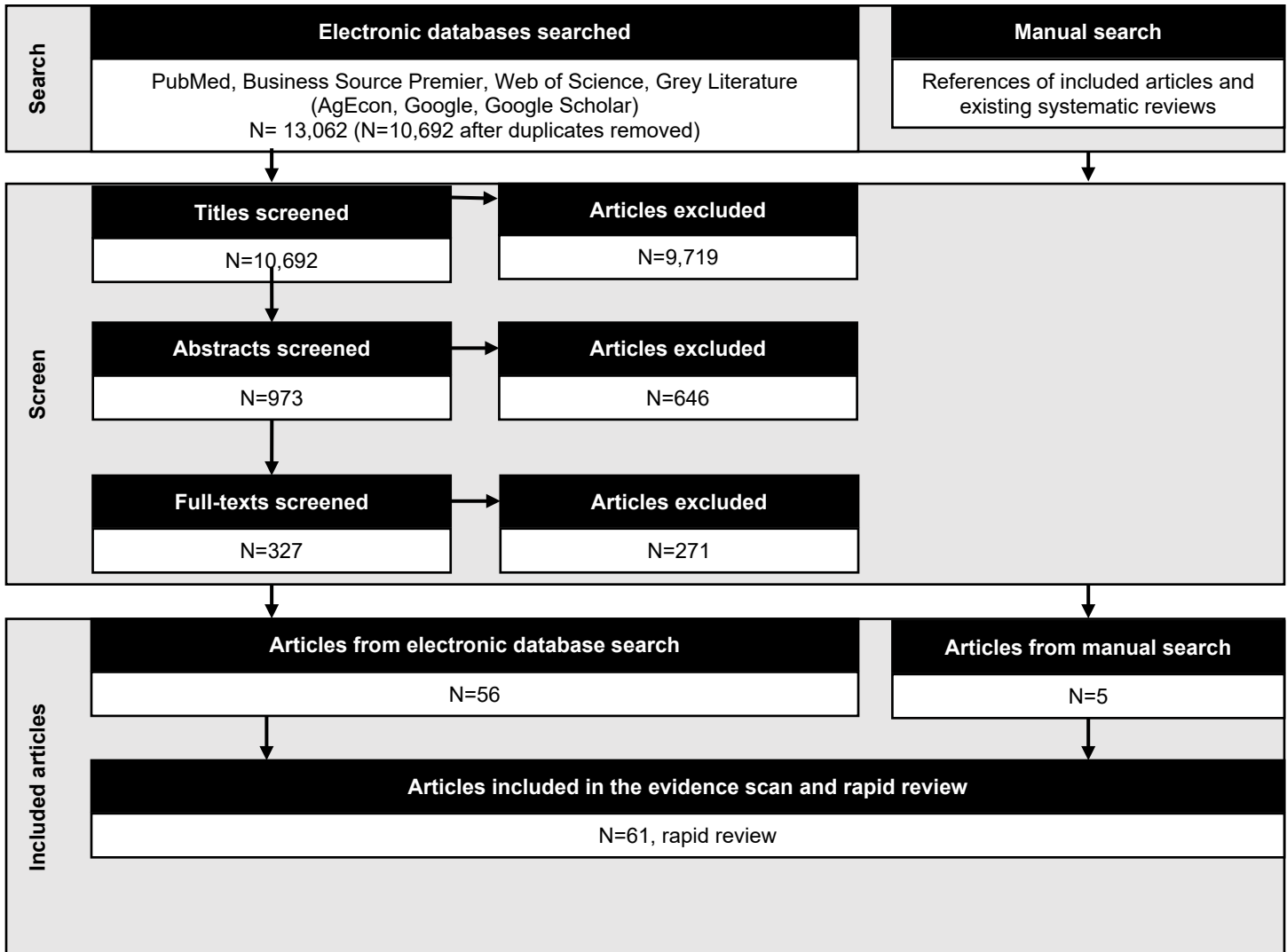
Recommendations for future research evaluating the relationship between income and HEI were determined based on the gaps and limitations observed during data extraction and synthesis, as previously described in the project methods. Future work addressing these gaps and limitations may contribute to the body of evidence available to answer this research question.

# Results

## Literature search and screening results

The literature search yielded 10,692 search results after the removal of duplicates (see **Figure 2-b**). Dual-screening resulted in the exclusion of 9,719 titles, 646 abstracts, and 183 full-texts articles. Reasons for full-text exclusion are in **Appendix 2-b**. Five additional articles were identified from the manual search. The body of evidence for the rapid review included 61 articles.

**Figure 2-b. Literature search and screen flowchart.**



## Description of evidence

This rapid review included 61 articles that examined the relationship between income and HEI. Four articles came from prospective cohort studies<sup>1-4</sup> and the rest (57 articles) were from cross-sectional study designs.<sup>5-61</sup> Common data sources of these studies included the National Health and Nutrition Examination Survey (NHANES)<sup>5,13,14,23,24,26,29,33,37-44,47-49,52-54,56,61</sup> and the Continuing Survey of Food Intake by Individuals (CSFII).<sup>7,45</sup> Four articles were included from the Healthy Aging in Neighborhoods of Diversity across the Life Span Study (HANDLS) but represented unique data by examining different sub-samples or analytic/assessment methods.<sup>1,6,9,34</sup>

## Population characteristics

Most of the studies (~41%) were conducted using data from national databases or by enrolling participants from multiple states, with a few select studies conducted exclusively in rural or urban cities or areas. Across the body of evidence, analytic sample sizes ranged from n=80 to n=43,996. More information on the location and analytic sample size from each individual article can be found in **Table 2-b**.

Studies varied across all populations and life stages. Most of the studies examined data in adults<sup>1,2,5-7,9-12,15-18,20,25,28,30,31,34,37,41-46,48-51,54,56-58,60,61</sup> with a smaller sub-set of articles examining data in children (toddlers through adolescents).<sup>4,8,14,19,21,24,26,27,29,32,33,35,38-40,52,53</sup> In addition, there were 7 articles that studied children and adults<sup>13,47</sup>, or child-adult dyads.<sup>3,22,36,55,59</sup> One study examined household data.<sup>23</sup>

Most studies enrolled participants regardless of sex, although select studies enrolled only women<sup>50</sup>, or those who were pregnant.<sup>16,28,51</sup> Most studies enrolled participants regardless of racial/ethnic background, but select studies enrolled only those who were Hispanic,<sup>51,61</sup> of Mexican-origin,<sup>40</sup> African-American,<sup>46,50</sup> Haitian-American,<sup>30</sup> or members of the Confederated Salish, Pend d'Oreille, or Kootenai tribes of Flathead nation.<sup>10</sup> Select studies exclusively enrolled participants with diagnosed diabetes<sup>12,44</sup> or cancer.<sup>31</sup>

## Exposure and comparator characteristics

Studies examined household income<sup>8,10,11,15-18,20,22,30,36,46,50,58,60</sup> or poverty (e.g., poverty-to-income ratio (PIR)).<sup>1,3-5,7,9,12,34,40,43-45,48,52,53,61</sup> Studies varied in the cut-off points used for income, poverty, or thresholds applied, whether or not household/family size was accounted for in the income variable, and/or percentage of residents in living poverty at that address according to Census data.

Both income or poverty and Federal assistance program participation/eligibility were examined in a subset of studies.<sup>24-26,28,31-33,39,55,59</sup>

Studies examined participation and eligibility in various Federal assistance programs,<sup>2,6,13,14,19,21,23,25-33,35,37-39,41,42,47,49,51,52,54-57,59</sup> including Supplemental Nutrition Assistance Program (SNAP, formerly Food Stamps) eligibility and participation,<sup>2,6,13,23-25,28,29,31,35,37-39,41,42,47,49,54,56,57</sup> National School Lunch Program (NSLP) or School Breakfast Program (SBP) participation,<sup>14,19,21,24,26,27,33,39</sup> Supplemental Assistance Program for Women, Infants and Children (WIC) participation and duration,<sup>25,32,39,51,59</sup> and other programs (e.g., Child and Adult Care Food Program (CACFP),<sup>55</sup> and Medicaid or Supplemental Security Income (SSI)<sup>25,31</sup>).

## Outcome assessment

All studies examined dietary patterns aligned with the DGA as measured by the HEI<sup>22</sup>, HEI-2005 (14 articles)<sup>7,12-15,18,23,26,30,36-38,56,58</sup>, HEI-2010 (31 articles)<sup>1,2,4-6,9-11,17,19-21,24,25,27-29,31-34,40-44,46,50,54,60,61</sup>, and/or HEI-2015 (15 articles)<sup>3,8,16,35,39,45,47-49,51-53,55,57,59</sup>. Scores on the HEI were determined using a variety of dietary assessment methods, including food frequency questionnaires or 24-hour dietary recalls.

## Synthesis

Results from all included studies are provided in **Table 2-b**. Income was significantly associated with HEI scores in 20 articles.<sup>1,3-7,9,13,20,22,30,36,40-44,48,49,54</sup> Results were reported as lower income/greater poverty associating with lower HEI scores, higher income/less poverty associating with higher HEI scores, and/or as participation versus non-participation in Federal assistance program(s) associating with lower HEI scores.

Eleven articles reported 'positive' associations (that is, higher income associated with higher HEI scores) with not all results reported reaching statistical significance.<sup>2,17,23,25,26,33,37,39,45,50,58</sup> Five articles<sup>14,21,19,24,59</sup> reported at

least 1 significant 'inverse' association with 3 finding that NSLP participants (compared to non-participants) had significantly higher HEI scores.<sup>14,19,21</sup> Gu et al<sup>24</sup> reported that NSLP was significantly associated with lower HEI scores and WIC participation was significantly associated with higher HEI scores, but comparisons based on income or SNAP status were not significant. Weinfield et al<sup>59</sup> similarly reported that longer WIC duration was significantly associated with higher HEI scores, but comparisons of HEI by poverty were not significant.

The remaining articles reported no significant association between income,<sup>8,10,11,15,16,18,31,32,46,55,60</sup> poverty-to-income ratio,<sup>12,34,52,53,61</sup> Federal assistance participation/eligibility/duration (SNAP,<sup>29,35,38,47,51,56,57</sup> NSLP,<sup>27</sup> WIC,<sup>51</sup>), or both income and Federal assistance<sup>28</sup> and HEI scores.

## Assessment of evidence

As outlined and described below, the body of evidence examining the relationship between income and HEI was assessed for the following elements.

### Risk of bias

Risk of bias assessments for each included article are provided in **Table 2-c**. The preponderance of evidence came from observational studies, particularly cross-sectional data or design, that did not account or adjust for key confounders including food insecurity/hunger and urban/rural setting. Many studies had serious or some concerns with classification of income due to self-selection of Federal assistance program participation/eligibility status and/or proxy calculations. Many studies had serious concerns related to comparisons with little difference between income levels of exposure groups or likelihood that participants' income or Federal participation/eligibility status was assessed at a single point in time but likely unstable. Many studies also had concerns with missing data and/or the selection of reported results due to the lack of a priori analysis plans/protocol.

### Consistency

The direction of findings consistently showed that lower income was associated with lower HEI scores and the magnitude of the effect was consistently small, with many reported results not reaching statistical significance. Participation in Federal assistance programs was correlated with lower diet quality, as measured by HEI scores. However, about half of the articles found no statistically significant relationships between income and HEI.

### Directness

The body of evidence had several concerns regarding directness, particularly the exposures and/or comparators examined by studies were not directly related to the question of interest. For example, studies examining SNAP participation tended to compare groups that had similar or nearly similar income levels. In addition, the population in several articles were all low-income or all participants in specific Federal assistance programs. Outcomes examined in all studies were directly related to the question.

### Precision

Several concerns with precision were identified across the body of evidence. Although sample sizes were relatively large, the reported effects tended to be small in magnitude (of little practical/clinical significance) and have wider confidence intervals indicating limited precision.



### Generalizability

Although all studies were conducted in the U.S. and many used nationally representative data, the generalizability was limited in several studies particularly related to the selection of participants. For example, several studies examined differences within exclusive populations such as all WIC participants, all low-income participants, only Mexican-origin children, or only Haitian-Americans.

## Summary statements and research recommendations

### Summary statements

The findings of the rapid review are presented in the following summary statement[s].

Evidence suggests lower income or greater poverty is correlated with lower HEI scores. Critical limitations in the design and conduct of most included studies were identified that impact the validity of the reported results. In addition, the findings that reached statistical significance tended to lack meaningful clinical/practical significance (e.g., 1 to 5 point higher HEI scores) but remaining within a range of needing improvement.

Studies widely varied in how they defined and examined income exposures. No clear trends were found between studies that examined similar or different income groupings.

Studies that examined Federal assistance eligibility/participation often reported indirect income exposures or comparisons, and/or treated income constant between participant groups.

Relatively few studies accounted for food security/hunger. No clear trends were found among exposures, outcomes, or significance of results based on whether food security was accounted for or not.

### Research recommendations

1. Conduct well-designed, longitudinal studies that examine the relationship between income and diet quality over time.
2. Assess income exposures using standard definitions and categories to improve comparability across studies.
3. Differentiate between participants in studies who are income-eligible, income-eligible nonparticipants, and income-ineligible nonparticipants of Federal assistance programs.
4. Account for hunger or food security status of participants, as well as other potential confounders including urban/rural setting and cultural/racial diversity or disparities, to better determine the response to income on dietary patterns as a function of these factors.

Table 2-b. Evidence examining the relationship between income and/or Federal assistance participation/eligibility and HEI<sup>a</sup>

Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
<b>Income</b>						
Bekelman, 2021 <sup>8</sup>	482	Children, 5 y; Colorado  <u>Data source:</u> Healthy Start study	Income: <\$75K v. ≥ \$75K	HEI-2015	OR: 0.84, 95% CI: 0.54, 1.31, NS	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with departure from intended exposure due to lack of accounting for food insecurity/hunger
Byker Shanks, 2020 <sup>10</sup>	80	Adults, ≥18 y; Flathead nation, Montana  <u>Data source:</u> N/A	Income, \$	HEI-2010	data NR, p< 0.21; NS	Minimal concerns with selection into study and selection of reported results
Chen, 2018 <sup>11</sup>	298	Adults: Parents of children, 9 to 10 y; rural Texas  <u>Data source:</u> Student Wellness Assessment and Advocacy Project [SWAAP]	Income: Low <\$40K; Medium \$40,001–\$70K; High >\$70,001	HEI-2010 adapted	β= 0.09, r=-0.29189, p=0.268; NS	Did not account for confounders of: Food security; Some concerns with outcome measurement due to adaption of HEI-2010
Deierlein, 2014 <sup>15</sup>	1306	Adults, 60 to 99 y; New York City, New York  <u>Data source:</u> Cardiovascular Health of Seniors and the Built Environment Study	Annual HH income: > \$30K (ref) v. ≤ \$30K	HEI-2005	HEI ≥ 80 v. <80 RR: 1.20 95% CI: 0.93, 1.55	Some concerns with selection bias; Some concerns with departure from intended exposure

\* All study designs and/or data reported were cross-sectional unless indicated by \*PCS, which indicates a prospective cohort study design.

† Unless otherwise noted, results are formatted as mean (SD), mean [SE], odds ratio (OR), relative risk (RR), and/or 95% Confidence Interval (CI). Results that were statistically significant are bolded and those that were not statistically significant are indicated either by the respective p value or NS.



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
Deierlein, 2021 <sup>16</sup>	1016	Adults, all pregnant women, ≥ 18 y; New York City, New York  <u>Data source:</u> New York University Children's Health and Environment Study (NYU CHES)	Income: <\$30K; \$80K-\$99.999K; ≥\$100K	HEI-2015	≥\$100k (ref) v. <\$30k: 1.92, 95% CI: -0.41, 4.25, NS ≥\$100k (ref) v. \$30-\$99.999k: 1.02, 95% CI: -0.53, 2.57, NS	Did not account for confounders of: Food security; Some concerns with selection bias; Some concerns with departure from intended exposure related to potential for changes from timing of assessments; Limited generalizability to non-pregnant populations
Drewnowski, 2016 <sup>17</sup>	1116	Adults, ≥ 18 y; Seattle, Washington  <u>Data source:</u> Seattle Obesity Study (SOS)	Income, ≤\$50K ref v. \$50K to < 100K; ≤\$50K ref v. ≥\$100K	HEI-2010; HEI-2005	HEI-2010: \$50K to <100K: 1.34, 95% CI: -0.13, 2.82 <b>≥\$100K: 2.57, 95% CI: 0.96, 4.19</b>  HEI-2005: \$50K to <100K: 0.72, 95% CI: -0.73, 2.19; NS ≥\$100K: 1.30, 95% CI: -0.28, 2.89; NS	Did not account for confounders of: Food security; Some concerns with departure from intended exposure
Flórez, 2015 <sup>18</sup>	639	Adults, ≥ 18 y, all SNAP participants; Pennsylvania  <u>Data source:</u> Pittsburgh Hill/Homewood Research on Eating, Shopping and Health (PHRESH) study	Adjusted annual HH income ≥ \$10K	HEI-2005	β= -0.0235, p=0.6787; NS	Some concerns with departure from intended exposure, missing data, outcome measurement and reported results; Limited generalizability to non-SNAP participants
Freedman, 2019 <sup>20</sup>	101	Adults, 19 to 92 y, living in urban food desert; Ohio  <u>Data source:</u> BRFSS	Annual HH Income	HEI-2010	Path modeling including the collective influence of individual, social, and built food environment factors on diet quality with income included in the models: <b>Cleveland: Income, β= 0.171, p&lt;0.05</b> Columbus: Income, β=0.300, p<0.10	Some concerns with classification of exposure and departure from intended exposure; Concerns with indirectness
Gibbs, 2016 <sup>22</sup>	177	Dyads of Children 4 to 6 y, with parents (primary food purchaser/preparer); Kansas	HH income, \$, mean	HEI	<b>Income: r=0.218, p &lt;0.05</b>	Did not account for confounders of: Urban vs. Rural; Food security



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
		<u>Data source:</u> Kansas University Docosahexaenoic Acid Outcomes Study (RCT); Nutrition Literacy Assessment Instrument for Parents (NLit-P)				
Laster, 2013 <sup>36</sup>	113	Dyads of Overweight/obese (BMI≥25), 2-7 mo post-partum mothers, ≥18 y and their preschooler, 2 to 5 y; North Carolina	HH income, up to \$15K \$15001-\$30K, \$30001-\$60K, ≥\$60001	HEI-2005	Mother HH income: <\$15K 59.5 (9), \$15001-\$30000, 65.9 (11), \$30001-\$60K, 66.4 (10.5), ≥\$60K, 70.3 (8.7), p<0.0001  Stepwise model predicting child HEI: \$15K v. >\$15K, β=-2.33 [1.10], p=0.04; \$15001 to \$60K v. ≥\$60K, β=-1.73 [0.72], p=0.02	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with classification of exposures due to proxy with caretakers
		<u>Data source:</u> Kids and Adults Now!—Defeat Obesity (KAN-DO)				
Huffman, 2014 <sup>30</sup>	487	Adults ≥35 y, Haitian-Americans without diabetes; Florida	<\$20K/y v. ≥ \$20K/y	HEI-2005	β=-5.30, 95% CI: 0.03, -10.6, p=0.051	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with selection into study, departure from intended exposures, and reported results. Limited generalizability related to studying only Haitian-American immigrants.
		<u>Data source:</u> NR				
Richards Adams, 2019 <sup>46</sup>	100	Adults, 18 to 74 y, African American living in a metropolitan area; Kentucky	Income	HEI-2010	Bivariate correlation r=0.13, NS Linear regression β=0.10, p=0.82, NS	Did not account for confounders of: Food security; Some concerns with selection into study; Limited due to convenience sample
		<u>Data source:</u> N/A				
Springfield, 2019 <sup>50</sup>	210	Adults, all women, African-American, previous breast cancer, and interested in weight-loss (all	Income, \$	HEI-2010	β=1.44 [0.52], p≤ 0.01, but did not move forward in adjusted models	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with selection into study; Limited generalizability due to participants



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
		overweight or obese); Chicago, IL  <u>Data source:</u> Moving forward study, a RCT for weight loss				self-selecting into study for weight loss
Weatherspoo n, 2017 <sup>58</sup>	2687	Adults, ≥ 19 y; Michigan  <u>Data source:</u> Michigan State University Extension (MSUE)	HH income \$100 and \$500/pp/mo v. <\$100/pp/mo	HEI-2005	Δ HEI exit-entry after SNAP-Ed only: – <b>0.68 [0.02], p&lt;0.01</b> Δ HEI exit-entry after EFNEP only: – <b>0.85 [0.03], p&lt;0.01</b> Data NR: HH income \$100 and \$500/pp/mo v. <\$100/pp/mo increased in ΔHEI scores, p<0.05; \$500 or more, NS	Did not account for confounders of: Food security; Serious concerns with departure from intended exposures; Comparator not directly related to question of interest
Wilcox, 2020 <sup>60</sup>	465	Adults, ≥18 y, shoppers for ≥50% household's food; South Carolina cities  <u>Data source:</u> N/A	Income: <\$10k; \$10-\$19.999k; ≥\$20k	HEI-2010	<\$10k: 47.42 v. \$10-\$19.999k: 47.26 v. ≥\$20k: 49.75, NS Income, F (4, 448)=6.71, p<0.001, r <sup>2</sup> =0.06; F(2, 448)=1.29, p=0.28	Did not account for confounders of: Cultural/racial diversity or disparities; Food security; Serious concerns with departure from intended exposures
<b>Poverty</b>						
Aggarwal, 2016 <sup>5</sup>	8957	Adults, ≥20 y; National dataset  <u>Data source:</u> NHANES, 2007-2010	FIPR: family income-to-poverty ratio, adjusted for HH size	HEI-2010	FIPR <130%: 45.6, 131-184%: 47.1, 185-399%: 48.4, ≥400%: 51.7 <b>&lt;130% (ref) v. 131-184%: 1.96 [0.86], p=0.030</b> <b>&lt;130% (ref) v. 185-399%: 3.21 [0.50], p&lt;0.001</b> <b>&lt;130% (ref) v. ≥400%: 6.48 [0.60], p&lt;0.001</b>	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns due to missing data
Beatty, 2014 <sup>7</sup>	37263	Adults, ≥ 20 y; National dataset  <u>Data source:</u> CSFII, 1989-1991, 1994-1996; NHANES, 2001-2008	HH Income <185% FPG (low)	HEI-2005	2005-2008, n=9258: <b>low-income 51.37 (14.99), 95% CI: 8.78, 94.60 v. higher-income 52.92 (11.29), 95% CI: 10.00, 95.38, p&lt;0.05</b> Data NR (in figures): For HEI below 45, higher-income individuals experienced a greater improvement over the period 1989–2008 than low-income individuals. Whereas at higher levels of the HEI	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with departure from intended exposure due to lack of accounting for food insecurity/hunger; Some concerns with outcome measurement due to timing of dietary data collected vs.. calculated; Some concerns with reported results; Limitations



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					distribution, low-income individuals experienced greater increases in HEI.	related to date range of data collected
Beydoun, 2015 <sup>9</sup>	2111	Adults, 30 to 64 y; Baltimore, Maryland  <u>Data source:</u> Healthy Aging in Neighborhoods of Diversity across the Life Span Study (HANDLS)	PIR: ≥ 125% poverty threshold v <125% poverty threshold	HEI-2010	<b>PIR≥125%: 43.82 (0.35) v. &lt;125%: 40.93 (0.34), p&lt;0.05</b>	Did not account for confounders of: Sex; Age; Food security; Some concerns with departure from intended exposure due to lack of accounting for food insecurity/hunger; Some concerns with outcome measurement
Beydoun, 2018 <sup>1</sup> *PCS	1466	Adults, 30 to 64 y; urban Maryland  <u>Data source:</u> HANDLS	PIR <125% poverty threshold, ≥125% poverty threshold	HEI-2010	<b>baseline, ≥125%, 44.5 [0.4] v. &lt;125%, 41.3 [0.4], p&lt;0.001</b> <b>follow-up, ≥125%, 47.95 [0.4] v.&lt;125%, 44.6 [0.46], p&lt;0.001</b> change, ≥125%, +0.78 [0.10] v. <125%, +0.68 [0.10], NS	Did not account for confounders of: Food security; Some concerns with selection bias; Some concerns with departure from intended exposure due to lack of accounting for food insecurity/hunger; Some concerns with reported results due to no protocol
Coltman, 2013 <sup>12</sup>	99	Adults, 18 to 75 y; diagnosed with type 2 diabetes; urban Illinois  <u>Data source:</u> N/A	PIR ≤130%, >130%, based on # of people living in HH	HEI-2005	PIR: ≤130%, 56.0 (11.3) v. >130%, 56.6 (9.6); NS Correlations with HEI: PIR: -0.075; NS	Critical concerns due to not accounting for confounders of: Cultural/racial diversity or disparities; Sex; Age; Food security; Serious concerns due to selection into study based on diabetic status; Some concerns with departure from intended exposure; Limited generalizability
Covington, 2020 <sup>3</sup> *PCS	207	Dyads of Children, 12 to 32 mo with their mothers; Mid-Atlantic region  <u>Data source:</u> NCT02615158	Poverty based on parent-reported income and family size, <1.0 indicated below poverty threshold	HEI-2010	<b>Between-person indirect effect: 3.797 [0.842], 95% CI: 2.133, 5.460, p&lt;0.05</b> Within-person indirect effect: -3.552 [2.230], 95% CI: -7.948, 0.844, NS	Did not account for confounders of: Cultural/racial diversity or disparities (68% Non-Hispanic Black); Food security; Some concerns due to missing data despite methods used to account for impact;
Kuczmariski, 2016 <sup>34</sup>	2111	Adults, ~48 y; Baltimore City, Maryland	PIR: ≥ 125% poverty threshold	HEI-2010	PIR ≥ 125% vs. <125%: 0.70 (0.49), NS	Did not account for confounders of: Food security; Some concerns



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
			vs. <125% poverty threshold			with departure from intended exposure
Martin, 2015 <sup>40</sup>	4799	Children, 5 to 17 y of Mexican-origin; National dataset  <u>Data source:</u> NHANES, 1999-2010	PIR-squared	HEI-2010	<b>-1.30, p&lt;0.05</b>	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with missing data. Limited generalizability due to sample being only Mexican-origin children.
Nowlin, 2016 <sup>43</sup>	11668	Adults, ≥20 y not pregnant; National dataset  <u>Data source:</u> NHANES, 2007-2012	PIR	HEI-2010	Regression coefficient [SE] PIR: ≥3.5 (ref) v. 1.3-3.49; ≥3.5 (ref) v. ≤1.29 <b>No T2D, n=9,509: -2.47 [0.6], p&lt;0.01; -3.15 [0.6], p&lt;0.01</b> Undiagnosed T2D, n=451: 4.68 [2.1] NS; -1.47 [2.0] NS; Diagnosed T2D, n=1708: 1.00 [1.4] NS; -0.96 [1.4] NS	Did not account for confounders of: Urban vs. Rural; Food security; Serious concerns with departure from intended exposures and reported results.
Orr, 2019 <sup>44</sup>	5882	Adults, ≥ 20 y with type 1 or 2 diabetes; National dataset  <u>Data source:</u> NHANES, 1999-2014	PIR, based on % HH income at; 100%, 100–200%, > 200% poverty threshold	HEI-2010	PIR, <100% (ref): 100-200% 0.74 95% CI: -0.79, 2.27, NS; <b>&gt;200% 3.65 95% CI: 2.35, 4.95, p&lt;0.001;</b> <b>Δ HEI/y: 0.18 95% CI: 0.04, 0.33, p=0.01;</b> Interaction, food security x NHANES cycle: NS	Did not account for confounders of: Urban vs. Rural; Some concerns with selection into study
Patetta, 2019 <sup>45</sup>	8012	Adults, 18 to 39 y; National dataset  <u>Data source:</u> NHANES 2011-14	<180% poverty threshold (low), 180-350% poverty threshold (middle), >350% poverty threshold (high)	HEI-2015	<b>Low v. high income and mean HEI: 52.4 v.61.2, p&lt;0.05;</b> low v. middle: 52.4 v. 55.8, NS; middle v. high: 55.8 v. 61.2, NS	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Sex; Age; Food security
Shan, 2019 <sup>48</sup>	43996	Adults, ≥20 y; National dataset  <u>Data source:</u> NHANES, 1999-2016	PIR: < 1, 1.3-3.49, ≥3.5	HEI-2015	PIR < 1.3: 2009-10 55.6, 95% CI: 55.0, 56.1; 2011-12 56 95% CI: 55.0, 56.9; 2013-14 55.7 95% CI: 55.0, 56.4; 2015-16 56.2 95% CI: 55.3, 57.2; 2015-16 v. 1999-00 difference, 0.81, 95% CI: -0.63, 2.26; NS	N/A





Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					PIR 1.3-3.49: 2009-10 57.1, 95% CI: 56.4, 57.8; 2011-12 57.7, 95% CI: 57.0, 58.4; 2013-14 57.2, 95% CI: 56.6, 57.8; 2015-16 56.4, 95% CI: 55.6, 57.1; <b>2015-16 v. 1999-00 difference: 1.32, 95% CI: 0.18, 2.46 p&lt;0.001</b>  PIR ≥3.5: 2009-10 58.8, 95% CI: 58.1, 59.5; 2011-12 59.9, 95% CI: 58.9, 60.8; 2013-14 59.5, 95% CI: 58.8, 60.2; 2015-16 59.3, 95% CI: 58.3, 60.3; <b>2015-16 v. 1999-00 difference, 3.23, 95% CI: 1.71, 4.75, p&lt; 0.001</b>	
Taverno Ross, 2020 <sup>4</sup> *PCS	260	Children, 10 to 17 y; South Carolina  <u>Data source:</u> Transitions and Activity Changes in Kids study	Poverty based on the percentage of residents living in poverty in the census tract for the child's home address.	HEI-2015	HEI growth curve: <b>0.2 [0.1], p&lt;0.05</b>	Did not account for confounders of: Urban vs. Rural; Food security
Thomson, 2019 <sup>52</sup>	9000	Children, 2 to 18 y; National dataset  <u>Data source:</u> NHANES 2009-2014	PIR: <1, ≥1	HEI-2015	Overall: PIR<1 vs. PIR ≥1, 53.9, 95% CI: 52.5, 55.4 vs.. 55.1, 95% CI: 54.1, 56.1, NS By Race/Ethnicity (in figure): no significant differences in HEI by PIR in non-Hispanic black, Mexican American, other Hispanic or other race groups; <b>Significant difference in non-Hispanic white group by PIR</b> By Age Group and by gender: No significant differences in HEI by PIR	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Sex; Age; Food security; Serious concerns with departure from intended exposures
Thomson, 2020 <sup>53</sup>	8894	Children, 2 to 18 y; National dataset  <u>Data source:</u> NHANES, 2009-2014	PIR: <1, ≥1	HEI-2015	PIR< 1 v. PIR≥1, mean, 95% CI Underweight: 47.7, 95% CI: 42.8, 52.8 v. 51.1, 95% CI: 46.6, 55.8, NS Normal weight: 53.9, 95% CI: 52.2, 55.6 v. 55.6, 95% CI: 54.5, 56.6, NS Overweight: 55.2, 95% CI: 52.5, 57.9 v. 54.4, 95% CI: 52.0, 56.7, NS	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Sex; Age; Food security; Serious concerns due to missing data





Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					Obese: 53.3, 95% CI: 51.1, 55.5 v. 54.3, 95% CI: 51.2, 57.6, NS	
Wilson, 2018 <sup>61</sup>	3555	Adults, ≥19 y, all Hispanic; National dataset  <u>Data source:</u> NHANES, 2007/08; 2009/10 Consumer Behavior Phone Follow-Up Modules	PIR ≤ 130% v. >130% poverty threshold	HEI-2010	HEI <51.6: 1.18, 95% CI: 0.99,1.44; NS	Did not account for confounders of: Urban vs. Rural; Food security; Serious concerns due to missing data
<b>Both income and Federal assistance program participation/eligibility</b>						
Gu, 2017 <sup>24</sup>	All y: 38,48 7 Y in or after 2008: 16,80 2	Children, 2 to 18 y; National dataset  <u>Data source:</u> NHANES, 1999-2012	Income: PIR NSLP/SBP; SBP; SNAP;	HEI-2010	PIR ≤1.3 v. 1.31-3.5 v. >3.5: <b>2007-2008, n=5,402: 47.8, 95% CI: 46.2, 49.4 v. 44.9, 95% CI: 43.3, 46.4 v. 46.8, 95% CI: 44.7, 48.8, p&lt;0.001</b> 2009-2010, n=5,751: 48.0, 95% CI: 46.8, 49.2 v. 48.1, 95% CI: 46.2, 49.9 v. 48.2, 95% CI: 46.1, 50.2, NS <b>2011-2012, n=5,649: 50.0, 95% CI: 48.6, 51.4 v. 49.7, 95% CI: 48.3, 51.2 v. 51.5, 95% CI: 49.3, 53.7, p=0.02</b>  SNAP Yes v. No, Mean (95% CI) <b>2007-2008: 47.0 (45.2, 48.8) v. 49.0 (46.5, 51.5), p=0.007</b> 2009-2010: 48.2 (46.7, 49.7) v. 48.0 (45.9, 50.1), NS <b>2011-2012: 49.6 (47.9, 51.2) v. 51.1 (49.0, 53.3), p=0.004</b> All years combined: NS  WIC Yes v. No, Mean (95% CI) 2007-2008: 51.2 (49.1, 53.3) v. 53.4 (51.3, 55.6), NS 2009-2010: 53.7 (51.2, 56.1) v. 51.2 (47.9, 54.5), NS <b>2011-2012: 55.8 (53.9, 57.8) v. 51.3 (48.9, 53.7), p=0.008</b>	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with departure from intended exposure



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					<p><b>All years combined: Higher v. Lower (numbers not reported), p=0.006</b></p> <p>NSLP/SBP Yes v. No, Mean (95% CI)  <b>2007-2008: 45.2 (44.2, 46.2) v. 47.5 (43.8, 51.3), p&lt;0.001</b>            2009-2010: 46.8 (45.6, 48.1) v. 43.2 (40.2, 46.2), NS            2011-2012: 49.0 (47.8, 50.3) v. 46.8 (43.2, 50.4), NS</p> <p><b>All years combined: Lower v. Higher (numbers not reported). p=0.003</b></p>	
Gupta, 2020 <sup>25</sup>	450	Adults, ~ 51.1y, primary food shoppers with low access to healthy food retail; Ohio  <u>Data source:</u> N/A	SNAP participation in past 12 mo; WIC participation in past 12 mo; Other federal assistance in past 12 mo (TANF, Medicaid, disability, or SSI) Income: <\$10K, \$10,001-\$20K, \$20,001-\$30K, \$30,001-\$40K, >\$40,001 (ref).	HEI-2010	<p>Income, &gt;\$40,001 (ref): &lt;\$10K <math>\beta</math>=-2.3, NS; \$10,001-\$20K <math>\beta</math>=-2.9, NS; \$20,001-\$30K <math>\beta</math>=-0.7; \$30,001-\$40K <math>\beta</math>=-1.8, NS;</p> <p><b>SNAP, non-participation (ref): <math>\beta</math>=-2.5, p=0.04;</b>            WIC, non-participation (ref): <math>\beta</math>=-2.2, NS; Other: <math>\beta</math>=0.4, NS;</p>	Some concerns with departure from intended exposure; Serious concerns with selection of reported results; Limited generalizability to those with higher access to healthy food retail.
Hanson, 2013 <sup>26</sup>	2376	Children, 6 to 17 y; National dataset  <u>Data source:</u> NHANES, 2003-2008	Family Income: <200% poverty threshold (ref), >200% poverty threshold; NSLP: no meals (ref), school lunch only, school breakfast and lunch;	HEI-2005	<p><u>Income, &gt;200% v. &lt;200% poverty threshold:</u>            weekday, 51.2 95% CI: 49.0, 51.4 v. 50.2 95% CI: 49.0, 51.4, NS;            weekend, 47.6 95% CI: 46.1, 49.2 v. 48.9 95% CI: 47.8, 50.0, NS;            difference, +3.3 95% CI: 1.7, 5.0 v. +1.3 95% CI: 0.2, 2.5, NS</p> <p><u>NSLP participation, NSLP only v. no meals, NSLP+SBP v. no meals:</u>            weekday: <b>50.0 95% CI: 48.7, 51.2 v. 52.1 95% CI: 50.3, 53.9, p&lt;0.05</b>, 50.5 95% CI: 49.4, 51.8 v. 52.1 95% CI: 50.3, 53.9, NS,</p>	Serious concerns due to not accounting for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Sex; Age; Food security; Serious concerns with classification of exposure, departure from intended exposure, missing data, and selection of reported results related to intent of study to capture weekday/weekend changes in HEI.



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					weekend, 48.5 95% CI: 46.8, 50.2 v. 46.9 95% CI: 45.0, 48.9, NS, 48.5 95% CI: 47.4, 49.7 v. 46.9 95% CI: 45.0, 48.9, NS; difference, <b>+1.4 95% CI: -0.3, 3.2 v. +5.2 95% CI: 2.8, 7.6, p&lt;0.05, +1.9 95% CI: 0.7, 3.1 v. +5.2 95% CI: 2.8, 7.6, p&lt;0.05;</b>	
Hill, 2020 <sup>28</sup>	168	Adult, ≥18 y, pregnant women in 2nd trimester recruited from WIC clinic; North Carolina  <u>Data source:</u> N/A	Monthly income: \$0-1,000, ≥ \$1,001; SNAP: Receives benefits or not	HEI-2010	Monthly income: \$0-\$1000, 54.96 (14.16) 95%CI: 52.19, 57.72, v. ≥ \$1001, 57.36 (13.11) 95%CI: 54.68, 60.05; NS  SNAP: receives benefits, 56.61 (13.36) 95%CI: 54.05, 59.17 v. not receiving benefits, 55.51 (14.05) 95%CI: 52.63, 58.48; NS	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Age; Food security; Some concerns with selection into study, classification of exposure, departure from intended exposures, missing data, and reported results. Limited generalizability to those who are not pregnant and without WIC
Kane, 2018 <sup>31</sup>	242	Adults, >18 y, diagnosed with cancer currently receiving treatment; Ohio  <u>Data source:</u> N/A	Income/mo: ≥\$4K, \$3K-\$3999, \$2K-\$2999, \$1K-\$1999, <\$1K Federal Food Assistance: SNAP, other, none	HEI-2010	<b>Bivariate-Income/mo, ≥\$4K 64.69 (10.52) (ref): \$3K-\$3999 63.61 (12.66), \$2K-\$2999 60.63 (11.01), \$1K-\$1999 57.25 (11.55), &lt;\$1K 56.44 (12.12), p≤0.001</b>  <b>Bivariate-Fed Food Assistance: None 62.55 (11.61) (ref): SNAP 55.18 (9.59), Other 55.73 (16.39), p≤0.01</b>  Regression - Income/mo, ≥\$4K (ref): \$3K-\$3999/mo, β=0.79, 95% CI: -2.97, 4.55, p=0.68	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Food security; Serious or some concerns with selection into study, classification of exposures, departure from intended exposures, missing data, and reported results.
Kay, 2020 <sup>32</sup>	231	Children, 24 to 34 mo non-HM fed; North Carolina, Florida, California, New York  <u>Data source:</u> Greenlight Intervention Study, a cluster RCT	Low income < \$19,999; Higher income ≥ \$20K; WIC participation v. not	HEI-2010	Low income, 62.9 (10.3) v. Higher income, 62.8 (10.7); NS WIC benefits, 62.8 (10.5) v. not, 63.4 (10.4); NS	Did not account for confounders of: Urban vs. Rural; Some concerns with selection into study, missing data, and outcome measurement. Limited generalizability



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
Kinderknecht, 2020 <sup>33</sup>	6389	Children, 5 to 18 y, participating in NSL; National dataset  <u>Data source:</u> NHANES, 2007-2016	NSLP participation or not, before and after Healthy, Hunger-Free Kids Act (HHFKA); Income: ≤130% poverty threshold (low); >130%-≤185% poverty threshold (low-middle); and >185% poverty threshold (middle-high)	HEI-2010	Stratified by income, difference between before and after HHFKA for NSLP participants v. nonparticipants: <b>low income, 3.4 95% CI: 0.5,6.3, p=0.02; low-middle income, 4.7 95% CI: 0.8,8.7, p=0.02;</b> middle-high income, 1.9 95% CI: -0.08,4.5; NS	Did not account for confounders of: Urban vs. Rural; Food security; Serious or some concerns with selection into study, classification of exposures, departure from intended exposures, missing data, and reported results. Limited generalizability
Liu, 2020 <sup>39</sup>	31420	Children, 2 to 19 y; National dataset  <u>Data source:</u> NHANES 1999-2016	PIR: <1.30, 1.30-1.849, 1.85-2.99, ≥3.00 SNAP: Yes/No WIC: Yes/No NSLP/SBP: Yes/No	HEI-2015	<u>2007-08</u> PIR: <1.30, 1.30-1.849, 1.85-2.99, ≥3.00]: 48.1 (46.4, 49.7), 46.0 (44.6, 47.4), 47.0 (45.3, 48.8), 49.1 (47.7, 50.5); SNAP Yes: 47.0 (45.4, 48.6), No: 48.5 (47.3, 49.7) WIC Yes: 49.7 (48.4, 51.0), No: 47.9 (46.7, 49.1) NSLP/SBP Yes: 46.4 (45.1, 47.6), No: 48.9 (47.6, 50.2) <u>2009-10</u> PIR: <1.30, 1.30-1.849, 1.85-2.99, ≥3.00]: 48.6 (47.4, 49.8), 50.0 (47.6, 52.5), 49.4 (47.2, 51.7), 50.0 (48.9, 51.1) SNAP Yes: 49.2 (48.1, 50.2), No: 49.7 (48.5, 50.8) WIC Yes: 51.5 (49.9, 53.0), No: 49.2 (48.2, 50.2) <b>NSLP/SBP Yes: 48.2 (47.3, 49.0), No: 50.2 (49.1, 51.4)</b> <u>2011-12</u> : PIR: <1.30, 1.30-1.849, 1.85-2.99, ≥3.00: 50.0 (48.9, 51.1), 51.2 (49.7, 52.7), 50.1 (48.5, 51.8), 53.4 (51.6, 55.2) <b>SNAP Yes: 49.6 (48.7, 50.5), No: 52.0 (51.2, 52.8)</b> WIC Yes: 52.8 (51.2, 54.5), No: 51.0 (50.1, 51.8) <b>NSLP/SBP Yes: 49.2 (48.3, 50.1), No:</b>	Serious risk due to confounding due to not accounting for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Sex; Age; Food security

Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					<p><b>52.3 (51.4, 53.3)</b>            2013-14: PIR: &lt;1.30, 1.30-1.849, 1.85-2.99, ≥3.00: 49.6 (48.2, 51.1), 49.9 (48.2, 51.7), 49.3 (47.6, 50.9), 50.7 (48.7, 52.8)            SNAP Yes: 50.1 (48.9, 51.2), No: 49.9 (48.8, 51.1)            WIC Yes: 51.3 (49.3, 53.2), No: 49.7 (48.8, 50.6)            NSLP/SBP Yes: 49.2 (48.0, 50.3), No: 50.4 (49.2-51.5)            2015-16 (no SNAP or WIC data this cycle):            PIR: &lt;1.30, 1.30-1.849, 1.85-2.99, ≥3.00: 48.3 (46.7, 49.9), 48.8 (47.2, 50.4), 50.7 (48.8, 52.7), 50.1 (48.3, 51.9);  <b>NSLP/SBP Yes: 47.9 (46.6, 49.2), No: 50.8 (49.5, 52.1)</b></p>	
Tovar, 2020 <sup>55</sup>	119	Child-care centers with providers and 374 children; Providence, Rhode Island  <u>Data source:</u> Healthy Start/Comienzos Sanos	Income: <\$25k, \$25,001-\$50k, \$75k+ Federal: Receives CACFP subsidies (Yes/No)	HEI-2015	Income: <\$25k (ref); \$25,001-\$50k, $\beta=2.9$ [3.0], $p=0.3$ ; \$75k+, $\beta=-5.6$ [4.0] $p=0.17$ , NS  CACFP: No (ref); Yes; $\beta=4.6$ [2.6], $p=0.08$ , NS	Did not account for confounders of: Urban vs. Rural; Age; Food security; Serious/some concerns on most domains of bias
Weinfield, 2021 <sup>59</sup>	1223	Dyads of Mothers with child ~ 3 y; National dataset  <u>Data source:</u> Special Supplemental Nutrition Program for WIC Infant and Toddler Feeding Practices Study-2	Poverty: >130% poverty threshold, 75% or less, >75% and <130% poverty threshold WIC Duration: Low, Intermediate, High	HEI-2015	Adjusted model WIC duration: Low (ref); <b>Intermediate, <math>\beta=0.36</math>, 95% CI: 0.04, 0.69, <math>p=0.03</math>; High, <math>\beta=0.41</math>, 95% CI: 0.12, 0.71, <math>p=0.007</math></b> Unadjusted model Poverty threshold: >130% (ref); 75% or below, $\beta=0.86$ , 95% CI: -0.64, 2.35, NS; 75%+ and <130%, $\beta=0.16$ , 95% CI: -0.88, 1.20, NS	Did not account for confounders of: Urban vs. Rural; Food security; Serious concerns with departure from intended exposures; Indirectly compared exposure via WIC duration
<b>Federal participation/ eligibility</b>						
Allen, 2016 <sup>6</sup>	1741	Adults, 30 to 64 y; Baltimore, Maryland	SNAP participation v. not	HEI-2010	<b>SNAP: -2.74 [0.90], <math>p=0.002</math></b> Food insecurity * SNAP: -0.80 [0.39],	Some concerns with selection bias due to missing f/u; Methods



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
		<u>Data source:</u> HANDLS			p=0.042 Covariate of PIR was significant predictor of HEI: -1.14 [0.57], p=0.044	used to assess exposure not well defined; Some concerns with departure from intended exposure due to SNAP status instability
Condon, 2015a <sup>13</sup>	16689	Children and Adults, ≥2 y; National dataset  <u>Data source:</u> NHANES, 2007-2010; MPED 2.0; CNPP Fact Sheet No. 1, 2006	SNAP: eligibility and participation	HEI-2005	SNAP (ref) v. income eligible nonparticipants v. higher income nonparticipants: <b>All ages: 56.8 v. 60.3, p&lt;0.05 v. 60.2, p&lt;0.05;</b> Children: 57.9 v. 61.0, p<0.05 v. 59.0, NS; <b>Adults: 53.9 v. 58.2, p&lt;0.05 v. 59.0, p&lt;0.05;</b> Older adults: 64.0 v. 65.6, NS v. 65.6, NS;  ≥16 y, matched SNAP-eligible participants, n=975 v. nonparticipants, n=572: 54.1 v. 55.8, NS	Did not account for confounders of: Urban vs. Rural; Some concerns with selection into study, departure from intended exposure, and missing data
Nguyen, 2014 <sup>41</sup>	4211	Adults, 20 to 64 y; National dataset  <u>Data source:</u> NHANES, 2003-2010	SNAP participation v. income eligible non-participants determined by PIR or ≤ 130% poverty threshold	HEI-2010	<b>SNAP participants 42.58 [0.33] v. eligible, nonparticipants 44.36 [0.27], p≤0.001.</b> Sensitivity analyses revealed effects by sex, ethnicity, and security status.	Did not account for confounders of: Cultural/racial diversity or disparities; Sex; Age; Food security; Exposure/comparator was not directly related to question of interest
Nguyen, 2015 <sup>42</sup>	8333	Adults, ~46 y, all low-income; National dataset  <u>Data source:</u> NHANES, 2003-2010	SNAP participation	HEI-2010	<b>Overall: β= -3.18 [0.53] p&lt;0.01</b>  SNAP + marginal food security: β=3.46 [0.99] p<0.01; SNAP + low food security: β=1.98 [0.88], p<0.05; SNAP + very low food security: β=3.84 [1.04] p<0.01	Did not account for confounders of: Urban vs. Rural; Some concerns with selection into study, classification of exposures, and departure from intended exposure. Limited generalizability
Singleton, 2020 <sup>49</sup>	14331	Adults, ≥18 y; National dataset  <u>Data source:</u> NHANES, 2009-2014	SNAP participation, eligible non-participants, ineligible non-participants via PIR	HEI-2015	SNAP Participants: PIR: β=0.24 [0.26], NS; Eligible Nonparticipants: PIR: β=-0.34 [1.17], NS; <b>Ineligible Nonparticipants: PIR: β=0.58 [0.17]</b>	Did not account for confounders of: Urban vs. Rural; Serious concerns with departure from intended exposures
Todd, 2015 <sup>54</sup>	1480	Adults, ~ 41y, all SNAP participants; National dataset	SNAP participation (days since received)	HEI-2010	<b>β= -0.090 [0.033], p&lt;0.05</b>	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or



Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
		<u>Data source:</u> NHANES, 2007-2010				disparities; Sex; Age; Limited generalizability
Bremer, 2018 <sup>2</sup>	146	Adults, > 18 y, from the intervention group of the trial; southwestern Virginia  <u>Data source:</u> SIPsmartER trial	SNAP-participants, SNAP-eligible nonparticipants, and Ineligible-nonparticipants	HEI-2010	At baseline, SNAP participants v. Eligible, nonparticipants v. Ineligible: 39.2 (10.8) v. 42.1 (13.6) v. 45.7 (12.5), p=0.160; NS  After 6 mo, SNAP participants v. Eligible, nonparticipants v. Ineligible: 41.3 (10.7) v. 42.2 (11.3) v. 50.8 (14.0), p=0.160; NS	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with classification of exposure due to self-selection/proxy calculations; Some concerns with departure from intended exposure due to lack of accounting for food insecurity/hunger;
Condon, 2015b <sup>14</sup>	5814	Children in school, 5 to 18 y; National dataset  <u>Data source:</u> NHANES, 2005-2010	NSLP participants v. nonparticipants (all income eligible for free/RP meals)  NSLP participants v. nonparticipants (all higher income)	HEI-2005	<b>NSLP participants v. nonparticipants (all free/RP meals): 60.5 [1.24] v. 55.1 [1.23], p&lt;0.05</b> In 5-8 y, NS; <b>In 9-13 y, 61.3 [1.75] v. 54.2 [1.78], p&lt;0.01</b> (similar results by sex in boys and girls); In 14-18 y, NS  NSLP participants v. nonparticipants (all higher income): 56.8 [1.19] v. 57.1 [1.31], NS In 5-8 y, NS; In 9-13 y, NS; In 14-18 y, NS	Did not account for confounders of: Urban/rural, Cultural/racial diversity or disparities; Food security; Some concerns with selection into study (excluded children who bring lunch from home), departure from intended exposure, and missing data.
Fox, 2019 <sup>19</sup>	4141	Children in Elementary, Middle, and High school; National dataset  <u>Data source:</u> School Nutrition and Meal Cost Study	NSLP participation v. not; SBP participation v. not	HEI-2010	NSLP vs.. nonparticipants: Elementary-school: 65.1 v. 60.8, NS Middle-school: 65.9 v. 62.9, NS High-school: 63.6 v. 59.7, NS <b>All students: 65.2 v. 60.6, p&lt;0.05</b>  SBP vs.. nonparticipants: Elementary-school: 66.4 v. 63.4, NS Middle-school: 63.7 v. 64.9, NS <b>High-school: 63.8 v. 59.8, p&lt;0.05</b> All students: 65.5 v. 62.8, NS	Did not account for confounders of: Food security
Gearan, 2020 <sup>21</sup>	2165	Children, 6 to 19 y; National dataset  <u>Data source:</u> School Nutrition and Meal Cost Study	NSLP participation or not on day of 24 hour recall (9% missing data imputed)	HEI-2010	<b>NSLP v. nonparticipants: 65% v. 61%, p&lt;0.05</b> 24h intake, both lower-income: 65.3 v. 61.4; difference: 3.9; NS <b>24h intake, both higher-income: 65 v. 60.9, difference: 4, p&lt;0.05</b> <b>Lunch intakes, both lower-income:</b>	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns related to missing data





Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
					<b>79.8 v. 68.0, difference: 11.8, p&lt;0.05</b> <b>Lunch intakes, both higher-income:</b> <b>80.5 v. 62.1, difference: 18.4, p&lt;0.05</b>	
Gregory, 2013 <sup>23</sup>	5105	Households of all low-income participants ≤ 200% poverty threshold; National dataset  <u>Data source:</u> NHANES, 2003-2008; ERS	SNAP participation v. nonparticipation over 12 mo	HEI-2005	<b>SNAP: 51.02 v. Non-SNAP 47.49, p&lt;0.01</b> SNAP v. Non-SNAP: OLS marginal effects -0.66 [0.65], NS <b>SNAP v. Non-SNAP: MFX Tx effects MLE -1.56 [0.25], p&lt;0.01</b>	Did not account for confounders of: Urban vs. Rural; Food security; Some concerns with classification of exposure and departure from intended exposure; Limited generalizability
Hearst, 2016 <sup>27</sup>	739	Children/Adolescents, 9th to 10th grade; rural Minnesota  <u>Data source:</u> Fueling Academics and Strengthening Teens Study (Break-FAST)	NSLP status: free/reduced price lunch v. full-price lunch	HEI-2010	Free/Red. cost lunch v. Full-price lunch: $\beta = -0.60$ [0.79], p=0.45, NS  Full-price lunch, n=472: 51.8 v. Free/Red. cost lunch, n=267: 52.1, NS	Did not account for confounders of: Food security; Some concerns with selection into study, departure from intended exposures, and missing data.
Hudak, 2021 <sup>29</sup>	2797	Children, 2 to 18 y; National dataset  <u>Data source:</u> NHANES, 2007-2008; 2011-2012	SNAP-eligible <150% poverty threshold; Nearly SNAP-eligible between 150% and 250% poverty threshold	HEI-2010	pre-ARRA: SNAP-eligible, 46.4 [1.02] v. nearly eligible 43.7 [1.00]; NS  post-ARRA: SNAP-eligible, 47.3 [0.73] v. nearly eligible 46.6 [0.73]; NS  SNAP benefit increase, overall before v. after ARRA: -1.99  ARRA-increase by age: Toddlers 2-3y, n=665: 2.55 [3.47]; Preschoolers 4-5y, n=550: -2.61 [3.01]; Children 6-11 y, n=1186: -2.86 [2.48]; Adolescents 12-18y, n=1186: -4.61 (2.21), p<0.05	Did not account for confounders of: Urban vs. Rural; Some concerns with selection into study and classification of exposures; Serious concerns due to departure from intended exposures.
Landry, 2019 <sup>35</sup>	598	Children, 3rd to 5th grade; Austin, Texas  <u>Data source:</u> TX Sprouts	SNAP Participation: Yes/No	HEI-2015	Unadjusted: SNAP Participation: Yes (ref); No, $\beta = 1.6$ , SE: 1.25, 95% CI: -0.85, 4.05, p=0.200, NS	Did not account for confounders of: Urban vs. Rural; Some concerns with departure from intended exposures, missing data, outcome measurement, and reported results.





Article*	N	Population	Exposure	Outcome	Results†	Summary of Limitations
Leung, 2012 <sup>37</sup>	3835	Adults, non-elderly; National dataset  <u>Data source:</u> NHANES 1999-2008	SNAP Participants vs. non-participants	HEI-2005	HEI: SNAP Nonparticipants (ref), SNAP Participants, RD=0.98, 95% CI: 0.94, 1.02, NS	Accounted for confounders; Some concerns with departure from intended exposures (i.e. variation in SNAP status), missing data, and reported results.
Leung, 2013 <sup>38</sup>	5193	Children, 4 to 19 y, all low-income ≤ 130% poverty threshold; National dataset  <u>Data source:</u> NHANES, 1999-2008	SNAP participants v. income eligible non-participants (former participants within last 12 mo were excluded)	HEI-2005	SNAP Nonparticipants, 47.2 (0.5) v. participants, 45.6 (0.6), NS	Did not account for confounders of: Urban vs. Rural; Some concerns with departure from intended exposures, missing data, and reported results.
Sanjeevi, 2021 <sup>47</sup>	Adult: 2784; Child: 2553	Adults and Children, 3 to 75 y, all low-income; National dataset  <u>Data source:</u> NHANES 2011-2016	SNAP current v. former participants with benefits cut off in past year; cut off for >1 y	HEI-2015	Adults: Current SNAP (ref); Benefits cut off in past year: $\beta=0.02$ [1.25], $p=0.99$ , NS; Benefits cut off >1 y: $\beta=-0.66$ [0.94], $p=0.49$ , NS  Children: Current SNAP (ref); Benefits cut off in past year: $\beta=-0.03$ [1.58], $p=0.99$ , NS; Benefits cut off >1 y: $\beta=-1.34$ [0.99], $p=0.18$ , NS	Did not account for confounders of: Urban vs. Rural; Serious concerns with departure from intended exposures; Limited generalizability
Thomas Berube, 2019 <sup>51</sup>	519	Adults, all Hispanic women who are pregnant; New York City, New York  <u>Data source:</u> Starting Early Trial	WIC Participation (yes/no) SNAP Participation (yes/no)	HEI-2015	WIC Participation: No (ref), Yes, $\beta=2.1$ , 95% CI: -0.1, 4.4, $p=0.06$ , NS SNAP: No (ref), Yes, $\beta=-0.3$ , 95% CI: -1.9, 1.3, $p=0.73$ , NS	Did not account for confounders of: Urban vs. Rural; Cultural/racial diversity or disparities; Food security; Limited generalizability
Waehrer, 2015 <sup>56</sup>	4158	Adults, ≥ 19 y; National dataset  <u>Data source:</u> NHANES, 2007-2010	SNAP eligible (≤ 150% poverty threshold) v. ineligible (150-250% poverty threshold)	HEI-2005	pre-ARRA ≤ 150%: 53.9; post-ARRA ≤ 150%: 53.5, NS pre-ARRA 150-250%: 54.9; post-ARRA 150-250%: 56.6, NS	Did not account for confounders of: Urban vs. Rural; Food security; Exposure was not directly related to the question of interest
Wang, 2021 <sup>57</sup>	157	Adults, all older adults/adults with disabilities receiving Supplemental Security	SNAP eligibility and participation	HEI-2015	Mean HEI-2015 score SNAP non-recipient, n=43: 45.8 v. recipient, n=114: 45.0, NS Expansion: baseline, n=213: 44.3 v. follow-up, n=157: 43.6, NS	Did not account for confounders of: Urban vs. Rural; Food security; Serious concerns due to missing data; Exposure was not

Article*	N	Population	Exposure	Outcome	Results <sup>†</sup>	Summary of Limitations
		Income (SSI); California				directly related to the question of interest
<u>Data source: N/A</u>						

<sup>a</sup> Abbreviations: ARRA, American Recovery and Reinvestment Act of 2008; EFNEP, Expanded Food and Nutrition Education Program; FPG, Federal Poverty Guidelines; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span Study; HEI, healthy eating index; Healthy, Hunger-Free Kids Act (HHFKA); HH, household; mo, months; N/A, not applicable or available; NHANES, National Health and Nutrition Examination Survey; NSLP, National School Lunch Program; NS, not statistically significant; % percent; PIR: poverty-to-income ratio; SBP, School Breakfast Program; SNAP, Supplemental Nutrition Assistance Program; SSI, Supplemental Security Income; WIC, Supplemental Assistance Program for Women, Infants and Children; y, years

**Table 2-c. Risk of bias for observational studies examining income and HEI<sup>a</sup>**

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Beydoun, 2018 <sup>1</sup> *PCS	SERIOUS	LOW	MODERATE	SERIOUS	MODERATE	MODERATE	SERIOUS
Bremer, 2018 <sup>2</sup> *PCS	SERIOUS	MODERATE	MODERATE	SERIOUS	MODERATE	MODERATE	LOW
Covington, 2020 <sup>3</sup> *PCS	SERIOUS	MODERATE	LOW	LOW	MODERATE	LOW	MODERATE
Taverno Ross, 2020 <sup>4</sup> *PCS	SERIOUS	MODERATE	MODERATE	LOW	MODERATE	MODERATE	MODERATE
Aggarwal, 2016 <sup>5</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Allen, 2016 <sup>6</sup>	SERIOUS	SERIOUS	MODERATE	SERIOUS	MODERATE	LOW	LOW
Beatty, 2014 <sup>7</sup>	SERIOUS	MODERATE	MODERATE	MODERATE	LOW	SERIOUS	SERIOUS
Bekelman, 2021 <sup>8</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	LOW
Beydoun, 2015 <sup>9</sup>	MODERATE	SERIOUS	LOW	MODERATE	MODERATE	LOW	MODERATE
Byker Shanks, 2020 <sup>10</sup>	MODERATE	MODERATE	LOW	LOW	LOW	LOW	MODERATE
Chen, 2018 <sup>11</sup>	MODERATE	MODERATE	LOW	LOW	LOW	MODERATE	LOW
Coltman, 2013 <sup>12</sup>	CRITICAL	SERIOUS	LOW	MODERATE	MODERATE	LOW	MODERATE
Condon, 2015a <sup>13</sup>	MODERATE	MODERATE	LOW	MODERATE	SERIOUS	MODERATE	MODERATE
Condon, 2015b <sup>14</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Deierlein, 2014 <sup>15</sup>	LOW	MODERATE	LOW	MODERATE	LOW	LOW	MODERATE
Deierlein, 2021 <sup>16</sup>	MODERATE	SERIOUS	LOW	SERIOUS	LOW	LOW	MODERATE

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Drewnowski, 2016 <sup>17</sup>	LOW	MODERATE	MODERATE	MODERATE	LOW	LOW	MODERATE
Flórez, 2015 <sup>18</sup>	LOW	LOW	MODERATE	MODERATE	MODERATE	MODERATE	MODERATE
Fox, 2019 <sup>19</sup>	MODERATE	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Freedman, 2019 <sup>20</sup>	LOW	MODERATE	MODERATE	MODERATE	LOW	LOW	MODERATE
Gearan, 2020 <sup>21</sup>	SERIOUS	MODERATE	LOW	LOW	MODERATE	LOW	LOW
Gibbs, 2016 <sup>22</sup>	SERIOUS	MODERATE	LOW	LOW	LOW	LOW	LOW
Gregory, 2013 <sup>23</sup>	SERIOUS	MODERATE	MODERATE	MODERATE	LOW	LOW	MODERATE
Gu, 2017 <sup>24</sup>	SERIOUS	MODERATE	LOW	SERIOUS	LOW	LOW	MODERATE
Gupta, 2020 <sup>25</sup>	LOW	MODERATE	LOW	MODERATE	LOW	LOW	SERIOUS
Hanson, 2013 <sup>26</sup>	SERIOUS	MODERATE	SERIOUS	SERIOUS	MODERATE	LOW	SERIOUS
Hearst, 2016 <sup>27</sup>	MODERATE	SERIOUS	LOW	MODERATE	MODERATE	LOW	MODERATE
Hill, 2020 <sup>28</sup>	SERIOUS	SERIOUS	MODERATE	MODERATE	MODERATE	LOW	MODERATE
Hudak, 2021 <sup>29</sup>	MODERATE	MODERATE	MODERATE	SERIOUS	MODERATE	LOW	LOW
Huffman, 2014 <sup>30</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Kane, 2018 <sup>31</sup>	SERIOUS	SERIOUS	MODERATE	MODERATE	MODERATE	LOW	SERIOUS
Kay, 2020 <sup>32</sup>	SERIOUS	MODERATE	LOW	LOW	MODERATE	MODERATE	LOW
Kinderknecht, 2020 <sup>33</sup>	SERIOUS	MODERATE	SERIOUS	MODERATE	SERIOUS	LOW	SERIOUS

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Kuczumarski, 2016 <sup>34</sup>	MODERATE	MODERATE	LOW	MODERATE	LOW	LOW	LOW
Landry, 2019 <sup>35</sup>	MODERATE	MODERATE	LOW	MODERATE	MODERATE	MODERATE	MODERATE
Laster, 2013 <sup>36</sup>	SERIOUS	MODERATE	MODERATE	LOW	LOW	LOW	LOW
Leung, 2013 <sup>38</sup>	MODERATE	MODERATE	LOW	MODERATE	SERIOUS	LOW	MODERATE
Leung, 2012 <sup>37</sup>	LOW	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Liu, 2020 <sup>39</sup>	SERIOUS	MODERATE	MODERATE	MODERATE	MODERATE	LOW	MODERATE
Martin, 2015 <sup>40</sup>	SERIOUS	MODERATE	LOW	LOW	MODERATE	LOW	LOW
Nguyen, 2014 <sup>41</sup>	MODERATE	MODERATE	MODERATE	MODERATE	LOW	LOW	LOW
Nyguen, 2015 <sup>42</sup>	MODERATE	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Nowlin, 2016 <sup>43</sup>	SERIOUS	MODERATE	LOW	SERIOUS	MODERATE	LOW	SERIOUS
Orr, 2019 <sup>44</sup>	MODERATE	SERIOUS	LOW	MODERATE	MODERATE	LOW	MODERATE
Patetta, 2019 <sup>45</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Richards Adams, 2019 <sup>46</sup>	MODERATE	SERIOUS	LOW	MODERATE	LOW	LOW	MODERATE
Sanjeevi, 2021 <sup>47</sup>	MODERATE	MODERATE	LOW	SERIOUS	MODERATE	LOW	SERIOUS
Shan, 2019 <sup>48</sup>	SERIOUS	MODERATE	LOW	MODERATE	SERIOUS	LOW	LOW
Singleton, 2020 <sup>49</sup>	MODERATE	MODERATE	MODERATE	SERIOUS	MODERATE	LOW	MODERATE
Springfield, 2019 <sup>50</sup>	SERIOUS	SERIOUS	LOW	LOW	LOW	LOW	LOW

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Thomas Berube, 2019 <sup>51</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	MODERATE
Thomson, 2020 <sup>53</sup>	SERIOUS	MODERATE	LOW	MODERATE	SERIOUS	LOW	LOW
Thomson, 2019 <sup>52</sup>	SERIOUS	LOW	MODERATE	SERIOUS	MODERATE	LOW	LOW
Todd, 2015 <sup>54</sup>	SERIOUS	MODERATE	SERIOUS	MODERATE	MODERATE	LOW	MODERATE
Tovar, 2020 <sup>55</sup>	SERIOUS	MODERATE	MODERATE	MODERATE	No Information	LOW	SERIOUS
Waehrer, 2015 <sup>56</sup>	MODERATE	SERIOUS	LOW	MODERATE	LOW	LOW	LOW
Wang, 2021 <sup>57</sup>	SERIOUS	LOW	LOW	LOW	LOW	LOW	MODERATE
Weatherspoon, 2017 <sup>58</sup>	MODERATE	SERIOUS	MODERATE	SERIOUS	MODERATE	MODERATE	MODERATE
Weinfield, 2021 <sup>59</sup>	SERIOUS	MODERATE	LOW	SERIOUS	MODERATE	LOW	LOW
Wilcox, 2020 <sup>60</sup>	SERIOUS	MODERATE	LOW	SERIOUS	MODERATE	LOW	MODERATE

<sup>a</sup> Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias for Nutrition Observational Studies" tool (RoB-NObs) (Dietary Guidelines Advisory Committee. 2020. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services*. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC.)

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## Chapter 3 - What is the relationship between overall diet cost and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI)?

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Emily Callahan, MS,<sup>a</sup> Molly Higgins, MLIS,<sup>b</sup> Marlana Bates, MPH, RD,<sup>c</sup> Laural Kelly English, PhD,<sup>c</sup> Julie Nevins, PhD,<sup>c</sup> Julia H Kim, PhD, MPH, RD,<sup>c</sup> Sara Scinto-Madonich, MS<sup>c</sup>

### Specific methods to conduct this rapid review

#### Develop a protocol

The research question, “What is the relationship between overall diet cost and following a dietary pattern that aligns with the Dietary Guidelines for Americans, as measured by the Healthy Eating Index (HEI)?”, was answered using a rapid review.

The analytic framework for the rapid review examining the relationship between diet cost and HEI is presented in **Figure 3-a**. This analytic framework visually represents the overall scope of the rapid review question, and depicts the contributing elements that were examined and evaluated. The intervention or exposure of interest is overall diet cost in U.S. households or populations. The comparators are different levels or categories of overall diet cost, or the overall cost of a different diet(s). The outcomes are dietary patterns that align with the Dietary Guidelines for Americans, as measured by the HEI in U.S. households or populations. The key confounders are urban versus rural, cultural/racial diversity or disparities, sex, age, energy, and SES. The other factors to be considered are cultural food choices, neighborhood characteristics (e.g., access to food/distance to stores/access to car/type of store), smoking, weight status, chronic disease status, convenience level, processing level, and food security status. The confounders and other factors to be considered may impact the relationships of interest.

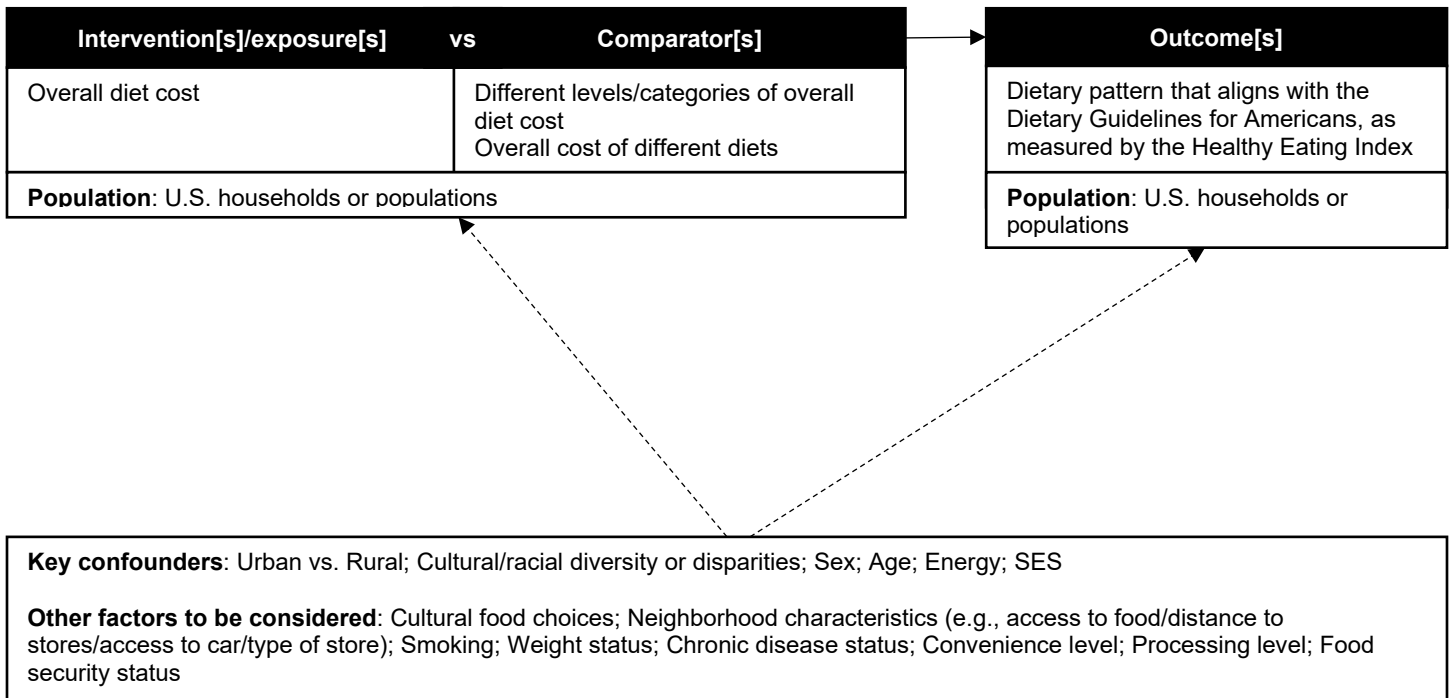
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<sup>a</sup> Project Lead, NESR team, NGAD, CNPP, FNS, USDA

<sup>b</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

<sup>c</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

**Figure 3-a. Analytic framework**



**Key definitions**

Dietary pattern: The quantities, proportions, variety, or combination of different foods, drinks, and nutrients (when available) in diets, and the frequency with which they are habitually consumed.

**Legend**

————> Relationship(s) of interest  
 - - - - -> Factors that may impact the relationship(s) of interest

**Search for and select studies**

The following outlines any departures from the search and select studies project methods for this specific rapid review:

- Title and abstract screening was completed together in 1 level and full text screening was at a separate level.
- For title and abstract screening, 80% of all records were single-screened and 20% of all records were dual-screened, independently. For the full-text screening level all records were dual-screened, independently by 2 analysts.

NESR analysts worked jointly with NEAT staff to establish the final inclusion and exclusion criteria and literature search strategy, which are detailed in **Table 3-a** and **Appendix 3-a**, respectively.

**Table 3-a. Inclusion and exclusion criteria**

Category	Inclusion Criteria	Exclusion Criteria
Study design	<ul style="list-style-type: none"> <li>Any study design that is not a narrative review, systematic review, or meta-analysis</li> </ul>	<ul style="list-style-type: none"> <li>Narrative reviews</li> <li>Systematic reviews</li> <li>Meta-analyses</li> </ul>
Intervention/ exposure	<ul style="list-style-type: none"> <li>Overall diet cost or change in overall diet cost</li> <li>Overall food expenditures or change in overall food expenditures</li> <li>All assessment methods of diet cost or expenditures will be included</li> <li>Measures that include labor or time within an overall diet cost or expenditure</li> </ul>	<ul style="list-style-type: none"> <li>Individual food, beverage, food group, or multiple food group costs</li> <li>Costs of labor or time alone, that are not part of an overall diet cost measure</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>Different levels/categories of overall diet cost</li> <li>Overall cost of a different diet</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>Dietary patterns that specifically align with the Dietary Guidelines for Americans, as measured by the total Healthy Eating Index (HEI)</li> <li>All versions or variations of HEI (e.g. HEI-2005, HEI-2010, HEI-2015)</li> <li>Change in total HEI over time</li> </ul>	<ul style="list-style-type: none"> <li>Studies that examine any other dietary pattern or diet quality indicator that include only individual or select foods and beverages and do not reflect the totality of the diet nor the Dietary Guidelines for Americans.</li> <li>Studies that only examine component scores of the HEI</li> </ul>
Publication date	<ul style="list-style-type: none"> <li>Jan 2008 - May 2021 and data inclusive of 2008 (e.g., 2000-2012; 2008-2009)</li> </ul>	<ul style="list-style-type: none"> <li>Articles published prior to Jan 2008</li> <li>Data prior to 2008 (e.g., 2000-2007; 1999-2005)</li> </ul>
Publication status	<ul style="list-style-type: none"> <li>Articles published in peer-reviewed journals</li> <li>Grey literature: reports that have not been peer reviewed but are available from government and nongovernmental organizations</li> </ul>	<ul style="list-style-type: none"> <li>Articles that have not been peer-reviewed and are not published in peer-reviewed journals, other than reports from government and nongovernmental organizations</li> </ul>
Language	<ul style="list-style-type: none"> <li>Articles published in English</li> </ul>	<ul style="list-style-type: none"> <li>Articles published in languages other than English</li> </ul>
Country	<ul style="list-style-type: none"> <li>Studies conducted the U.S.</li> </ul>	<ul style="list-style-type: none"> <li>Studies conducted in countries outside the U.S.</li> </ul>
Study participants	<ul style="list-style-type: none"> <li>Human participants/populations               <ul style="list-style-type: none"> <li>Males</li> <li>Females</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Non-human participants (e.g., animal studies, in-vitro models)</li> </ul>

## Extract data and assess the risk of bias

NESR analysts extracted and summarized data from each included article to objectively describe the body of evidence available to answer a rapid review question. The following outlines any departures from the extract data and assess risk of bias project methods for this specific rapid review:

- Data extraction and risk of bias assessment was completed on all included articles and verified by a 2<sup>nd</sup> analyst.

## Synthesize the evidence

Evidence synthesis was completed by describing the evidence and evaluating the included studies individually and collectively as previously described in the project methods.

## Summary statements

NESR analysts formed summary statements, as previously described in the project methods, outlining the themes observed during the data synthesis of studies examining diet cost and HEI.

## Recommend future research

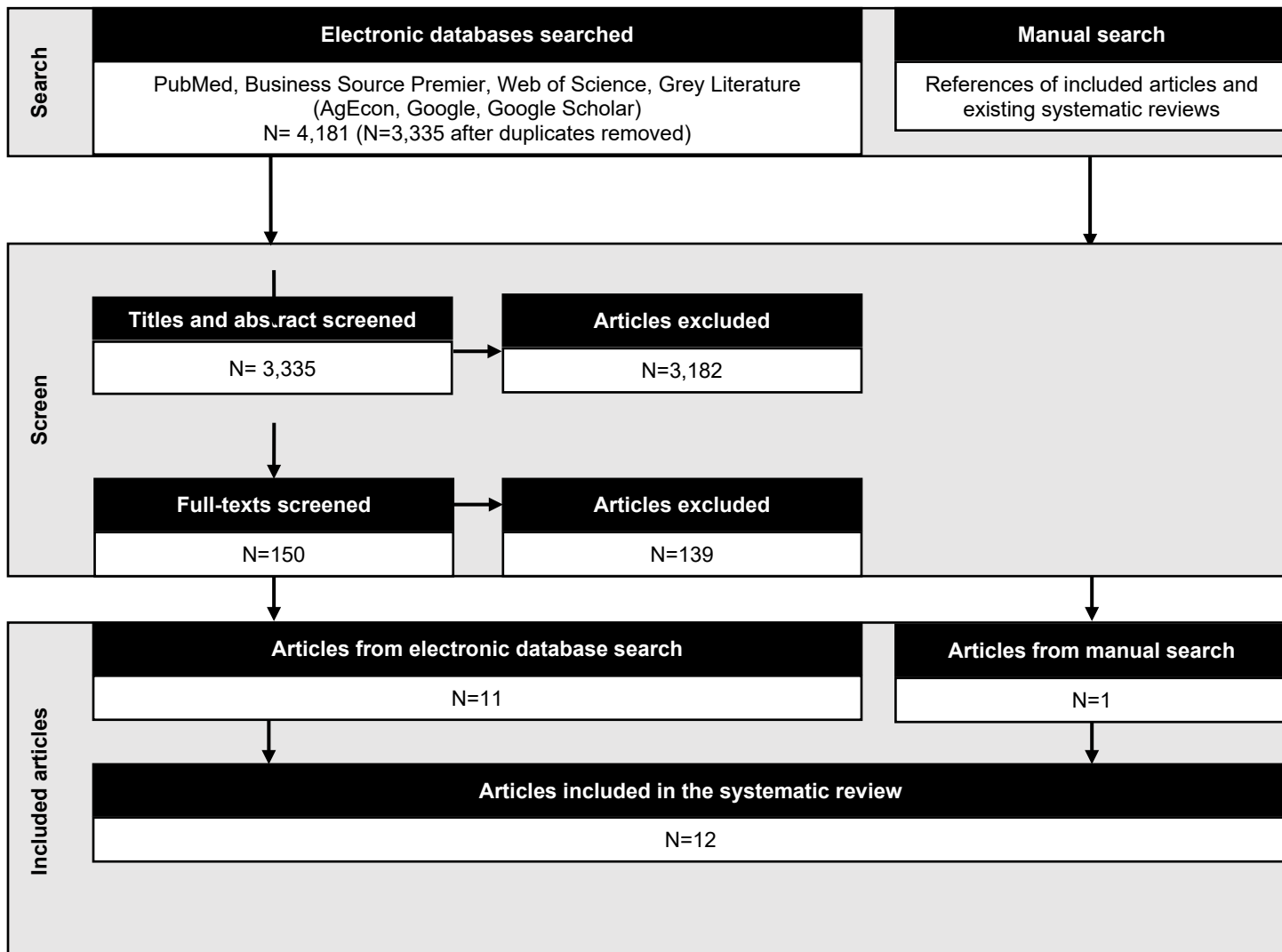
Recommendations for future research evaluating the relationship between diet cost and HEI were determined based on the gaps and limitations observed during data extraction and synthesis, as previously described in the project methods. Future work addressing these gaps and limitations may contribute to the body of evidence available to answer this research question.

# Results

## Literature search and screening results

The literature search yielded 3,335 search results after the removal of duplicates (see **Figure 3-b**). Screening resulted in the exclusion of 3,182 titles and abstracts, and 140 full-texts articles. Reasons for full-text exclusion are in **Appendix 3-b**. One additional article was identified for inclusion from the manual search. The body of evidence included 12 articles.

**Figure 3-b. Literature search and screen flowchart**



## Description of evidence

This rapid review included 12 articles that examined the relationship between diet cost and HEI.<sup>1-12</sup> One article was an RCT<sup>9</sup>, 2 were prospective cohort studies<sup>3,12</sup>, and the remaining 9 were cross-sectional studies.<sup>1,2,4-8,10,11</sup> The sample sizes of the studies ranged from 134<sup>9</sup> to 11,181<sup>10</sup> participants or dyads. One sample size was unreported but used data from NHANES.<sup>1</sup>

## Population characteristics

Seven independent study populations were examined in the 12 articles. Two articles used nationally representative data (NHANES),<sup>1,10</sup> 3 articles were from the population included in the Seattle Obesity Study III (SOS III) study,<sup>6,7,11</sup> 2 articles were from populations from the Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) study,<sup>2,3</sup> and 2 articles came from the same population from Massachusetts.<sup>8,9</sup> The remaining 3 articles were individual populations from Texas and Pennsylvania.<sup>4,5,12</sup> Ten articles assessed

only adults,<sup>1-7,10-12</sup> 1 article assessed only children,<sup>8</sup> and 1 article assessed child-parent dyads.<sup>9</sup> While similar data were analyzed in the articles from the same study populations, each article contributed unique sub-analyses or analytic/assessment methods.

### Exposure and comparator characteristics: diet cost and food expenditures

There were 2 categories of the exposure examined in the included articles, diet cost and food expenditures.

Eight articles assessed diet cost<sup>6-11</sup> or monetary value of the diet<sup>2,3</sup> that was based on the cost of the diet that was consumed by the participant. In this subset of studies, diet cost was estimated from consumption data, which were linked to external food prices, and used to calculate a diet cost. While this method most directly answers the question, it has the limitation that costs were estimated using databases that may not be reflective of what the participants paid for the food, the geographic locations that they lived or from the same period of time that the diet data was collected. The food price databases that were used varied across the studies, and included the CNPP Food Prices Database,<sup>2,10</sup> UNC's Packaged Food Purchase and Price Database,<sup>3</sup> local retail prices from a large supermarket (i.e., Safeway),<sup>6,7,11</sup> or national online supermarket prices.<sup>8,9</sup> Diet costs were estimated either per day<sup>2,3,8,9</sup> or per month.<sup>6,7,10,11</sup>

Seven articles assessed food expenditures<sup>4-7,11,12</sup> or grocery spending<sup>1</sup> that were based on the amount spent on purchases of food at home and/or food away from home. Two articles reported only expenditures from food at home,<sup>7,11</sup> while the other 5 articles reported total food expenditures which included both food at home and food away from home.<sup>4-6,12</sup> Expenditures were estimated from purchase data, either grocery receipts<sup>12</sup> or a self-reported estimate of how much money they spent on food per capita<sup>1,5-7,11,12</sup> or per household.<sup>4</sup> One article did not report the method used for collecting expenditure data.<sup>1</sup> Expenditures were generally adjusted to be reflective of the amount of time and number of people the expenditures represent. Two articles reported expenditures per week,<sup>4,5</sup> while 4 articles reported expenditures per month.<sup>6,7,11,12</sup> However, what is purchased by the study participant may not reflect what was actually consumed, and therefore, this approach is an indirect measure of the relationship being examined.

### Outcome assessment: HEI score

All studies examined dietary patterns aligned with the DGA as measured by the HEI. Four articles assessed HEI-2015,<sup>4,6,7,11</sup> 4 articles assessed HEI-2010,<sup>2,3,10,12</sup> 3 articles assessed HEI-2005,<sup>5,8,9</sup> and 1 article did not report which version of HEI was used in the analysis.<sup>1</sup> Scores on the HEI were determined using a variety of validated dietary assessment methods, including food frequency questionnaires, 24-hour dietary recalls, or 3 day diet records.

## Synthesis

### Diet cost

Eight articles assessed the cost of the diet and HEI by measuring diet cost as the exposure and results from these studies are provided in **Table 3-b**.<sup>2,3,6-11</sup> Six<sup>2,3,6,7,10,11</sup> of these 8 articles reported that higher cost diets had higher HEI scores or that lower cost diets had lower HEI scores. Three of the 6 articles with significant findings were from the SOS III cohort and included unique data that answered this question but were from the same population of participants.<sup>6,7,11</sup>

The 2 other articles (using data from 1 RCT) showed non-significant associations between diet cost and HEI scores.<sup>8,9</sup> One article showed a non-significant time-varying association between higher diet costs and lower HEI scores over the 18 month intervention in both children and their parents. The other article, which was a cross sectional analysis of baseline data, showed a non-significant association between higher diet costs and

higher HEI scores in children. However, this trial was in a population of children with type 1 diabetes and their parents that were generally high income, and may not be generalizable to the U.S. population.

### Food expenditures

Seven articles assessed the relationship between the cost of the diet and HEI by measuring food expenditures as the exposure and results from these studies are provided in **Table 3-c**.<sup>1,4-7,11,12</sup> Four<sup>4,6,7,12</sup> out of 7 articles reported that higher food expenditures were significantly associated with higher HEI scores, or that lower food expenditures were significantly associated with lower HEI scores. Two of the 4 articles with significant findings were from the SOS III cohort and contributed unique analyses that answered this question but were from the same population of participants.<sup>6,7</sup> The 3 other articles found relationships in the same direction but did not reach statistical significance.<sup>1,5,11</sup>

Total food expenditures were generally calculated by summing together expenditures from food at home and food away from home. One of the studies looked at the relationship between all three of these variables and HEI, and saw a positive association with both total and food at home expenditures, but an inverse association with food away from home and HEI.<sup>4</sup> This means that the total expenditure relationship is being driven by food at home related expenditures. Although this is only 1 study, it is an important consideration when looking at this data.

### **Assessment of evidence**

As outlined and described below, the body of evidence examining the relationship between diet cost or expenditures and HEI was assessed for the following elements.

#### Risk of bias

Risk of bias assessments for each included article are provided in **Table 3-d** and **Table 3-e**. The majority of studies were cross-sectional or cohort studies and did not account for at least 1 key confounder. Many studies had serious concerns with deviations from intended exposures because of using price data that was not specific to what participants paid. Most studies had concerns with missing data and/or the selection of reported results due to the lack of a priori analysis plans or reporting very similar results from the same cohort of participants. One article with non-significant findings had many serious risks of bias for confounding, classification and deviations from intended exposures and outcome measurement due to the fact that they did not adequately describe how the exposure or outcomes were collected or handled and they did not adjust for any confounding factors in the analysis included in this rapid review<sup>1</sup>.

#### Consistency

The direction of the findings were very consistent and the magnitude was consistently small. Most studies reported at least 1 significant association between higher diet cost or expenditures and higher HEI scores. All articles, but one, showed either a significant or non-significant association in a consistent direction, with higher diet cost or expenditures and higher HEI.

#### Directness

There were serious concerns with the directness of exposure measurements. Food expenditure represented purchasing costs that are generally self-reported and are not limited to individual diets. Diet cost is more direct and measures cost of the foods that were consumed but are linked to price databases or sources that were not where the participants actually shopped with a lack of adjustment for geographic location.



## Precision

There were some concerns with precision across the body of evidence. The effects were relatively consistent with large sample sizes; however, samples may not be large enough to detect small differences in HEI scores.

## Generalizability

All studies in the body of evidence were conducted in the U.S. and the majority of studies were generalizable to the U.S. population. However, those studies with convenience samples in children with type 1 diabetes and their families, have very limited generalizability. Additionally, multiple studies were completed in the same population of participants (SOS III; HANDLS) and while each contributed unique data, they should not be interpreted as completely independent.

# Summary statements and research recommendations

## Summary statements

The findings of the rapid review are presented in the following summary statements.

### Diet cost

Evidence suggests a relationship between higher diet costs of foods consumed by participants and higher HEI scores. There were critical limitations including that the prices used were generally not the prices that the participants actually paid, from the same location, or at the same time point as the purchase.

### Food expenditures

Evidence suggests a relationship between higher total expenditures of food purchases and higher HEI scores. There were critical limitations including that total expenditures were generally self-reported and may not be specific to the foods consumed by the participants.

Total expenditures from food includes both food at home and food away from home. The relationship between total expenditures and HEI scores may be driven by expenditures from food at home, and attenuated by expenditures from food away from home.

## Research recommendations

1. Conduct well-designed longitudinal studies that examine the relationship between diet cost or food expenditures and diet quality over time.
2. Standardize and update national food price databases to increase comparability across studies.
3. Assess diet cost by using prices specific to individuals or standardized national food price databases that are adjusted for participant location and time period of diet data collection.
4. Assess food expenditures that are specific to food at home and food away from home separately, since expenditures from food at home may have a positive relationship with diet quality as where expenditures from food away from home may have an inverse relationship with diet quality.
5. Account for potential confounders to better determine the relationship between diet cost and diet quality.

## Sensitivity Analysis

Articles using data collected prior to 2008 (e.g., 2000-2007; 1999-2005), regardless of publication date, were excluded for this rapid review for the reasons stated in the project methods. However, national price databases are commonly used to determine diet cost, and NESR analysts recognized that articles may not have been included as a result of using the most up to date national data that was available at the time of the authors

analyses. A sensitivity analysis was completed that included articles published in 2008 or later, but that used data from prior to 2008.

There were 5 articles included in the sensitivity analyses, of which 4 found an association between higher diet costs or expenditures and higher HEI scores and were in general agreement with the results of the rapid review.<sup>abcde</sup> All 5 articles used NHANES data and either the CNPP Food Price Database or Consumer Expenditure Survey Data.

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<sup>a</sup> Carlson, A, Dong, D, Lino, M. Are the total daily cost of food and diet quality related: a random effects panel data analysis. 2010.

<sup>b</sup> Carlson, A, Dong, D., Lino, M.. Association between Total Diet Cost and Diet Quality Is Limited. Journal of Agricultural and Resource Economics. 2014. 39:47-68

<sup>c</sup> Carlson, A, Lino, M, Fungwe, TV, Guenther, PM.. Eating a Healthy Diet: Is Cost a Major Factor? 2009.

<sup>d</sup> Malbi, J, Castner, L, Ohls, J, Fox, MK, Crepinsek, MK, Condon, E. Food Expenditures and Diet Quality Among Low-Income Households and Individuals," Final Report submitted to USDA, FNS for Contract Number AG-3198-D-07-0114, 2010, <http://www.fns.usda.gov/sites/default/files/FoodExpendDietQuality.pdf>.

<sup>e</sup> Rehm, C. D., Monsivais, P., Drewnowski, A.. The quality and monetary value of diets consumed by adults in the United States. Am J Clin Nutr. 2011. 94:1333-9

**Table 3-b. Evidence examining the relationship between diet cost and HEI score<sup>a</sup>**

Author, Year	Population	Exposure	Outcome	Results
<b>Beydoun, 2015</b> <sup>2</sup>	Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) Analytic N: 2,111	Monetary Value of the Diet (\$/d)  Data source: CNPP Food Prices Database, 2003-2004 (updated for inflation)	HEI-2010	<b>MVD per \$1/d: <math>\beta</math>=\$-1.65 [0.12], <math>p</math>&lt;0.0001 MVD per \$3/d: <math>\beta</math>=\$-4.98 [0.35], (IQR: \$3.70/d (Q1) to \$6.62/d (Q4)), <math>p</math>&lt;0.0001</b>
Cross-sectional				
<b>Beydoun, 2018</b> <sup>3</sup>	Healthy Aging in Neighborhoods of Diversity across the Life Span (HANDLS) Analytic N: 1,466	Monetary Value of the Diet (\$/d)  Data source: UNC's Packaged Food Purchase and Price Database, 2004-2013	HEI-2010	<b>T2 v. T1: <math>\beta</math>=0.71 [0.19], T3 v. T1: <math>\beta</math>=1.33 [0.22], <math>p</math>&lt;0.001</b>
PCS				
<b>Gupta, 2020</b> <sup>6</sup>	Seattle Obesity Study III (SOS III) Analytic N: 755	Diet Cost (\$/mo)  Data source: local retail prices from a large supermarket (i.e. Safeway)	HEI-2015	<b>Mean HEI (SD): Lowest cost T1 (n=252) 62.57 (9.91) v. middle cost T2 (n=252) 67.18 (9.70) v. highest cost T3 (n=251) 71.55 (7.87), <math>p</math>&lt;0.0001</b>
Cross-sectional				
<b>Gupta, 2021</b> <sup>7</sup>	Seattle Obesity Study III (SOS III) Analytic N: 747	Diet Cost (\$/mo)  Data source: local retail prices from a large supermarket (i.e. Safeway)	HEI-2015	<b>Mean HEI (SD): <math>\leq</math>\$252: 62.6 (10) (ref) v. <math>&gt;</math>\$253–<math>\leq</math>\$299: 67.1 (9.77), <math>p</math>&lt;0.0001 v. <math>\geq</math>\$300: 71.5 (7.81), <math>p</math>&lt;0.0001</b>
Cross-sectional				

Author, Year	Population	Exposure	Outcome	Results
<b>Rose, 2020</b> <sup>11</sup>	Seattle Obesity Study III (SOS III) Analytic N: 768	Diet Cost (\$/mo)	HEI-2015	Linear models: <b>Mean HEI per \$100: 5.33, 95% CI: 4.15, 6.50, p&lt;0.0001</b> Curvilinear models: <b>17.82, 95% CI: 9.76, 25.88, p&lt;0.0001</b> <b>Quadratic model: -2.06, 95% CI: -3.35, -0.78, p&lt;0.0002</b>
Cross-sectional		Data source: local retail prices from a large supermarket (i.e. Safeway)		
<b>Rehm, 2015</b> <sup>10</sup>	NHANES Analytic N:11,181	Diet Cost (\$/mo)	HEI-2010	<b>Q1, n = 2545: 44.2, 95% CI: 42.7, 45.7 (ref)</b> <b>Q2, n = 2348: 50.1, 95% CI: 48.7, 51.5, p&lt;0.001</b> <b>Q3, n = 2231: 55.8, 95% CI: 54.1, 57.6, p&lt;0.001</b> <b>Q4, n = 2073: 60.2, 95% CI: 58.2, 62.1, p&lt;0.001</b> <b>Q5, n = 1984: 66.6, 95% CI: 65.3, 67.9, p&lt;0.001</b>
Cross-sectional		Data source: CNPP Food Prices Database, 2003-2004 (updated for inflation)		
<b>Nansel, 2015</b> <sup>8</sup>	Youth with Type 1 Diabetes Analytic N: 252	Diet Cost (\$/d)	HEI-2005	Mean HEI (SD): T1 (lowest) \$6.67 [0.37] v. T2 \$6.80 [0.36] v. T3 \$7.35 [0.37], p-trend=0.20, NS
Cross-sectional (baseline data from RCT)		Data source: National online supermarket prices		
<b>Nansel, 2016</b> <sup>9</sup>	Youth with Type 1 Diabetes and their parents Analytic N: 136	Diet Cost (\$/d)	HEI-2005	Youth: $\beta=-0.0005$ , 95% CI: -0.02, 0.02, p=0.96, NS; Adults: $\beta=-0.06$ , 95% CI: -0.13, 0.01, p=0.11, NS
RCT		Data source: National online supermarket prices		

<sup>a</sup> Abbreviations: CNPP, Center for Nutrition Policy and Promotion; d, day; HEI, healthy eating index; HANDLS, Healthy Aging in Neighborhoods of Diversity across the Life Span; HH, household; mo, month; NS, not significant; PCS, prospective cohort study; RCT, randomized controlled trial; SOS III, Seattle Obesity Study III

**Table 3-c. Evidence examining the relationship between food expenditures and HEI scores<sup>a</sup>**

	Population	Exposure	Outcome	Results
<b>Carpio, 2020</b> <sup>4</sup>	Staff and Faculty at Public University in West Texas	Weekly food expenditures (\$/wk; HH)	HEI-2015	<b>Total food expenditures: <math>\beta=0.058</math> [0.03], <math>p&lt;0.10</math>;</b> <b>Food at home expenditures (natural log): <math>\beta=0.085</math> [0.029], <math>p&lt;0.01</math>;</b> Food away-from-home expenditures (natural log): Coefficient -0.002 [0.010], NS;
Cross-sectional	Analytic N: 142	Diet source: self report		
<b>Sanjeevi, 2018</b> <sup>12</sup>	Low-income women in Texas	Food expenditures relative to TFP cost (\$/mo; per capita)	HEI-2010	<b><math>\beta=5.29</math>, SE: 2.60, <math>p=0.04</math></b>
PCS	Analytic N: 144	Diet source: monthly grocery receipts		
<b>Gupta, 2020</b> <sup>6</sup>	Seattle Obesity Study III	Food expenditures (\$/mo; per capita)	HEI-2015	<b>Mean HEI (SD): Lowest expenditure T1 65.23 (9.53) v. middle expenditure T2 (n=271) 66.80 (10.04) v. highest expenditure T3 (n=232) 69.45 (9.68), <math>p&lt;0.0001</math></b>
Cross-sectional	Analytic N: 755	Diet source: self report		
<b>Gupta, 2021</b> <sup>7</sup>	Seattle Obesity Study III	Food expenditures at home (\$/mo; per capita)	HEI-2015	<b>Mean HEI (SD): <math>\leq\\$100</math>: 65.2 (9.96) (ref) v. <math>&gt;\\$100-\leq\\$175</math>: 66.4 (9.88), <math>p=0.177</math> v. <math>\geq\\$175</math>: 69.9 (9.27), <math>p=0.0001</math>;</b>
Cross-sectional	Analytic N: 747	Diet source: self-report		
<b>Rose, 2020</b> <sup>11</sup>	Seattle Obesity Study III	Food expenditures at home (\$/mo; per capita)	HEI-2015	Linear model, Mean HEI per \$100: 0.09, 95% CI: -0.49, 0.67, NS Curvilinear model, NR, NS
Cross-sectional	Analytic N: 768	Diet source: self report		

	Population	Exposure	Outcome	Results
<b>Anderson, 2016</b> <sup>1</sup>	NHANES; SNAP participants	Grocery Spending (per capita)	HEI (unspecified)	$\beta=0.004$ (0.004), NS
Cross-sectional	Analytic N: NR	Diet source: NR		
<b>Dubowitz, 2015</b> <sup>5</sup>	PHRESH: majority African-American population near Pittsburgh	Weekly food expenditures (\$/wk; per capita)	HEI-2005	$\beta=0.004$ ; NS
Cross-sectional	Analytic N: 1,372	Diet source: self-report		

<sup>a</sup> Abbreviations: HEI, healthy eating index; HH, household; mo, month; NHANES, National Health and Nutrition Examination Survey; PCS, prospective cohort study; PHRESH, Pittsburgh Hill/Homewood Research on Neighborhood Change and Health; NR, not reported; NS, not significant; RCT, randomized controlled trial; wk, week

**Table 3-d. Risk of bias for the randomized controlled trial examining diet cost or expenditures and HEI<sup>a</sup>**

Article	Randomization	Deviations from intended interventions (effect of assignment) and (per-protocol)	Missing outcome data	Outcome measurement	Selection of the reported result
Nansel, 2016 <sup>9</sup>	LOW	SOME CONCERNS	SOME CONCERNS	LOW	SOME CONCERNS

<sup>a</sup> Possible ratings of low, some concerns, or high determined using the "[Cochrane Risk-of-bias 2.0](#)" (RoB 2.0) (August 2016 version)" (Higgins JPT, Sterne JAC, Savović J, Page MJ, Hróbjartsson A, Boutron I, Reeves B, Eldridge S. A revised tool for assessing risk of bias in randomized trials In: Chandler J, McKenzie J, Boutron I, Welch V (editors). *Cochrane Methods. Cochrane Database of Systematic Reviews* 2016, Issue 10 (Suppl 1). dx.doi.org/10.1002/14651858.CD201601.)

**Table 3-e. Risk of bias for observational studies examining diet cost or expenditures and HEI<sup>a</sup>**

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Anderson, 2016 <sup>1</sup>	SERIOUS	LOW	SERIOUS	SERIOUS	NI	SERIOUS	MODERATE
Beydoun, 2018 <sup>3</sup>	LOW	MODERATE	MODERATE	SERIOUS	MODERATE	LOW	MODERATE
Beydoun, 2015 <sup>2</sup>	LOW	MODERATE	SERIOUS	SERIOUS	MODERATE	LOW	MODERATE
Carpio, 2020 <sup>4</sup>	SERIOUS	SERIOUS	MODERATE	SERIOUS	MODERATE	LOW	MODERATE
Dubowitz, 2015 <sup>5</sup>	MODERATE	MODERATE	LOW	LOW	MODERATE	LOW	MODERATE
Gupta, 2020 <sup>6</sup>	SERIOUS	MODERATE	LOW	MODERATE	MODERATE	LOW	SERIOUS

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Gupta, 2021 <sup>7</sup>	LOW	MODERATE	LOW	MODERATE	MODERATE	LOW	SERIOUS
Nansel, 2015 <sup>8</sup>	SERIOUS	SERIOUS	LOW	MODERATE	MODERATE	LOW	MODERATE
Rehm, 2015 <sup>10</sup>	MODERATE	LOW	LOW	SERIOUS	LOW	LOW	LOW
Rose, 2020 <sup>11</sup>	LOW	MODERATE	LOW	MODERATE	MODERATE	LOW	SERIOUS
Sanjeevi, 2018 <sup>12</sup>	SERIOUS	MODERATE	MODERATE	LOW	LOW	LOW	LOW

<sup>a</sup> Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias for Nutrition Observational Studies" tool (RoB-NObs) (Dietary Guidelines Advisory Committee. 2020. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services*. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC.)



## References of the articles included in the diet cost and HEI rapid review

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12. Sanjeevi N, Freeland-Graves JH. Association of Grocery Expenditure Relative to Thrifty Food Plan Cost with Diet Quality of Women Participating in the Supplemental Nutrition Assistance Program. *J Acad Nutr Diet*. 2018;118(12):2315-2323 doi:10.1016/j.jand.2018.07.015. Epub 2018 Sep 28.

## Chapter 4 - What is the relationship between income and time spent on food-at-home-related activities?

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Julia H Kim, PhD, MPH, RD,<sup>a</sup> Julie Nevins, PhD,<sup>a</sup> Molly Higgins, MLIS,<sup>b</sup> Marlana Bates, MPH, RD,<sup>a</sup> Laural Kelly English, PhD,<sup>a</sup> Sara Scinto-Madonich, MS,<sup>a</sup> Emily Callahan, MS<sup>c</sup>

### Specific methods to conduct this rapid review

#### Develop a protocol

The research question, “What is the relationship between income and time spent on food-at-home-related activities?” was answered using a rapid review.

The analytic framework for the rapid review examining the relationship between income and time spent on food-at-home-related activities is presented in **Figure 4-a**. This analytic framework visually represents the overall scope of the rapid review question, and depicts the contributing elements that were examined and evaluated. The intervention or exposure of interest is income (e.g., household, city, regional income) and income proxy (i.e., socioeconomic factor; geographic area; income-based federal assistance program participation/eligibility) in U.S. households or populations. The comparators are different levels/categories of income or income proxy. The outcome is time spent on food-at-home-related activities, including preparation, cooking, and cleaning in U.S. households or populations. The key confounders are food-away-from-home and household characteristics (e.g., household size (e.g., number of children, number of adults), single or dual head of household; marital status; level of employment; workload division). NESR analysts made a post-hoc change when assessing the risk of bias for confounding. NESR analysts determined that adjusting for food-away-from-home would be over controlling for the outcome due to the collinearity of time spent on food-at-home-related activities and time spent on food-away-from-home activities. Therefore, articles that did not account for food-away-from-home in their analyses were not rated differently for risk of bias due to confounding. The other factors to be considered are food security; race/ethnicity; sex; seasonal differences; urban/rural; cultural food choices; neighborhood characteristics (e.g., access to food/distance to stores/access to car/type of store); use of convenience foods; time preferences/value of food-related activities or cooking skills or cooking equipment. The confounders and other factors to be considered may impact the relationships of interest.

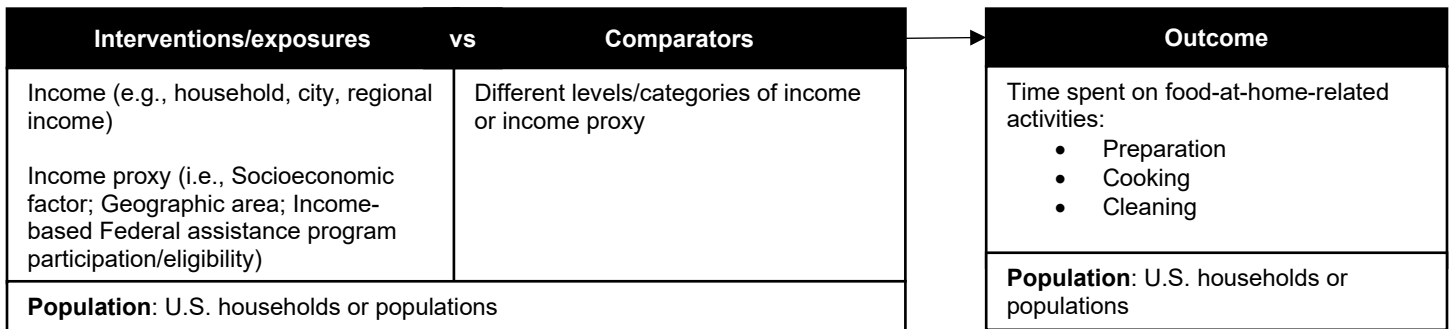
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<sup>a</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

<sup>b</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

<sup>c</sup> Project Lead, NESR team, NGAD, CNPP, FNS, USDA

**Figure 4-a. Analytic framework**



**Key confounders:** Household characteristics (e.g., Household size (e.g., number of children; number of adults), single or dual head of household; marital status; level of employment; workload division)  
**Other factors to be considered:** Food security; Race/ethnicity; Sex; Seasonal differences; Urban/rural; Cultural food choices; Neighborhood characteristics (e.g., access to food/distance to stores/access to car/type of store); Use of convenience foods; Time preferences/value of food-related activities or cooking skills or cooking equipment

**Key definitions**

Low income: before-tax income at or below 130 percent of the U.S. poverty guidelines

Higher income: before-tax income above 130 percent of the U.S. poverty guidelines

Food-at-home: Food that is prepared at home and includes ready-to-eat and non-ready-to-eat foods that are brought from grocery stores, food pantries, super centers, mass merchandisers, convenience stores, drug stores, farmers markets, and food co-ops (ERS, 2018)

**Legend**

————> Relationship of interest

-----> Factors that may impact the relationship of interest

## Search for and select studies

The following outlines any departures from the search and select studies project methods for this specific rapid review:

- Articles were screened at the title, abstract, and the full-text level, separately.
- One person screened 100% of the articles and a 2<sup>nd</sup> person screened 20% of articles at the title and abstract screening levels. All articles were dual-screened at the full-text level (2<sup>nd</sup> person verified excluded articles). Included articles were hand-searched.

NESR analysts worked jointly with NEAT staff to establish the final inclusion and exclusion criteria and literature search strategy, which are detailed in **Table 4-a** and **Appendix 4-a**, respectively.

**Table 4-a. Inclusion and exclusion criteria**

Category	Inclusion Criteria	Exclusion Criteria
Study design	<ul style="list-style-type: none"> <li>• Any study design that is not a narrative review, systematic review, or meta-analysis</li> </ul>	<ul style="list-style-type: none"> <li>• Narrative reviews</li> <li>• Systematic reviews</li> <li>• Meta-analyses</li> </ul>
Intervention/ exposure	<ul style="list-style-type: none"> <li>• Income (e.g., household, city, regional income)</li> <li>• Income proxy:               <ul style="list-style-type: none"> <li>○ Socioeconomic factor (e.g., education)</li> <li>○ Geographic area</li> <li>○ Income-based Federal assistance program participation/eligibility</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Income proxies that are not a direct proxy for income determined by the author</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>• Different levels or categories of income or SES factor proxy for income</li> <li>• Higher vs. lower income geographic areas</li> <li>• Different participation/eligibility status in income-based Federal assistance program(s)</li> </ul>	<ul style="list-style-type: none"> <li>• Comparison of geographic areas without a proxy for income</li> </ul>

Category	Inclusion Criteria	Exclusion Criteria
Outcomes	<ul style="list-style-type: none"> <li>Time spent on food-at-home-related activities: <ul style="list-style-type: none"> <li>Preparation (e.g., cutting food, setting table, transportation, shopping)</li> <li>Cooking</li> <li>Cleaning, including storing and putting away food/drinks</li> </ul> </li> <li>Studies that examine transportation, shopping, and/or eating as part of a combined measure that also includes either preparation, cooking, and/or cleaning</li> </ul>	<ul style="list-style-type: none"> <li>Studies that only examine time spent on transportation, shopping, and/or eating</li> <li>Studies that only examine time spent on snacking</li> <li>Time spent on food-away-from-home-related activities, including fast-food (FF) or full-service (FS) restaurants</li> </ul> <p>Definitions (ERS, 2018):</p> <ul style="list-style-type: none"> <li><u>Food-away-from-home</u>: Food prepared outside of home and includes food from FS restaurants and FF restaurants</li> <li><u>Fast-food restaurants</u>: Eating places where consumers pay before they eat (e.g., bakery, burger restaurant, and sandwich or coffee shop)</li> <li><u>Full-service restaurants</u>: Eating places where consumers eat before they pay</li> </ul>
Date of publication and data examined	<ul style="list-style-type: none"> <li>Published January 2008 – April 2021 and data inclusive of 2008 (e.g., 2000-2012; 2008-2009)</li> </ul>	<ul style="list-style-type: none"> <li>Articles published prior to January 2008</li> <li>Data prior to 2008 (e.g., 2000-2007; 1999-2005)</li> </ul>
Publication status	<ul style="list-style-type: none"> <li>Articles published in peer-review journals</li> <li>Grey literature: reports that have not been peer-reviewed but are available from government and non-governmental organizations</li> </ul>	<ul style="list-style-type: none"> <li>Articles that have not been peer-reviewed and are not published in peer-reviewed journals, other than reports from government and non-governmental organizations</li> </ul>
Language	<ul style="list-style-type: none"> <li>Articles published in English</li> </ul>	<ul style="list-style-type: none"> <li>Articles published in languages other than English</li> </ul>
Country	<ul style="list-style-type: none"> <li>Studies in the U.S.</li> </ul>	<ul style="list-style-type: none"> <li>Studies conducted outside the U.S.</li> </ul>
Study participants	<ul style="list-style-type: none"> <li>Human participants/populations</li> </ul>	<ul style="list-style-type: none"> <li>Non-human participants (e.g., animal studies, in-vitro models)</li> </ul>

## Extract data and assess the risk of bias

NESR analysts extracted and summarized data from each included article to objectively describe the body of evidence available to answer a rapid review question. The following outlines any departures from the extract data and assess risk of bias project methods for this specific rapid review:

- One NESR analyst extracted data (author, year, study design, cohort, year that time data were collected, data source for time, year that income data were collected, data source for income, analytic N, geographic location, location description, population description, intervention/exposure description, comparator, outcome type (preparation, cooking, and/or cleaning), outcome description, outcome definition, results, results summary, key confounders, other factors to be considered) and a 2<sup>nd</sup> analyst verified the results.
- Risk of bias assessment was completed by 1 NESR analyst and verified by a 2<sup>nd</sup> analyst.

## Synthesize the evidence

Evidence synthesis was completed by describing the evidence and evaluating the included studies individually and collectively as previously described in the project methods.

## Summary statements

NESR analysts formed summary statements, as previously described in the project methods, outlining the themes observed during the data synthesis of studies examining income and time spent on food-at-home-related activities.

## Recommend future research

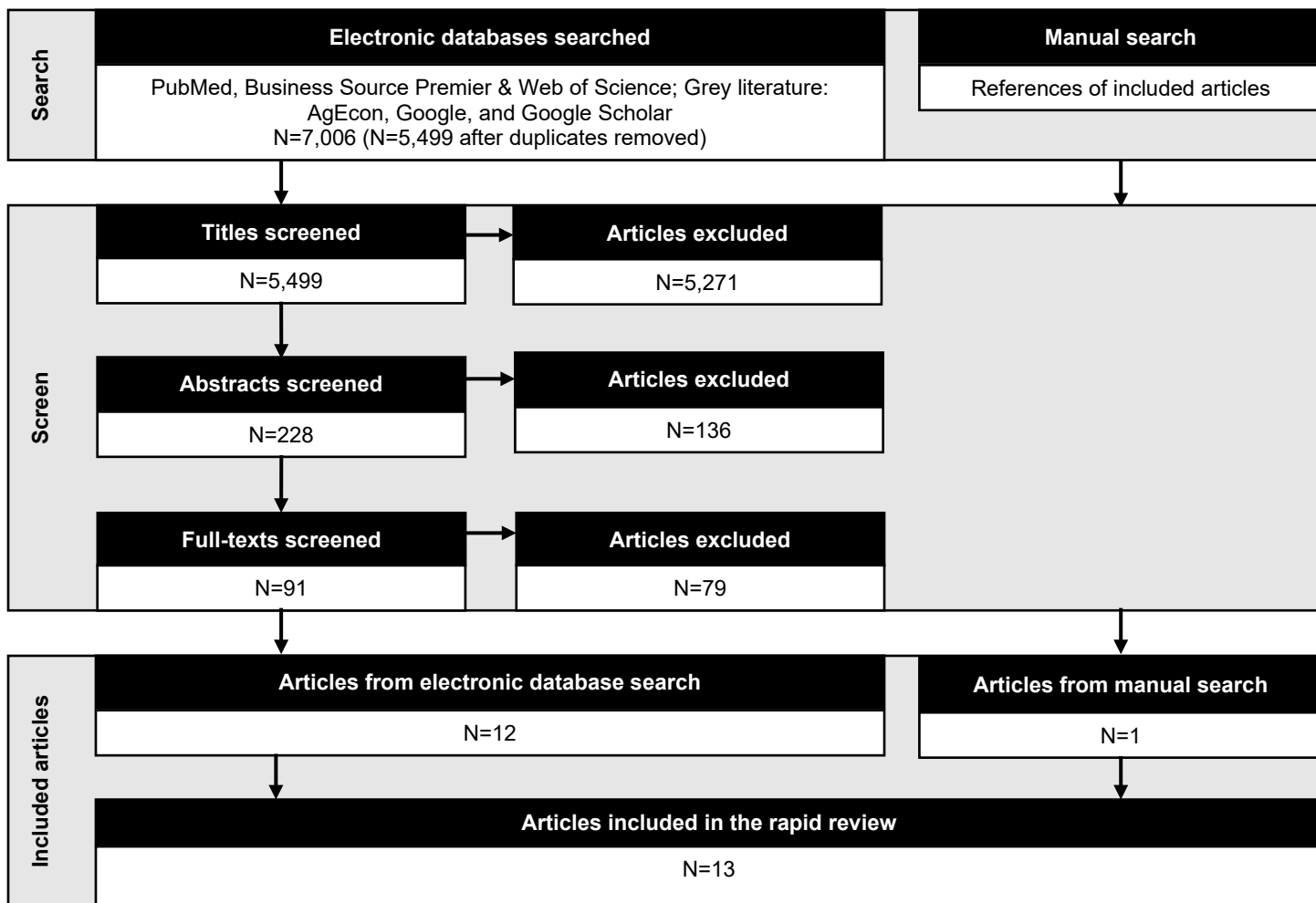
Recommendations for future research evaluating the relationship between income and time spent on food-at-home-related activities were determined based on the gaps and limitations observed during data extraction and synthesis, as previously described in the project methods. Future work addressing these gaps and limitations may contribute to the body of evidence available to answer this research question.

# Results

## Literature search and screening results

The literature search yielded 5,499 search results after the removal of duplicates (see **Figure 4-b**). Dual screening resulted in the exclusion of 5,271 titles, 136 abstracts, and 79 full-texts articles. Reasons for full-text exclusion are in **Appendix 4-b**. One additional article was identified from the manual search. The body of evidence included 13 articles.

**Figure 4-b. Literature search and screen flowchart**



### Description of the evidence

Thirteen studies (13 articles) were included in the body of evidence that addressed the relationship between income, including income proxy, and time spent on food-at-home-related activities (see **Figure 4-b**). Basic characteristics and results are shown in **Table 4-b**. All studies were cross-sectional. The majority (85%) of studies included populations that were nationally representative.<sup>1-11</sup> One study each was conducted in Seattle, Washington,<sup>12</sup> and Minneapolis and St. Paul, Minnesota.<sup>13</sup> Studies generally included men and women with and without children. Of the five studies that reported race/ethnicity,<sup>3,6,7,12,13</sup> all but one<sup>13</sup> had predominantly (>65%) non-Hispanic White populations. The study conducted in Minneapolis and St. Paul, Minnesota had 28% White, 23% African American, 21% Asian, 17% Hispanic, and 11% mixed or other race/ethnicity participants.<sup>13</sup> Therefore, the study populations for the majority of studies represent the racial/ethnic diversity of the U.S. population. The sample sizes in these 13 studies were large, ranging from 1,078<sup>1</sup> to 118,635.<sup>10</sup>

## Study characteristics

The majority of studies included participants who completed the survey of interest and were adults 18 years and older, regardless of marital status. Some exceptions were 1 study that only included adults aged 45-75 without children,<sup>1</sup> another study that excluded participants with a child aged 16 to 17,<sup>8</sup> and another study that only included Hispanic women with a child less than age 13.<sup>9</sup> The years in which data were collected for analyses varied widely ranging from 2001-2018, and included 2006-2008<sup>3,4,8</sup> and 2003-2011.<sup>9,10</sup> Mean age of participants ranged from 32.8<sup>9</sup> to 64.3 years.<sup>1</sup>

## Exposure

Eight<sup>1-4,8,10-12</sup> of the 13 included articles examined the effect of income on time spent on food-at-home-related activities. Gough et al.,<sup>3</sup> Hamrick et al.,<sup>4</sup> and Senia et al.,<sup>8</sup> assessed time data from the American Time Use Survey (ATUS) from 2006-2008, and therefore, likely include some of the same data in their analyses. However, data eligibility criteria differed between these studies and all were included, given that their samples may not be entirely overlapping. Gough et al.,<sup>3</sup> only included women and also included participants who completed 2014-2015 ATUS, Hamrick et al.,<sup>4</sup> included anyone who completed the 8<sup>th</sup> Current Population Survey, and Senia et al.,<sup>8</sup> included anyone who are the only adult members ( $\geq 18$  years) in the household and with no children age 16-17.

One study examined both income above or below the poverty threshold and SNAP participation and eligibility. Of the studies that examined income, 1 study examined labor income (income from wages, salary, tips, commissions, bonuses, and military pay) and non-labor income (income from government transfers (e.g., social security, disability, welfare), pension benefits, and any income from assets) separately.<sup>1</sup> The federal poverty threshold, 130%, and 185% were used as cut-off points in numerous articles, possibly with overlapping data.<sup>3,4,8</sup> For example, a study compared moderate/upper income, defined as  $\geq 185\%$  the poverty threshold to low income (130 to  $< 185\%$  poverty threshold) and to sub-poverty ( $< 130\%$  poverty threshold).<sup>3</sup> Two studies had different income cut-offs of  $< \$50,000$  versus  $\$50,000-99,999$  versus  $\geq \$100,000$ <sup>12</sup> and  $< \$25,000$  versus  $\$25,000-59,000$  versus  $\geq \$60,000$ .<sup>11</sup> Three<sup>2,3,10</sup> of these studies collected income data from the American Time Use Survey during various years from 2003-2012 and two from the Eating and Health Module,<sup>4,8</sup> a supplement of the ATUS. Studies also used income data from the Health and Retirement Survey,<sup>1</sup> the Home Cooking Survey,<sup>11</sup> and a study-specific survey.<sup>12</sup>

Six<sup>4-7,9,13</sup> of the 13 included articles examined the effect of income proxies on time spent on food-at-home-related activities. Although there may be overlapping data between Raschke et al.,<sup>6</sup> Hamrick et al.,<sup>4</sup> and Sliwa et al.,<sup>9</sup> all of these studies had different date ranges of 2003-2009, 2006-2008, and 2003-2011 and therefore, the samples may not be entirely overlapping. Three<sup>4-6</sup> of these studies examined SNAP participation and/or eligibility, 1 study compared different levels of employment (i.e., not employed versus part-time versus full-time),<sup>13</sup> 1 study compared those who worked from home (higher income) to those who worked away from home (lower income),<sup>7</sup> and 1 study compared US-born Hispanic mothers (higher income) to immigrant or migrant Hispanic mothers (lower income).<sup>9</sup> The data source and years for the income proxies varied from 2003-2018 and included the American Time Use Survey,<sup>6,9</sup> Eating and Health Module,<sup>4</sup> Consumer Expenditure Quarterly Interview Survey,<sup>5</sup> Leave and Job Flexibilities Module,<sup>7</sup> and a study-specific survey.<sup>13</sup>

## Outcome

The studies differed in their definition of the outcome of time spent on food-at-home-related activities. Twelve<sup>1-10,12,13</sup> of the 13 included articles had "preparation" as part of their definition for food-at-home-related activities. As part of the outcome definition, 9 studies<sup>1,4,6-12</sup> included "cleaning," 6 studies<sup>5,6,8,9,11,12</sup> included "cooking," 5 studies<sup>2,4,6,7,9</sup> included "presentation," and 3 studies<sup>5,7,8</sup> included both grocery shopping and transportation. Nine of the articles assessed time spent on food-at-home-related activities using the American Time Use



Survey<sup>2,3,5-10</sup> and/or the Eating and Health Module,<sup>4,8</sup> 2 studies used a study-specific survey,<sup>12,13</sup> and 1 study each used the Consumption and Activities Mail Survey<sup>1</sup> and the Home Cooking Survey.<sup>11</sup>

## Synthesis of the evidence

### Income

Among the 4 studies from 5 articles<sup>2,4,8,11,12</sup> that included men and women, there were mixed findings. Three studies<sup>2,8,11</sup> found no association between income (log family income or \$25,000-59,999 versus  $\geq$ \$60,000) and time spent on preparing and/or cooking, cleaning, food-related travel and grocery shopping. One of these studies did not describe how income was assessed and did not report model adjustments.<sup>2</sup> Two studies found a significant and positive relationship between income and time spent on cooking and cleaning<sup>11</sup> and preparing, cooking, and cleaning.<sup>12</sup> It is important to note that the income comparators ( $<$ \$25,000 to \$25,000-59,999 and to  $\geq$ \$60,000<sup>11</sup> and  $<$ \$50,000 to  $\geq$ \$50,000<sup>12</sup>) were higher than the exposure and comparators in studies that found an inverse relationship between income and time spent on food-at-home-related activities. The 2 studies that found a significant and inverse relationship (i.e., higher income associated with less time spent on food-at-home-related activities) compared below or above 185% poverty threshold<sup>4</sup> and below 130% poverty threshold to 130-185% poverty threshold.<sup>8</sup>

Three studies<sup>1,3,10</sup> assessed the relationship between income among women only and time spent on food-at-home-related activities. There were mixed findings within these 3 studies. All 3 studies<sup>1,3,10</sup> found a significant, inverse relationship between income in mothers and child-free women and time spent on food preparation and clean-up afterwards. Additionally, those with lower income levels tended to spend more time on food preparation. In 1 study, mothers with sub-poverty income ( $<$ 130% poverty threshold) spent an average of 8.16 more minutes and mothers with low income (130% to  $<$ 185% poverty threshold) spent 3.28 more minutes in food preparation per day than mothers with middle/upper income ( $\geq$ 185% poverty threshold).<sup>3</sup> This was no longer significant among childfree women.<sup>3</sup> Another study<sup>1</sup> found an inverse relationship but this was between non-labor income, defined as income from government transfers (e.g., social security, disability, welfare), pension benefits, and any income from assets. No studies found a direct relationship. Overall, women, especially those with children, spend less time on food-at-home-related activities as income increases.

Two studies<sup>1,10</sup> assessed the relationship between income among men only and time spent on food-at-home-related activities. One study found an inverse relationship and 1 study found no relationship. Due to a limited number of studies and mixed findings, it is unclear whether there is a relationship between income and time spent on food-at-home-related activities for men.

### Income proxies

Five studies from 6 articles<sup>4-7,9,13</sup> examined income proxies, 2 (from 3 articles) of which examined SNAP participation and/or eligibility,<sup>4-6</sup> 1 examined employment level (not employed versus part-time versus full-time),<sup>13</sup> 1 examined immigrant or migrant Hispanic mothers compared to U.S.-born Hispanic mothers,<sup>9</sup> and working away from home compared to working at home (higher income).<sup>6</sup>

#### *SNAP participation/eligibility*

All 2 studies from 3 articles<sup>4-6</sup> that examined SNAP participation and/or eligibility found that those who participated in SNAP spent more time on food preparation, presentation, clean-up, cooking, food-related travel and/or grocery shopping than SNAP non-participants,<sup>6</sup> and SNAP-eligible non-participants,<sup>5</sup> and SNAP non-eligible<sup>4</sup> non-participants. One of two studies that compared SNAP participation to SNAP eligible non-participants did not find a significant difference in time spent on food preparation, including travel time related to food preparation, cooking time, and grocery shopping time.<sup>4</sup> Specifically, SNAP participants spent 74.7

minutes per day on meal preparation, compared to 72.8 minutes per day among SNAP-eligible non-participants, and 57.6 minutes per day among non-SNAP, non-eligible (income above the 130% poverty threshold) participants (N=37,832,  $p < 0.10$ ).<sup>4</sup> Therefore, individuals who were ineligible for SNAP due to income spent significantly less time on meal preparation than SNAP participants or SNAP-eligible non-participants.<sup>4</sup> Although there is a small body of evidence, there is consistent evidence that SNAP participants spent significantly more time on food-at-home-related activities than SNAP non-participants. It is less clear whether there is a difference between SNAP participants and SNAP-eligible non-participants on time spent on meal preparation and/or cooking, cleaning, presentation, grocery shopping, and food-related travel.

### *Other income proxies*

Two of three studies that examined income proxies found a significant association with participants with lower income based on income proxies spending more time on food preparation only,<sup>13</sup> food preparation, cooking, serving, and clean-up.<sup>9</sup> U.S.-born Hispanic mothers (higher income,  $n = 1,345$ ) spent significantly less time (70.8 min/day) on food preparation, cooking, presentation, and clean-up than immigrant or migrant Hispanic mothers (lower income,  $n = 2,277$ ) of 107.8 minutes per day.<sup>9</sup> There was a dose-response relationship between mother's employment level (unemployed versus part-time versus full-time) and time spent on food preparation, with time spent on food preparation decreasing as level of employment increases.<sup>13</sup> For men, those who worked full-time spent less time than those who worked part-time or who were unemployed. However, there was no significant difference between men who were unemployed and men who worked part-time and time spent on food preparation per week.<sup>13</sup>

One study found a significant, positive relationship, with those who worked away from home (higher income) spending more time on food preparation, presentation, clean-up, grocery shopping, and travel to grocery store (mean: 40.7 min/day, SE: 5.4) than those who worked at home (lower income; Mean: 30.3 min/day, SE: 1.2).<sup>7</sup>

### *Summary*

The results of all 13 articles suggest that at lower income levels (i.e., 185%, 130% or poverty threshold cut-offs), particularly women, spent more time on food-at-home-related activities. When comparing income levels higher than 185% poverty threshold (i.e.,  $< \$50,000$  versus  $\geq \$50,000$ ;  $< \$25,000$  versus  $\$25,000$ - $50,000$  or  $\geq \$60,000$ ), there is a significant, positive association between income and time spent on preparation, cooking, and/or cleaning.<sup>11,12</sup> There is also a consistent pattern of SNAP participants spending significantly more time on food preparation, presentation, clean-up, grocery shopping, and/or food-related travel than SNAP non-participants, regardless of SNAP-eligibility.

### *Assessment of the evidence*

**Risk of bias:** Half of the studies did not account for household characteristics, which included 1 of the following: household size, single or dual head of household, marital status, level of employment, or workload division (**Table 4-d**).

**Consistency:** There was some consistency of an inverse relationship between income and time spent on food-at-home-related activities, especially among women and when comparing at 130% and 185% poverty thresholds. Additionally, evidence was consistent with those who participated in SNAP spending significant more time on food-at-home-related activities than those who were SNAP non-participants, including those who were SNAP-eligible.

**Directness:** The majority of studies (62%) directly measured the income, comparator, outcomes, and population that are outlined in the Analytic Framework (**Figure 4-a**). The remaining studies measured income proxies, rather than income directly.

**Precision:** All studies had large sample sizes and relatively small measures of variance.

**Generalizability:** All studies were conducted in the U.S., with the majority (85%) of studies using nationally-represented data. Therefore, studies are representative of the U.S. population.

## Summary statements and research recommendations

### Summary statements

The findings of the rapid review are presented in the following summary statements.

#### Income

Evidence indicates that those with lower income spend more time on food-at-home-related activities, particularly among women in the U.S.

Among all women, participants with higher income ( $\geq 185\%$  poverty threshold or above the poverty threshold) spend significantly less time on food preparation or food preparation and clean-up.

Among women without children, there was no association between income and time spent on food preparation or food preparation and clean-up.

Among men, there is not enough evidence to determine whether there is an association between income and time spent on food preparation and cleaning due to inconsistent findings.

#### Income proxies

*SNAP participation/eligibility:* A small but consistent body of evidence suggests that those who participate in SNAP, compared to those who do not participate in SNAP, spend significantly more time on food-at-home-related activities.

It is less clear whether there is a difference between SNAP participants and SNAP-eligible non-participants on meal preparation due to few studies and inconsistent findings.

Studies had serious risks of bias for confounding due to not adjusting for household characteristics. One study also had a serious risk of bias for deviations from intended exposures due to unbalanced co-exposures (i.e., education, race, marital status) between exposure and comparator groups.

*Other income proxies:* There is not enough evidence to determine whether there is a relationship between income proxies and time spent on food-at-home-related activities.

### Research recommendations

- Account for household characteristics (e.g., household size, single or dual head of household, marital status, level of employment, workload division) when examining the relationship between income and time spent on food-at-home-related activities.
- Increase use of consistent definition, assessment, and measurement of time spent on food-at-home-related activities.
- More research is needed to examine the effect of income on food-at-home-related activities, particularly in men.
- Determine eligibility in SNAP among SNAP non-participants when examining the effect of SNAP participation/eligibility on time spent on food-at-home-related activities.

Table 4-b. Cross-sectional evidence examining the relationship between income and time spent on food-at-home-related activities<sup>a</sup>

Article	Population, N	Exposure and Comparator	Outcome Definition	Results	Model adjustments
<b>Dunn, 2015<sup>1</sup></b>	National Working adults (45-75y) without children N=1,078	Labor income (wages, salary, tips, commissions, bonuses, military pay); continuous  Non-labor income (e.g., social security, disability, welfare, pension, income from assets); continuous  <u>Data source:</u> Health and Retirement Survey (2001-2009 odd years)	Time (min/week) spent on preparing meals and cleaning-up afterwards in previous week  <u>Data source:</u> Consumption and Activities Mail Survey (2001-2009 odd years)	Average marginal effects (SE) of time spent on meal preparation (minutes last week), Tobit model <u>Single-headed households (per \$10,000):</u> Male labor income (n=171): -2.346 (4.475), p>0.05 Male non-labor income (n=171): 1.735 (4.364), p>0.05 <b>Female labor income (n=481): -15.050 (4.748), p&lt;0.01</b> Female non-labor income (n=481): 3.947 (3.013), p>0.05  <u>Dual-headed households (per \$10,000):</u> Male labor income (n=210): 0.450 (2.458), p>0.05 Male non-labor income (n=210): -0.684 (1.979), p>0.05 <b>Female labor income (n=216): -12.759 (5.971), p&lt;0.05</b> Female non-labor income (n=216): -0.441 (2.135), p>0.05	Age, respondent, and year-fixed effects, labor supply, and household assets
<b>Forrester, 2018<sup>2</sup></b>	National Households who completed their 8 <sup>th</sup> interview in the Current Population Survey  Mean age ranges from 35.24 (unmarried male) to 45.35 (two earner married male) N=37,713	Income (not described)  <u>Data source:</u> American Time Use Survey (ATUS; 2003-2012)	Food preparation and presentation  <u>Data source:</u> ATUS (2003-2012)	Mean time spent on food preparation and presentation does not show much variation within subcategories of income; Statistical test NR	NR



Article	Population, N	Exposure and Comparator	Outcome Definition	Results	Model adjustments
Gough, 2019 <sup>3</sup>	National Women aged 18-55; 65% non-Hispanic White, 13% non-Hispanic Black, 15% Hispanic; Married 55%; Employment status: employed full time 54%, employed part time 19%, out of the labor force 21%, unemployed 6% N=17,914	Poverty Threshold (categorical): • ≥ 185% poverty threshold • 130 to <185% poverty threshold • <130% poverty threshold  <u>Data source:</u> ATUS (2006-2008, 2014-2015)	Time spent in food preparation (yes/no and min/day among those who prepared food)  <u>Data source:</u> ATUS (2006-2008, 2014-2015)	65% of women spent any time preparing food (mean (SE): 54.38 (43.35) min/day, range: 1-210 min/day)  <u>Mothers' Likelihood of preparing food, n=8517</u> OR (95% CI), logistic regression Middle/Upper income: Ref <b>Low income (130-185% poverty threshold): 1.38 (1.15, 1.65), p&lt;0.01</b> <b>Sub-poverty income (&lt;130% poverty threshold): 1.64 (1.39, 1.94), p&lt;0.001</b>  <u>Childfree Women's Likelihood of preparing food, n=3198</u> OR (95% CI), logistic regression Middle/Upper income: Ref Low income: 1.16 (0.89, 1.51), p>0.10 Sub-poverty income: 1.07 (0.86, 1.35), p>0.10  <u>Mothers' average min/day in food preparation, n=8517</u> Coefficient (SE), OLS regression Middle/Upper income: Ref <b>Low income: 3.28 (1.91), p&lt;0.10</b> <b>Sub-poverty income: 8.16 (1.83), p&lt;0.001</b> <b>Low income vs. sub-poverty income, p is statistically significant</b>  <u>Childfree Women's average min/day in food preparation, n=3198</u> Coefficient (SE), OLS regression (adjusted for age, marital status, education, race/ethnicity, citizenship, employment, urban residence, weekend day, and year) Middle/Upper income: Ref Low income: 2.94 (3.21), p>0.10 Sub-poverty income: 4.91 (3.40), p>0.10	Age, marital status, education, race/ethnicity, citizenship, employment, urban residence, weekend day, and year (all models)

Article	Population, N	Exposure and Comparator	Outcome Definition	Results	Model adjustments
<b>Hamrick, 2011<sup>4</sup></b>	National Participants who completed the ATUS data and Eating and Health Module for 2006-2008 N=37,832	Income (categorical): • <185% poverty threshold • >185% poverty threshold • Income missing  <u>Data source:</u> Eating and Health Module (2006-2008)	Meal preparation defined as food and drink preparation, food presentation, kitchen and food cleanup  <u>Data source:</u> ATUS/Eating and Health Module (2006-2008)	<u>Mean meal prep time (minutes), total population, p&lt;0.10</u> <b>Income &lt;185% poverty threshold: 40.3</b> <b>Income &gt;185% poverty threshold: 29.5</b> <b>Income missing: 40.2</b>  <u>Mean meal prep time (minutes), participants, p&lt;0.10</u> <b>Income &lt;185% poverty threshold: 70.8</b> <b>Income &gt;185% poverty threshold: 56.4</b> <b>Income missing: 75.3</b>	None
<b>Monsivais, 2014<sup>12</sup></b> <b>Seattle Obesity Study</b>	Seattle, WA Participants who completed survey; mean age 54y, 67.4% women, 81% White, 7.5% African American, 6.7% Asian, 2.7% Hispanic, 2% other N=1,319	Household income (categorical): • <\$50,000/year • \$50,000-\$99,999/year • ≥\$100,000/year  <u>Data source:</u> Study-specific survey (2008-2009)	Average hours spent on preparing, cooking, and cleaning up from meals each time.  Responses stratified into three groups: <1 hr/day (n=212, 16%) 1-2 hrs/day (n=566, 43%) >2 hrs/day (n=541, 41%)  <u>Data source:</u> Study-specific survey (2008-2009)	Household income >\$50,000/year (%), Pearson chi-square  Hours/day spent preparing, cooking, and cleaning up from meals, p=0.005 <b>&lt;1 hr/day (n=212): 46.7%</b> <b>1-2 hrs/day (n=566): 58.3%</b> <b>&gt;2 hrs/day (n=541): 57.1%</b>	None
<b>Senia, 2017<sup>8</sup></b>	National Participants who completed ATUS/Eating and Health module, are the only adult member (≥18y) in a household with no children 16-17y N=11,070	Income (continuous)  Income (categorical): • 130-185% poverty • <130% poverty  <u>Data source:</u> ATUS (2006-2008)	Preparing, cooking, cleaning time, food-related travel, grocery shopping  <u>Data source:</u> ATUS (2006-2008)	<u>Marginal effect (SE) of probability of positive food preparation duration</u> Double-hurdle model: <b>&lt;130% poverty: 0.04 (0.01), p&lt;0.01</b> 130-185% poverty: 0.01 (0.01), p≥0.1 <b>Log of real family income: -0.01 (0.00), p&lt;0.01</b>  <u>Marginal effect (SE) of expected duration of food preparation (min/day)</u> Double-hurdle model <b>&lt;130% poverty: 5.30 (1.35), p&lt;0.01</b> <b>130-185% poverty: 3.72 (1.86), p&lt;0.05</b> Log of real family income: -1.09 (0.68), p≥0.10	Food-at-home and fast food price indices, age, sex, race/ethnicity, foreign-born, missing income, education, presence of child (0-5 and 6-15 y), metropolitan area, holiday, day of the week, region, year, season



Article	Population, N	Exposure and Comparator	Outcome Definition	Results	Model adjustments
Smith, 2014 <sup>10</sup>	National  Free-living residents of households in all 50 states and District of Columbia ≥18y  N=118,635	Income (categorical): <ul style="list-style-type: none"> <li>Below poverty (family income &lt; weighted average poverty threshold for relevant year)</li> <li>Above poverty threshold</li> </ul> <u>Data source:</u> ATUS (2003-2011)	Any time spent in food preparation or meal-related cleaning into 3 categorical variables by gender:  Female: Not cooking: 32% Cooking 1-59 min/day: 35% Cooking ≥ 60 min/day: 33%  Male: Not cooking: 60% Cooking 1-39 min/day: 23% Cooking ≥ 40 min/day: 17%  <u>Data source:</u> ATUS (2003-2011)	Men (n=51,139):  Percentage of men in each cooking category from 2003-2007 to 2008-2011 (post-recession), Multinomial logistic regression  <u>Below poverty:</u> 0 minutes/day: 2003-2007: 62%, 2008-2011: 56%, Change: -6% 1-39 minutes/day: 2003-2007: 22%, 2008-2011: 24%, Change: 2% ≥40 min/day: 2003-2007: 16%, 2008-2011: 20%, Change: 4%  <u>Above poverty:</u> 0 minutes/day: 2003-2007: 61%, 2008-2011: 59%, Change: -2% 1-39 minutes/day: 2003-2007: 22%, 2008-2011: 23%, Change: 1% ≥40 min/day: 2003-2007: 16%, 2008-2011: 18%, Change: 2% <b>Change in percentage of men cooking below (6%) vs. above (2%) poverty: p&lt;0.01</b>  Women (n=67,496): <b>Household income below federal poverty threshold was associated with a strong and consistent increase in likelihood of women cooking for longer durations.</b>	Holidays, age, education, race/ethnicity, household type, individual employment status, and state-level unemployment



Article	Population, N	Exposure and Comparator	Outcome Definition	Results	Model adjustments
<b>Wolfson, 2019<sup>11</sup></b>	National Participants of the GfK KnowledgePanel (55,000 US adults recruited through equal probability, with sampling frame covering 97% of US households)  N=1,112	Income (categorical): <ul style="list-style-type: none"> <li>• Low income: &lt; \$25,000</li> <li>• Middle income: \$25,000–\$59,000</li> <li>• Highest income: ≥\$60,000</li> </ul> <u>Data source:</u> Home Cooking Survey	Cooking and cleaning time defined as minutes that the participant, or someone in their household, typically spends cooking dinner and cleaning up after dinner on weekdays and on weekends.  <u>Data source:</u> Home Cooking Survey	Mean (SEM) time (min/day) spent on dinner cooking and cleaning, Multivariate negative binomial regression  <u>Weekday</u> <b>&lt;\$25,000: 44.87 (3.11)</b> <b>\$25,000-59,000: 58.63 (2.27), vs. Low income, p&lt;0.001</b> <b>≥\$60,000: 53.11 (1.83), vs. Low income, p=0.03</b>  <u>Weekend</u> <b>&lt;\$25,000: 44.55 (3.16)</b> <b>\$25,000-59,000: 56.72 (2.39), vs. Low income, p=0.004</b> <b>≥\$60,000: 53.53 (1.85), vs. Low income, p=0.02</b>	Income, gender, age, race/ethnicity, education, SNAP/WIC status, employment status, primary grocery shopper status

<sup>a</sup> Abbreviations: ATUS: American Time Use Survey; CI: confidence interval; min: minutes; NR: Not Reported; OLS: ordinary least-squares; OR: odds ratio; SE: standard error; SEM: standard error of mean; SNAP: Supplemental Nutrition Assistance Program; WIC: Special Supplemental Nutrition Program for Women, Infants and Children

Bold indicates statistically significant findings



Table 4-c. Cross-sectional evidence examining the relationship between income proxy and time spent on food-at-home-related activities <sup>a</sup>

Article	Population, N	Exposure and Comparator(s)	Outcome Definition	Results	Model adjustments
<b>Bauer, 2012<sup>13</sup></b> <b>Project F-EAT</b>	Minneapolis and St. Paul, MN  Parents of adolescents who participated in the EAT 2010 study; age mean ranged from 40.6 to 45.4y; 71% in married/committed relationship; White n=961 (28%), African American/Black n=817 (23%), Hispanic n=592 (17%), Asian n=728 (21%), Mixed/other n=395 (11%)  N=3,256	<u>SES proxy:</u> Employment <ul style="list-style-type: none"> <li>• Not employed (lowest income)</li> <li>• Part time (middle income)</li> <li>• Full time (highest income)</li> </ul> <u>Data source:</u> Study-specific survey (2009-2010)	Food preparation time (hours/week)  <u>Data source:</u> Study-specific survey (2009-2010)	Adjusted means (SE) Time spent on food preparation (hours/week), Linear regression <u>Fathers, p&lt;0.001*</u> <b>Not employed (n=298): 7.4 (0.39) a</b> <b>Part time (n=133): 6.8 (0.56) a</b> <b>Full time (n=752): 4.7 (0.23) b (p&lt;0.05)</b> <u>Mothers, p&lt;0.001</u> <b>Not employed (lowest income, n=760): 11.5 (0.30) a (p&lt;0.05)</b> <b>Part time (middle income, n=368): 10.1 (0.41) b (p&lt;0.05)</b> <b>Full time (highest income, n=945): 8.8 (0.26) c (p&lt;0.05)</b>  *Different letters indicate statistically significant differences	Relationship status, race/ethnicity, education, age, language spoken at home, and number of children in home
<b>Hamrick, 2011<sup>4</sup></b>	National  Participants who completed the ATUS data and the Eating and Health Module for 2006-2008  N=37,832	<u>SES proxy:</u> Participation and eligibility in SNAP/food stamps: <ul style="list-style-type: none"> <li>• SNAP participation</li> <li>• Non-SNAP, income-eligible</li> <li>• Non-SNAP, income &gt;130% poverty threshold</li> </ul> <u>Data source:</u> Eating and Health Module (2006-2008)	Meal preparation defined as food and drink preparation, food presentation, kitchen and food cleanup  <u>Data source:</u> ATUS (2006-2008)	<u>Mean meal prep time (min/day), total population, p&lt;0.10</u> <b>SNAP/FSP participation household: 47.9</b> <b>Non-SNAP but income eligible: 39.9</b> <b>Non-SNAP, income &gt;130% poverty threshold: 30.4</b>  <u>Mean meal prep time (min/day), participants, p&lt;0.10</u> <b>SNAP/FSP participation household: 74.7</b> <b>Non-SNAP but income eligible: 72.8</b> <b>Non-SNAP, income &gt;130% poverty threshold: 57.6</b>	None



Article	Population, N	Exposure and Comparator(s)	Outcome Definition	Results	Model adjustments
<b>Kim, 2020<sup>5</sup></b>	National Households with annual incomes <130% poverty threshold N=8,408	<u>SES proxy:</u> <ul style="list-style-type: none"> <li>SNAP participant</li> <li>SNAP eligible non-participants</li> </ul> <u>Data source:</u> Consumer Expenditure Quarterly Interview Survey (2013-2014)	Time (min/day) spent in food preparation, including travel time related to food preparation, cooking time, and grocery shopping time  <u>Data source:</u> ATUS (2013-2014)	<u>Time (min/day) spent in food preparation, Regression difference-in-differences model</u> <u>Predicted mean (robust SE)</u> <b>Any SNAP: 8.065 (2.695), p&lt;0.01</b> After: -0.104 (4.768), p>0.05 <b>SNAP*After benefit decrease: -13.892 (4.127), p&lt;0.01</b> R <sup>2</sup> = 0.159  <u>Time (min/day) spent cooking, Regression difference-in-differences model</u> <u>Predicted mean (robust SE)</u> <b>Any SNAP: 5.824 (2.156), p&lt;0.01</b> R <sup>2</sup> = 0.162 Additionally adjusted for after SNAP benefit decrease	Education, age, age-squared, sex, race, labor force participation, family size, metropolitan, holiday indicator, and fixed effects for day, month, and state
<b>Raschke, 2012<sup>6</sup></b>	National Participants aged 18-65y N=18,740	<u>SES proxy:</u> Hourly market wage by SNAP participation: <ul style="list-style-type: none"> <li>SNAP participants (n=935): \$10.90/hr</li> <li>SNAP non-participants (n=17,805): \$21.01/hr</li> </ul> <u>Data source:</u> ATUS, Current Population Survey - Food Security Supplement (2003-2009)	Home food production (min/d), which includes food preparation, presentation, and clean up  <u>Data source:</u> ATUS (2003-2009)	Mean time (min/day) in home food production, Welch's t-test, p<0.05 <b>SNAP participants (lower income, n=935): 66.95</b> <b>SNAP non-participants (higher income, n=17,805): 53.52</b>	None
<b>Restrepo, 2020<sup>7</sup></b>	National Mean 39y, 54.4% female, 68.5% non-Hispanic White, 12.1% Hispanic, 9.7% non-Hispanic Black N=1,784	<u>SES proxy:</u> <ul style="list-style-type: none"> <li>Worked away from home</li> <li>Worked from home</li> </ul> <u>Data source:</u> Leave and Job Flexibilities Module (2017-2018)	Food preparation includes food and drink preparation, food presentation, kitchen and food clean-up, grocery shopping, and travel to grocery store  <u>Data source:</u> ATUS (2017-2018)	Coefficient estimate (SE) food preparation in minutes/d, p<0.10 <b>Worked away from home (lower income, n=1637): 30.3 (1.216)</b> <b>Worked from home (higher income, n=147): 40.7 (5.433)</b>	None



Article	Population, N	Exposure and Comparator(s)	Outcome Definition	Results	Model adjustments
Sliwa, 2015 <sup>9</sup>	National  Hispanic mothers with at least 1 child <13y; mean age 32.8y; 66.2% households with child under 6 (p<0.05 between exposure groups with more US-born mothers with children <6 than im/migrant mothers); 24% single mother household (p<0.05 between exposure groups with more US-born mothers having higher % of single mother household)  N=3,622	<u>SES proxy:</u> <ul style="list-style-type: none"> <li>Im/migrant (n=2277): 52.8% &lt;=130% of poverty guideline; 19.3% &gt;130-185% of poverty guideline; 27.9% &gt;185% of poverty guideline</li> <li>US-born (n=1345): 36.6% &lt;=130% of poverty guideline; 16.6% &gt;130-185% of poverty guideline; 46.7% &gt;185% of poverty guideline</li> </ul> <u>Data source:</u> ATUS (2003-2011)	Food preparation defined as total minutes spent preparing, cooking, serving food, clean up (e.g., putting away food and drinks, tidying the kitchen)  <u>Data source:</u> ATUS (2003-2011)	Mean (SE) daily food preparation (minutes), adjusted Wald test, p<0.001 <b>Im/migrant (lower income, n=2277): 107.8 (2.0)</b> <b>US-born (higher income, n=1345): 70.8 (2.1)</b>	Hours worked/8, worked late hours, Nativity X origin interaction, Education, Single mother, Number children in HH, presence of child <6, maternal age, weekend diary day, and survey year

<sup>a</sup> Abbreviations: ATUS: American Time Use Survey; min: minutes; FSP: Food Stamp Program; NR: Not Reported; OR: odds ratio; SE: standard error; SES: socioeconomic status; SNAP: Supplemental Nutrition Assistance Program; WIC: Special Supplemental Nutrition Program for Women, Infants and Children

Bold indicates statistically significant findings

**Table 4-d. Risk of bias for observational studies examining income and time spent on food-at-home-related activities<sup>a</sup>**

Article	Confounding	Selection of participants	Classification of exposures	Deviations from intended exposures	Missing data	Outcome measurement	Selection of the reported result
Bauer, 2012 <sup>13</sup>	MODERATE	LOW	LOW	MODERATE	LOW	MODERATE	MODERATE
Dunn, 2015 <sup>1</sup>	MODERATE	MODERATE	LOW	LOW	MODERATE	MODERATE	MODERATE
Forrester, 2018 <sup>2</sup>	SERIOUS	LOW	SERIOUS	LOW	NO INFORMATION	MODERATE	MODERATE
Gough, 2019 <sup>3</sup>	MODERATE	LOW	LOW	LOW	MODERATE	MODERATE	MODERATE
Hamrick, 2011 <sup>4</sup>	SERIOUS	LOW	LOW	LOW	LOW	MODERATE	MODERATE
Kim, 2020 <sup>5</sup>	MODERATE	LOW	LOW	LOW	LOW	MODERATE	MODERATE
Monsivais, 2014 <sup>12</sup>	SERIOUS	LOW	LOW	LOW	MODERATE	MODERATE	MODERATE
Raschke, 2012 <sup>6</sup>	SERIOUS	LOW	LOW	SERIOUS	LOW	MODERATE	MODERATE
Restrepo, 2020 <sup>7</sup>	SERIOUS	MODERATE	MODERATE	SERIOUS	MODERATE	MODERATE	MODERATE
Senia, 2017 <sup>8</sup>	MODERATE	LOW	LOW	LOW	LOW	MODERATE	MODERATE
Sliwa, 2015 <sup>9</sup>	SERIOUS	LOW	MODERATE	SERIOUS	MODERATE	MODERATE	MODERATE
Smith, 2014 <sup>10</sup>	MODERATE	LOW	LOW	LOW	MODERATE	MODERATE	MODERATE
Wolfson, 2019 <sup>11</sup>	MODERATE	LOW	LOW	LOW	MODERATE	MODERATE	MODERATE

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<sup>a</sup> Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias for Nutrition Observational Studies" tool (RoB-NObs) (Dietary Guidelines Advisory Committee. 2020. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services*. U.S. Department of Agriculture, Agricultural Research Service, Washington, DC.)

## References of the articles included in the income and time spent on food-at-home-related activities rapid review

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2. Dunn RA. Labor supply and household meal production among working adults in the Health and Retirement Survey. *Review of Economics of the Household*. 2013;13(2):437-457. doi:10.1007/s11150-013-9223-8.
3. Forrester K, Klein J. An analysis of female labor supply, home production, and household consumption expenditures. *J Demogr Econ*. 2018;84(3):257-307. doi:10.1017/dem.2018.8.
4. Gough M, Lippert AM, Martin MA. The role of time use behaviors in the risk of obesity among low-income mothers. *Women's Health Issues*. 2019;29(1):23-30. doi:10.1016/j.whi.2018.10.002.
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8. Raschke C. Food stamps and the time cost of food preparation. *Review of Economics of the Household*. 2011;10(2):259-275. doi:10.1007/s11150-011-9128-3.
9. Restrepo BJ, Zeballos E. The effect of working from home on major time allocations with a focus on food-related activities. *Rev Econ Househ*. 2020:1-23. doi:10.1007/s11150-020-09497-9.
10. Senia MC, Jensen HH, Zhylve vs.kyy O. Time in eating and food preparation among single adults. *Review of Economics of the Household*. 2014;15(2):399-432. doi:10.1007/s11150-014-9258-5.
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## Chapter 5 - What factors influence the purchase and/or consumption of at-home convenience foods? How are these foods described in the literature?

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Sara Scinto-Madonich, MS,<sup>a</sup> Laural Kelly English, PhD,<sup>a</sup> Molly Higgins, MLIS,<sup>b</sup> Marlana Bates, MPH, RD,<sup>a</sup> Julie Nevins, PhD,<sup>a</sup> Julia H Kim, PhD, MPH, RD,<sup>a</sup> Emily Callahan, MS<sup>c</sup>

### Specific methods to conduct the evidence scan

#### Develop a protocol

The research question, “What factors influence the purchase and/or consumption of at home-convenience foods?” was addressed with an evidence scan. Similar to the rapid reviews, a protocol was developed and followed. However, results were not extracted and no risk of bias assessment was completed. The following section describes the volume and characteristics of articles that address the purchase and/or consumption of at home-convenience foods.

The analytic framework for the evidence scan examining the relationship between different factors and the purchase and/or consumption of at-home convenience foods is presented in **Figure 5-a**. This analytic framework visually represents the overall scope of the evidence scan question, and depicts the contributing elements that were examined and evaluated. The intervention or exposure of interest is any factor in U.S. households or populations. The comparator is a different factor or level or factor, or no comparator. The outcomes are purchase and/or consumption of at-home convenience foods in U.S. households or populations. There are no key confounders. The other factors to be considered are how at-home convenience foods are described in the literature and may impact the relationships of interest.

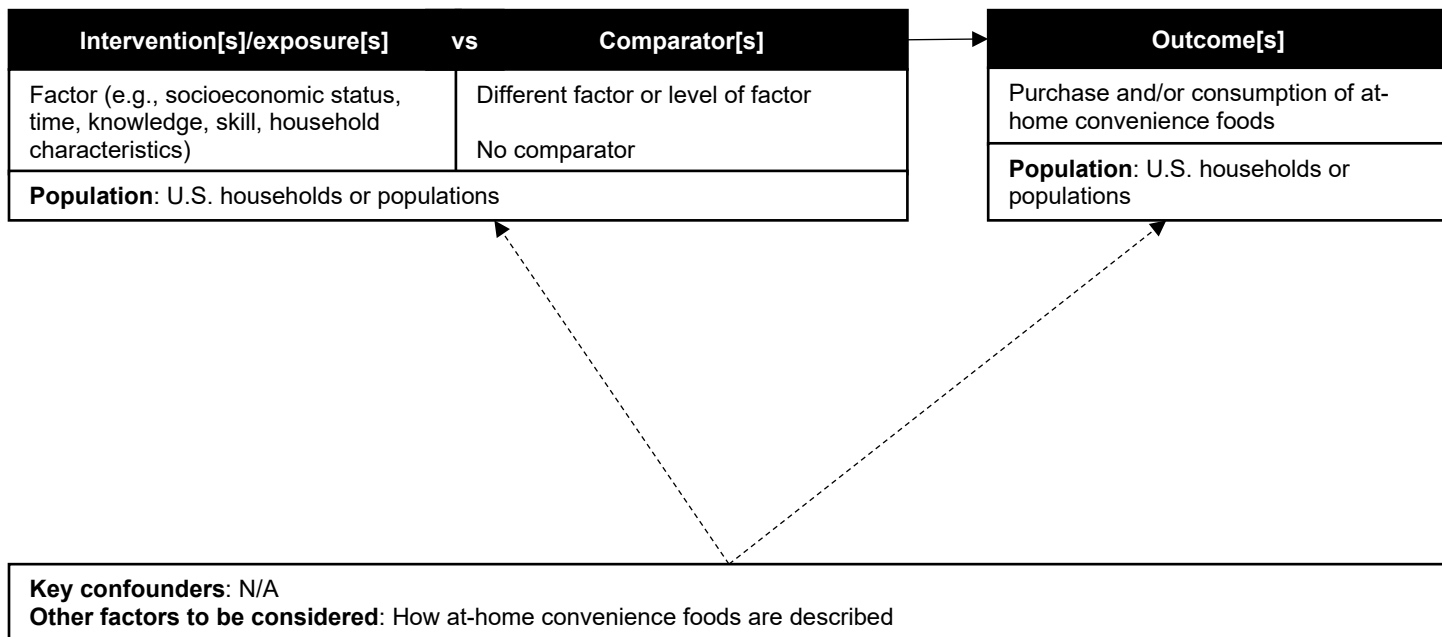
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<sup>a</sup> Analyst, NESR team; Panum Group, under contract with the FNS, USDA

<sup>b</sup> Librarian, NESR team; Panum Group, under contract with the FNS, USDA

<sup>c</sup> Project Lead, NESR team, NGAD, CNPP, FNS, USDA

**Figure 5-a. Analytic framework**



**Key definitions**

Food-at-home: Food that is prepared at home and includes ready-to-eat and non-ready-to-eat foods that are brought from grocery stores, food pantries, super centers, mass merchandisers, convenience stores, drug stores, farmers markets, and food co-ops (ERS, 2018)

Food-away-from-home: Food prepared outside of home and includes food from full-service and fast-food restaurants (ERS, 2018)

Fast-food restaurants: Eating places where consumers pay before they eat (e.g., bakery, burger restaurant, and sandwich or coffee shop) (ERS, 2018)

Full-service restaurants: Eating places where consumers eat before they pay (ERS, 2018)

**Legend**

- > Relationship(s) of interest
- > Factors that may impact the relationship(s) of interest

**Search for and select studies**

The following outlines any departures from the search and select studies project methods for this specific evidence scan:

- Scopus was searched instead of Web of Science because of the overwhelming number of results from Web of Science. This decision was made because the two databases cover similar topic areas and because this was an evidence scan.
- 80% of all records were single-screened at title, abstract, and full-text levels and 20% of all records were dual-screened, independently at each of these levels.
- A manual search was not completed.

NESR analysts worked jointly with NEAT staff to establish the final inclusion and exclusion criteria and literature search strategy, which are detailed in **Table 5-a** and **Appendix 5-a**, respectively.



**Table 5-a. Inclusion and exclusion criteria**

Category	Inclusion Criteria	Exclusion Criteria
Study design	<ul style="list-style-type: none"> <li>Any study design, including qualitative, that is not a narrative review, systematic review, or meta-analysis</li> </ul>	<ul style="list-style-type: none"> <li>Narrative reviews</li> <li>Systematic reviews</li> <li>Meta-analyses</li> </ul>
Intervention/exposure	<ul style="list-style-type: none"> <li>Any factor (e.g., socioeconomic status, time, knowledge, skill, household characteristics)</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Comparator	<ul style="list-style-type: none"> <li>Different factor or level of factor</li> <li>No comparator</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Outcomes	<ul style="list-style-type: none"> <li>Purchase and/or consumption of at-home convenience foods that are:               <ul style="list-style-type: none"> <li>Ready-to-eat</li> <li>Ready-to-heat</li> <li>Ready-to-cook/bake</li> <li>Other</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Purchase and/or consumption of at-home foods that do not fit into the inclusion categories</li> <li>Purchase and/or consumption of food-away-from-home, including fast-food and full-service restaurants</li> <li>Purchase and/or consumption of beverages only</li> </ul>
Publication date	<ul style="list-style-type: none"> <li>Jan 2008 – May 2021</li> <li>Data inclusive of 2008 (e.g., 2000-2012; 2008-2009)</li> </ul>	<ul style="list-style-type: none"> <li>Before Jan 2008, after May 2021</li> <li>Data prior to 2008 (e.g., 2000-2007; 1999-2005)</li> </ul>
Publication status	<ul style="list-style-type: none"> <li>Articles that have been peer-reviewed</li> <li>Grey literature: reports that have not been peer-reviewed but are available from government and nongovernmental organizations</li> </ul>	<ul style="list-style-type: none"> <li>Articles that have not been peer reviewed and are not published in peer-reviewed journals, other than reports from government and nongovernmental organizations</li> </ul>
Language	<ul style="list-style-type: none"> <li>Articles published in English</li> </ul>	<ul style="list-style-type: none"> <li>Articles published in languages other than English</li> </ul>
Country	<ul style="list-style-type: none"> <li>Studies conducted in the U.S.</li> </ul>	<ul style="list-style-type: none"> <li>Studies conducted outside the U.S.</li> </ul>
Study participants	<ul style="list-style-type: none"> <li>Human participants/ populations</li> </ul>	<ul style="list-style-type: none"> <li>Non-human participants (e.g., animal studies, in-vitro models)</li> </ul>

## Extract data

NESR analysts extracted data from each included article to objectively describe the body of evidence available to inform the evidence scan. The following outlines any departures from the extract data and assess risk of bias project methods for this specific question:

- Basic data extraction occurred at the full-text screening level, and therefore 80% of the articles were extracted by 1 analyst and 20% of the articles were extracted independently by 2 analysts and compared for agreement.

- The following data elements were extracted or bucketed into categories by the NESR analysts: publication year, study design, intervention/exposure category (factor), outcome categories (level(s) of convenience, food group(s), purchase and/or consumption), and any other notes.
  - Level of convenience groupings used to categorize included articles:
    - Ready-to-eat (RTE): foods that require no preparation before consumption
    - Ready-to-heat (RTH): foods that are already cooked, but require a change in temperature before consumption.
    - Ready-to-cook (RTC) or ready-to-bake (RTB): foods that are somewhat pre-prepared, but still require cooking or baking.
    - Ready-to-prepare (RTP): foods which require preparation of multiple ingredients, as well as cooking or baking
      - The specific ready-to-prepare level of convenience outcome category was added during the evidence scan process as we observed how convenience foods were being described in the literature. We listed an “Other” level of convenience outcome category in original protocol to allow for this specific situation.
  - Food groups used to categorize included articles
    - Vegetables
    - Fruit
    - Grains
    - Proteins
    - Dairy
    - Snacks
    - Sweets
    - Multi-component foods/meals
    - Other
  - Only factors and purchase and/or consumption outcome categories were extracted for qualitative studies. This was because the qualitative data was often not clear enough to determine the level of convenience and/or food groups.
  - For both qualitative and quantitative studies, factors and purchase and/or consumption categories were extracted. Level of convenience and food group(s) examined was also extracted for quantitative studies because the qualitative data was often not clear enough to determine the level of convenience and/or food groups.
- No results were extracted from the included articles
- No risk of bias assessment was completed

## Describe the evidence

NESR analysts summarized the volume and characteristics of included studies to inform the question, what factors influence the purchase and/or consumption of at home-convenience foods? The NESR analysts summarized the data using evidence tables and figures. The results of this evidence scan do not answer the question, since no results were extracted, however it describes the landscape of available evidence pertaining to this topic.

## Recommend future research

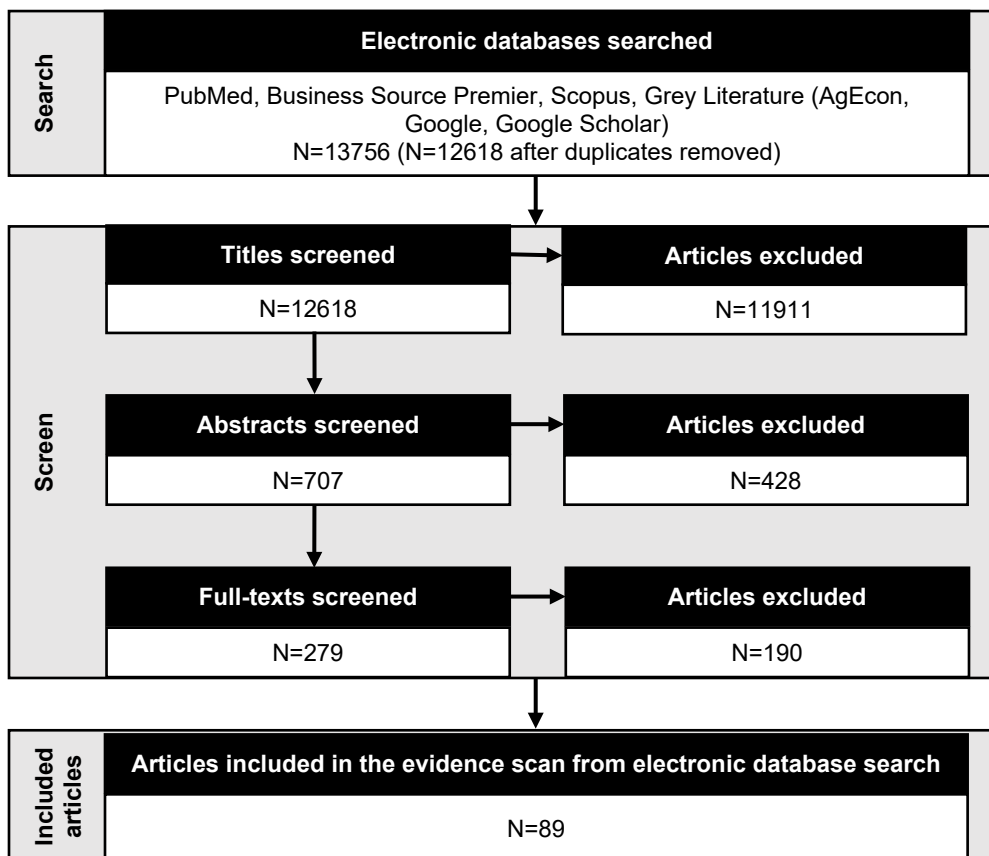
Recommendations for future research evaluating at home-convenience foods were determined based on the gaps and limitations observed during data extraction and the description of the evidence, as previously described in the project methods. Future work addressing these gaps and limitations may contribute to the body of evidence contributing to this topic.

## Results

### Literature search and screening results

The literature search yielded 12,618 search results after the removal of duplicates (see **Figure 5-b**). Dual-screening resulted in the exclusion of 11,911 titles, 428 abstracts, and 190 full-text articles. Reasons for full-text exclusion are in **Appendix 5-b**. A manual search was not conducted and all included articles were obtained through the electronic database search. The body of evidence included 89 articles:

**Figure 5-b. Literature search and screen flowchart**



## Description of the evidence

This evidence scan included 89 articles that examined the relationship between different factors and the purchase and/or consumption of at-home convenience foods. Sixty-five articles included cross-sectional data,<sup>1-65</sup> 10 included qualitative data,<sup>1,15,66-73</sup> 5 each were prospective cohort<sup>74-78</sup> and uncontrolled before-and-after studies,<sup>79-83</sup> and 3 each were non-RCTs<sup>84-86</sup> and RCTs.<sup>87-89</sup> Two articles included both cross-sectional and qualitative data.<sup>1,15</sup>

### Intervention/exposure characteristics

Ten articles included qualitative data<sup>1,15,66-73</sup> and 81 articles included quantitative data.<sup>1-65,74-89</sup> Within each article, 1 or more factors were identified or examined in relation to purchase and/or consumption of at-home convenience foods. Factors were identified by the study participants themselves in qualitative studies, while researchers selected which factors to study in relation to at-home convenience foods in quantitative studies.

#### *Qualitative studies*

The most common factor identified by study participants that influenced the purchase and/or consumption of at-home convenience foods was:

- price of food,<sup>15,68-70,73</sup>
- time,<sup>15,66,72,73</sup>

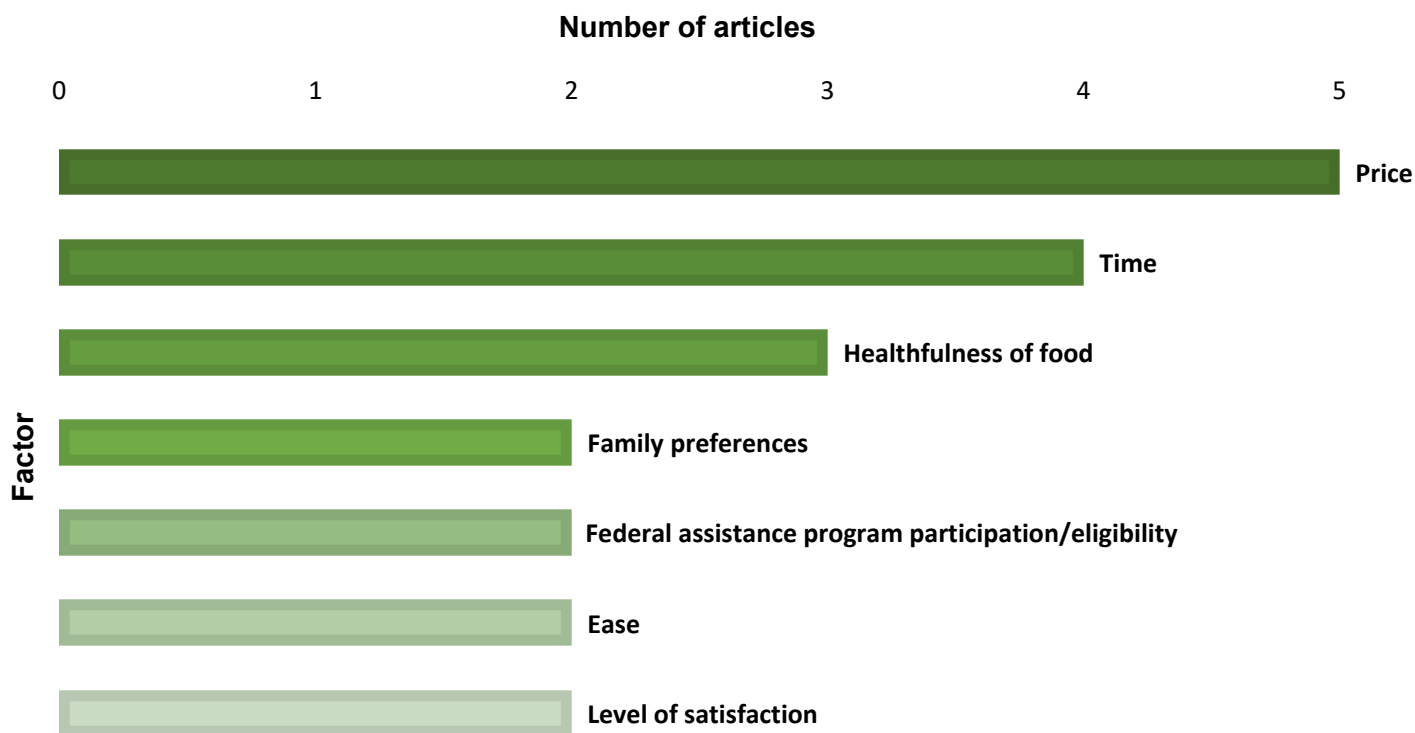
- healthfulness of the food,<sup>15,66,68</sup>
- family preferences,<sup>15,67</sup>
- federal assistance program participation/eligibility (such as SNAP or WIC),<sup>15,68</sup>
- ease of preparation,<sup>15,69</sup>
- and level of satisfaction.<sup>69,72</sup>

The less common factors identified included:

- age,<sup>73</sup>
- food security,<sup>15</sup>
- number of people in the household,<sup>68</sup>
- SES factor,<sup>68</sup>
- knowledge/skill,<sup>71</sup>
- shopping frequency,<sup>1</sup>
- day of the week (weekend v. weekday),<sup>72</sup>
- and meal skipping.<sup>72</sup>

**Figure 5-c** shows the more common factors identified in qualitative studies in relation to at-home convenience foods.

**Figure 5-c. Qualitative study factors identified related to the purchase/consumption of at-home convenience foods**



*Quantitative studies*

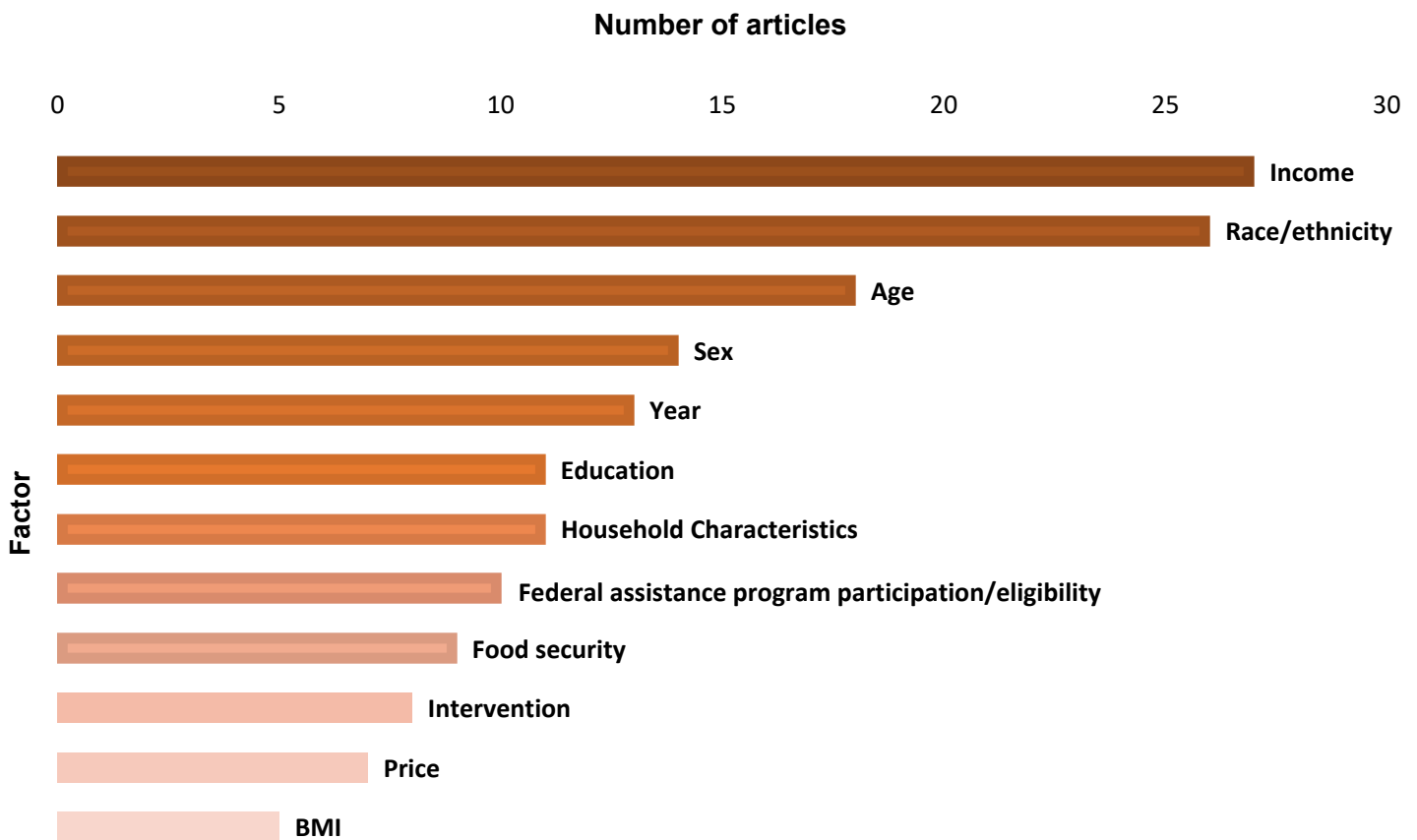
The most common factors examined in quantitative studies in relation to the purchase and/or consumption of at-home convenience foods was:

- income, <sup>2,4,7,10,16,17,19-21,23,26,29-31,34,38,45,47,53,54,56,59,60,62,65,77,78</sup>
- race/ethnicity, <sup>2,7,8,10,11,14-17,19-22,24,25,31,34,37-39,43,44,53,56,65,77</sup>
- age, <sup>7,10,16,17,19,21,28-30,34,38,42,45,47,50,53,54,65</sup>
- sex, <sup>7,10,16,17,19,21,30,34,37,38,47,53,55,65</sup>
- year (e.g., 2008, 2009, 2010), <sup>2,29,31,35,40,41,46,49,51,59,63,64,75</sup>
- education, <sup>2,10,16,17,29,34,47,54,56,60,65</sup>
- household characteristics (e.g., number of children in the household, marriage status, language spoken at home), <sup>7,15,29,30,34,47,54,56,62,65,77</sup>
- federal assistance program participation/eligibility, <sup>5,18,26,27,32-34,45,62,65</sup>
- food security, <sup>1,9,15,30,52,53,58,61,74</sup>
- intervention (e.g., dietary behavior change intervention, price discount intervention, in-store healthy foods promotion intervention), <sup>79,80,82,83,85,87-89</sup>

- price of food,<sup>11,24,30,31,36,77,78</sup>
- and BMI.<sup>10,34,37,45,76</sup>

**Figure 5-d** shows the more common factors examined in quantitative studies in relation to purchase/consumption of at-home convenience foods.

**Figure 5-d. Quantitative study factors examined related to the purchase/consumption of at-home convenience foods**



The less commonly examined factors were:

- lifestyle factors (e.g., smoking status, alcohol intake, stress/stress management, time, physical activity, breakfast consumption (yes or no), tradition/habit, shopping frequency, times cooking from scratch per day, identification as a healthy eater/cook),<sup>3,11,16,17,19,21,24,30,34,36-38,42,74</sup>
- SES factors (e.g., overall SES, access/distance to a store, work hours, car ownership/access, quality of the food environment),<sup>29,34,48,57,62,65,75,86</sup>
- personal characteristics (e.g., depressed mood, birthplace (US versus non-US), language(s) spoken, acculturation, knowledge/skill, food agency, family preferences),<sup>7,11,13,24,36,47,74</sup>

- food characteristics (e.g., taste, brand, quality/healthfulness of food, package size, ease of preparation),<sup>11,24,30,36,77,84</sup>
- location (e.g., urban versus rural/suburban, geographic region, city),<sup>4,29,56,57,63,75</sup>
- federal assistance program-related factors (e.g., WIC food package revisions, amount of time since receiving SNAP benefits, WIC eligibility of item, use of WICShopper app),<sup>5,6,12,27,81</sup>
- and other factors (e.g., store type, month of the year).<sup>4,26,39,41,59</sup>

### Outcome characteristics

At-home convenience foods were categorized based on the level of convenience, the food group(s) examined, and whether purchase and/or consumption was studied. The most commonly studied (and most convenient) category was RTE foods, followed by RTH foods, RTC or RTB foods, and ending with the least commonly studied (and least convenient) category of RTP foods:

- Seventy-two articles studied RTE foods,<sup>1-6,8,9,11,12,14-21,23-27,29-34,37-41,43-65,74,76-89</sup>
- 45 articles studied foods that were RTH,<sup>1,2,4,5,7,8,10,12,13,15,20,22,25-29,31-33,35-37,39-41,43-47,51,52,54,60,62,63,65,74-76,81,87-89</sup>
- 19 articles studied RTC or RTB foods,<sup>2,4,26,32,33,36,39-41,43,44,46,51,60,63,64,74,76,87</sup>
- and 11 articles studied foods that were RTP.<sup>2,4,12,20,26,33,39,40,43,44,60</sup>

The most commonly studied foods were sweets, followed by grains, snacks, vegetables, fruit, multi-component foods/meals, proteins, dairy, and other foods that did not fit into any of the listed groupings:

- Thirty-seven articles studied at-home convenience foods that were sweets;<sup>2,4,8,12,15,20,21,23,26,27,29,31-34,37,39-41,43,44,46,49-52,58,60,63-65,74,76,79,85-87</sup>
- 32 articles studied grains;<sup>6,8,12,15,17,19-21,27,30-32,39-41,43,44,46,49-51,53,55,56,61,62,65,74,77,79,83,89</sup>
- 30 articles studied snacks;<sup>2,4,15,20,23,26,27,29,31-34,37,39-41,43,44,46,49-52,60,63,65,74,80,82,86,87</sup>
- 28 articles each studied vegetables,<sup>1,2,4,5,8,12,26,28,29,31,33,38-40,43-46,59-62,65,75,79,81,87,88</sup>
- 28 articles studied fruit,<sup>1,2,4,5,8,16,26,28,29,31,33,38,40,43-46,60,62,63,65,75,78,79,81,85,87,88</sup>
- 28 articles studied multi-component foods/meals;<sup>2,4,7,10,12,20,22,25,29,32,35-37,40,41,43-47,52,60,62-64,74,76,89</sup>
- 26 articles studied proteins;<sup>2-4,11,14,15,24,26,29,32,33,35,39-41,43-46,49,51,62,65,76,84,87</sup>
- 14 articles studied dairy;<sup>6,15,32,33,39,40,43,44,46,62-65,76</sup>
- and 13 articles studied other foods.<sup>9,12,13,18,25,27,29,32,44,46,48,54,57</sup>

Lastly, 59 articles examined purchase of at-home convenience foods<sup>1-6,8,9,11,12,14,18,23,24,26,27,29-33,35,36,39-41,43,46,49,52,54,56,57,59-68,70,73,75-84,86-89</sup> and 38 articles examined consumption of at-home convenience foods.<sup>1,7,10,13,15-17,19-22,24,25,28,30,34,37,38,42,44,45,47,48,50,51,53,55,58,66,67,69-74,85,86</sup>

### *Ready-to-eat food groups*

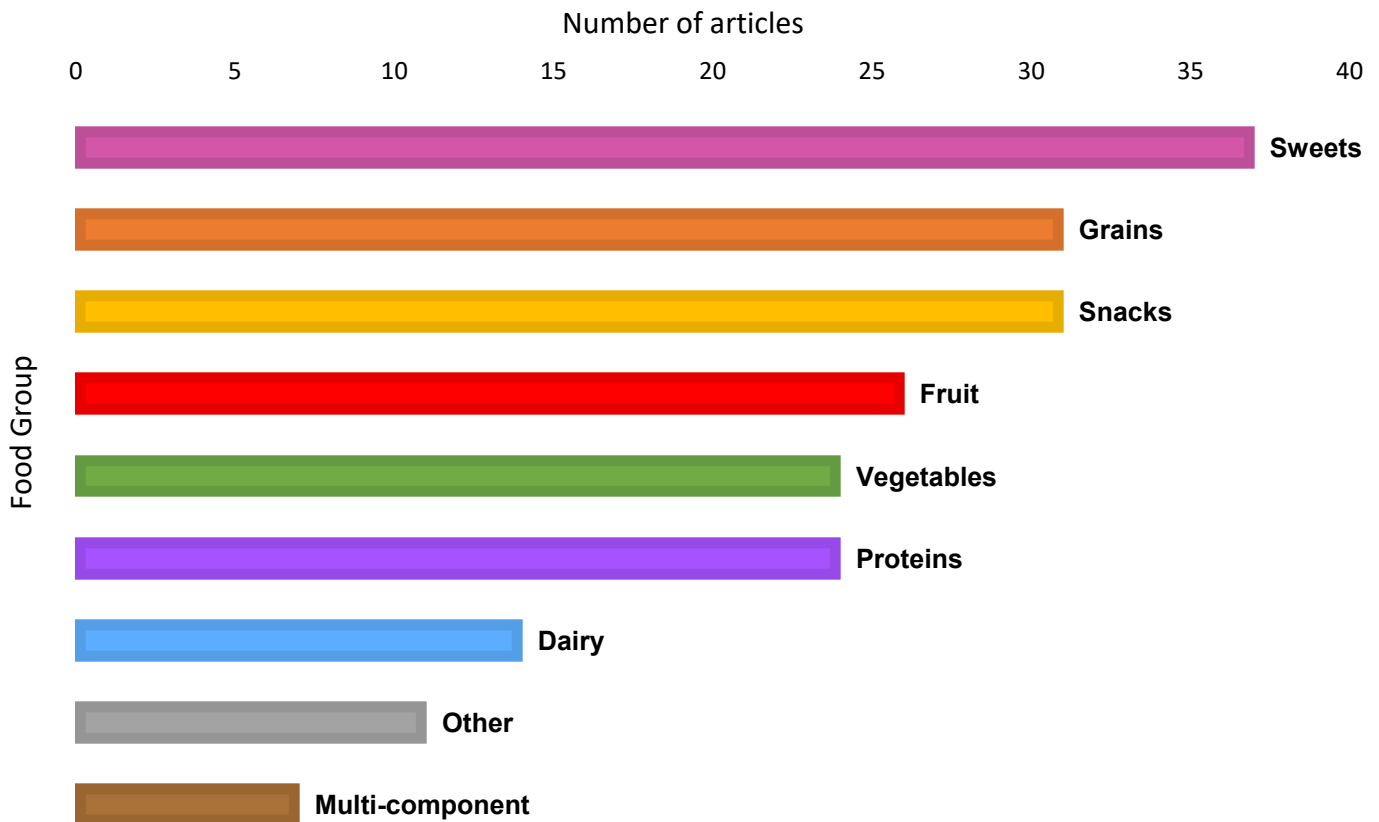
Of the RTE foods, the most common group was:



- sweets (e.g., candy, cookies, cupcakes),<sup>2,4,8,12,15,20,21,23,26,27,29,31-34,37,39-41,43,44,46,49-52,58,60,63-65,74,76,79,85-87</sup>
- grains (e.g., bread, cereal),<sup>6,8,15,17,19-21,27,30-32,39-41,43,44,46,49-51,53,55,56,61,62,65,74,77,79,83,89</sup>
- snacks (e.g., granola bars, chips, crackers),<sup>2,4,15,20,23,26,27,29,31-34,37,39-41,43,44,46,49-52,60,63,65,74,80,82,86,87</sup>
- fruit (e.g., canned fruit, apples, bananas),<sup>1,2,4,5,8,16,26,29,31,33,38,40,43-46,60,62,63,65,78,79,81,85,87,88</sup>
- vegetables (e.g., canned vegetables, bagged salad, baby carrots),<sup>1,2,4,5,8,26,29,31,33,38,39,43-46,59-62,65,79,81,87,88</sup>
- proteins (e.g., canned beans/tuna, peanut butter, deli meat),<sup>2-4,11,14,15,24,26,29,32,33,39,41,43-46,49,51,62,65,76,84,87</sup>
- dairy (e.g., yogurt, cheese),<sup>6,15,32,33,39,40,43,44,46,62-65,76</sup>
- other (e.g., condiments, unspecified),<sup>9,18,25,27,29,32,44,46,48,54,57</sup>
- and finally multi-component foods/meals.<sup>29,32,44,46,47,63,64</sup>

Figure 5-e shows the breakdown of RTE food groups, which was fairly mixed.

Figure 5-e. Ready-to-Eat Food Groups



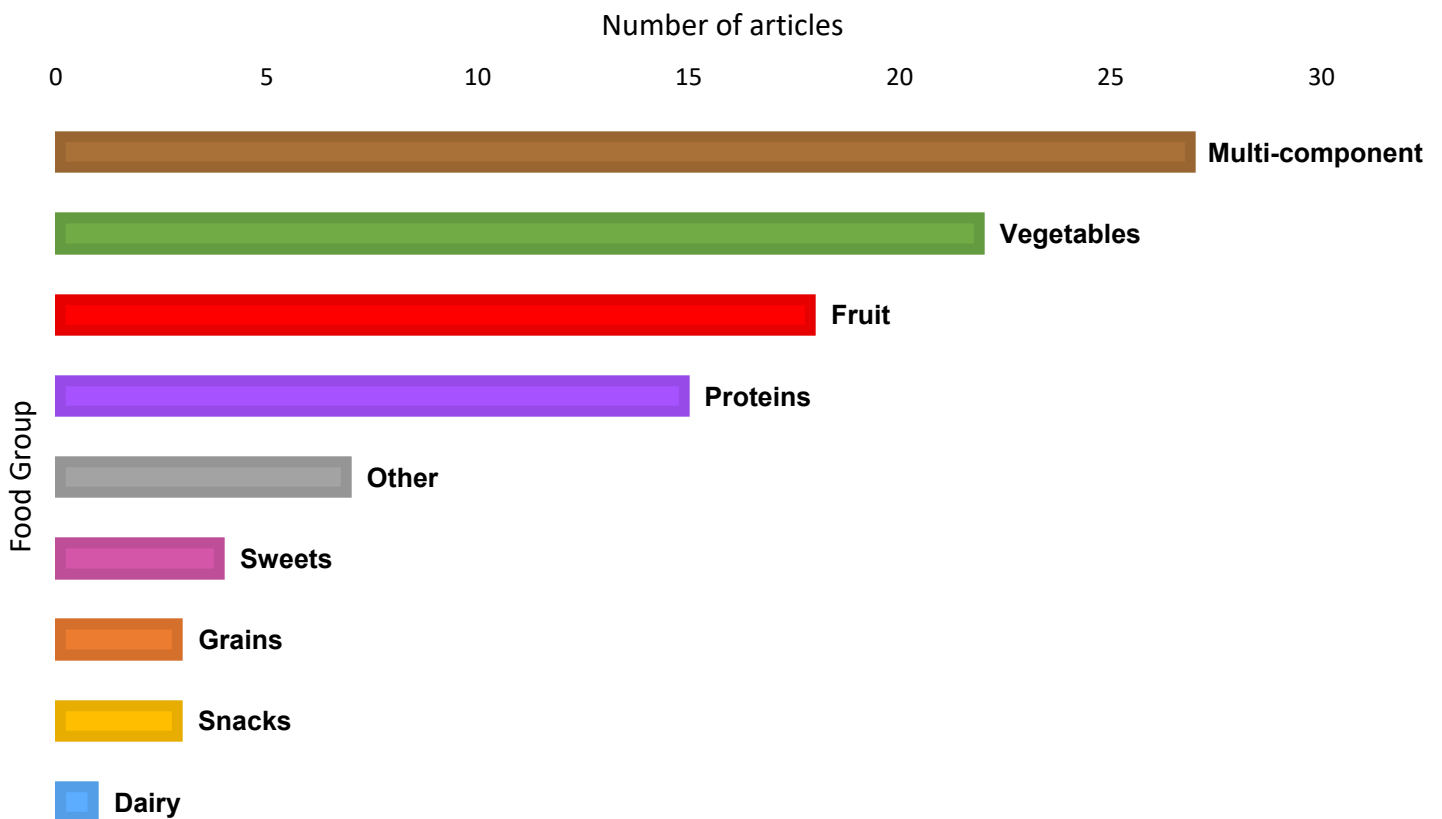
*Ready-to-heat food groups*

The most common RTH group was:

- multi-component foods/meals (e.g., frozen or chilled pre-cooked meals),<sup>2,4,7,10,12,20,22,25,29,32,35-37,40,41,43-47,52,60,62,63,74,76,89</sup>
- vegetables (e.g., frozen vegetables),<sup>1,2,4,5,8,12,26,28,29,31,33,39,40,43,44,46,60,65,75,81,87,88</sup>
- fruit (e.g., frozen fruit),<sup>1,2,4,5,8,26,28,29,31,33,43,44,46,60,75,81,87,88</sup>
- proteins (e.g., frozen or chilled pre-cooked meats/fish),<sup>2,4,15,26,32,33,35,39,41,43,44,46,51,76,87</sup>
- other (e.g., sauces, broth, unspecified),<sup>12,13,27,29,44,46,54</sup>
- sweets (e.g., frozen cakes/pies),<sup>26,33,43,46</sup>
- grains (e.g., frozen pancakes/waffles, instant rice),<sup>12,43,46</sup>
- snacks (e.g., frozen snacks),<sup>40,43,46</sup>
- and ending with dairy (e.g., frozen whipped topping, cheese dip).<sup>46</sup>

**Figure 5-f** shows the breakdown of RTH food groups. Compared to the more convenient RTE food group breakdown, the share for multi-component foods/meals increased substantially and the shares for grains, snacks, sweets, and dairy decreased substantially.

**Figure 5-f. Ready-to-Heat Food Groups**



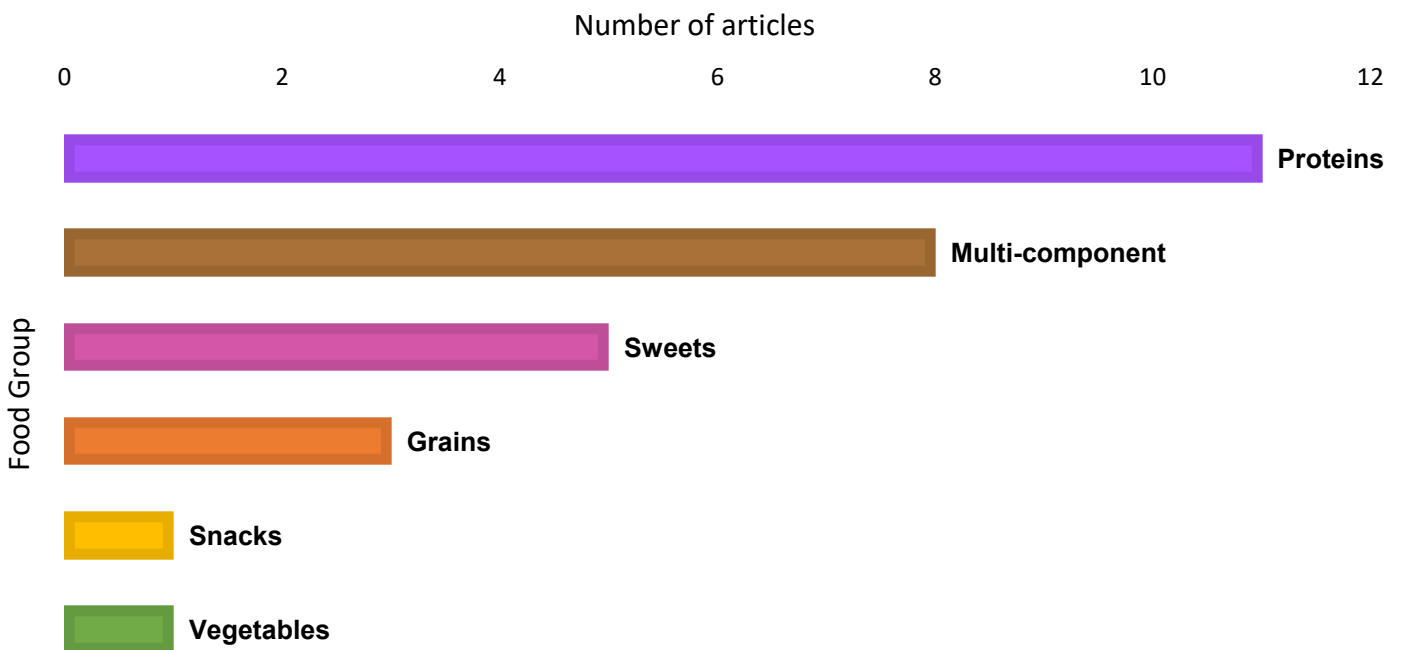
*Ready-to-cook and ready-to-bake food groups*

For the RTC/RTB foods, the most common category became:

- proteins (e.g., processed meat),<sup>2,4,26,32,33,39-41,51,76,87</sup>
- multi-component foods/meals (e.g., instant mashed potatoes),<sup>36,43,44,46,60,63,64,74</sup>
- grains (e.g., microwave popcorn),<sup>43,44,46</sup>
- snacks,<sup>63</sup>
- sweets (e.g., cookie dough, RTB desserts),<sup>33,39,43,46,63</sup>
- and vegetables (e.g., pre-cut fresh vegetables).<sup>26</sup>

**Figure 5-g** shows the breakdown of RTC/RTB food groups. The share for proteins increased for this category, mainly because bacon was included in the processed meat category of many articles. The shares for vegetables and snacks decreased, and the dairy, fruit, and other categories were not represented in the RTC/RTB level of convenience.

**Figure 5-g. Ready-to-Cook/Ready-to-Bake Food Groups**



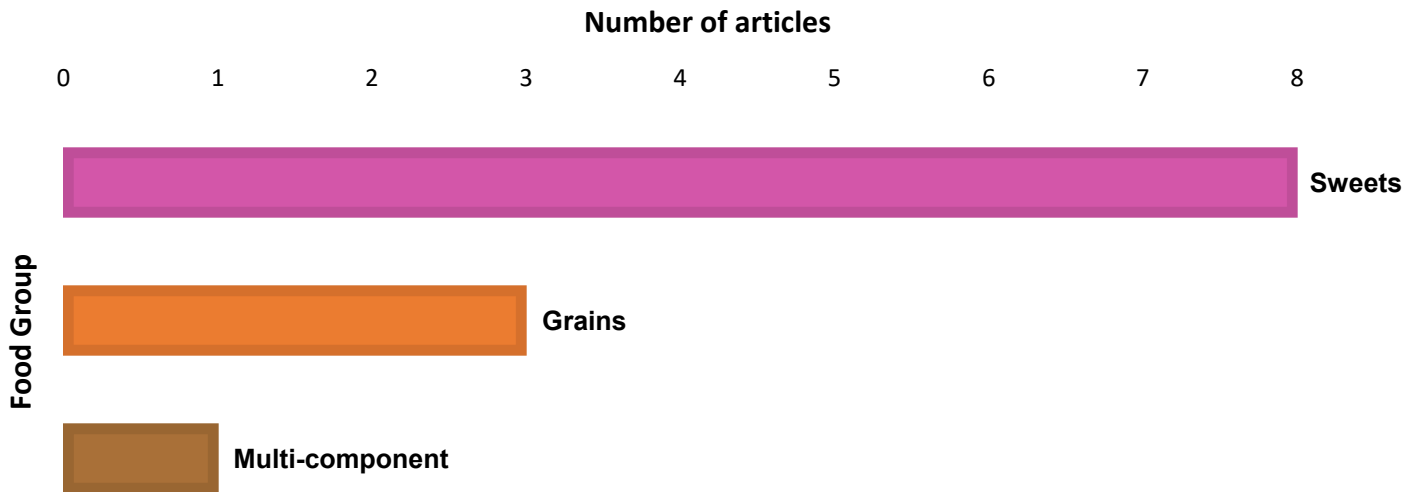
*Ready-to-prepare food groups*

There were only 3 groups represented in the RTP category. From most to least common:

- sweets (e.g., baking mixes),<sup>2,4,26,33,39,40,44,60</sup>
- grains (e.g., pancake mix),<sup>12,40,43</sup>
- and multi-component foods/meals (e.g., boxed mac and cheese).<sup>20</sup>

**Figure 5-h** shows the breakdown of RTP food groups. The share for sweets dominated this category, the share for multi-component foods/meals decreased substantially, and RTP vegetables, snacks, and proteins were not found in the literature.

**Figure 5-h. Ready-to-Prepare Food Groups**



### Research recommendations

1. Establish and use standard definitions for at-home convenience foods, RTE, RTH, RTP, RTC, and RTB to improve their identification, as well as the ability to compare results between studies.
2. Provide sufficient detail about specific foods included in a food category to help determine whether the outcome fits the eligibility criteria of at-home convenience foods.

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## Appendices

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### Appendix 0-a: Abbreviations

Abbreviation	Full name
ATUS	American Time Use Survey
BMI	Body Mass Index
CACFP	Child and Adult Care Food Program
CNPP	Center for Nutrition Policy and Promotion
CSFII	Continuing Survey of Food Intakes by Individuals II
DGA	Dietary Guidelines for Americans
FNS	Food and Nutrition Service
FSP	Food Stamp Program
HANDLS	Healthy Aging in Neighborhoods of Diversity across the Life Span Study
HEI	Healthy Eating Index
NEAT	Nutrition and Economic Analysis Team
NEMS-S	Nutrition Environment Measures Survey in stores
NESR	Nutrition Evidence Systematic Review team
NGAD	Nutrition Guidance and Analysis Division
NHANES	National Health and Nutrition Examination Survey
NSLP	National School Lunch Program
PCS	Prospective Cohort Study
PICO	Population, Intervention, Comparator, Outcome
PIR	Poverty Index Ratio
RCT	Randomized Controlled Trial
ROB	Risk of bias
RTB	Ready-to-bake
RTC	Ready-to-cook

<b>Abbreviation</b>	<b>Full name</b>
RTE	Ready-to-eat
RTH	Read-to-heat
RTP	Ready-to-prepare
SBP	School Breakfast Program
SE	Standard Error
SES	Socioeconomic status
SNAP	Supplemental Nutrition Assistance Program
SOS III	Seattle Obesity Study III
SSI	Supplemental Security Income
TFP	Thrifty Food Plan
U.S.	United States
USDA	United States Department of Agriculture
WIC	Women, Infants, and Children

## Appendix 0-b: Risk of Bias for Nutrition Observational Studies (ROB-NObS) Tool\*

<b>Bias due to confounding</b>	
<p>1.1 Is there potential for confounding of the effect of exposure in this study?</p> <p><i>If N or PN: skip all remaining questions (1.2 to 1.8) and go to Bias due to confounding: Risk of bias judgement; the study can be considered to be at low risk of bias due to confounding and no further signalling questions need be considered.</i></p> <p><i>If Y or PY, answer question 1.2 to determine whether there is a need to assess time-varying confounding.</i></p>	
<p>1.2. <u>If Y or PY to 1.1</u>: Was the analysis based on splitting follow-up time according to exposure received?</p> <p><i>If N or PN, skip 1.3 and answer questions 1.4 to 1.6, which relate to baseline confounding.</i></p> <p><i>If Y or PY, go to question 1.3.</i></p>	
<p>1.3. <u>If Y or PY to 1.2</u>: Were exposure discontinuations or switches likely to be related to factors that are prognostic for the outcome?</p> <p><i>If N or PN, answer questions 1.4 to 1.6, which relate to baseline confounding only. Do not answer 1.7 and 1.8, which relate to both baseline and time-varying confounding.</i></p> <p><i>If Y or PY, skip questions 1.4 to 1.6, and answer questions 1.7 and 1.8, which relate to both baseline confounding and time-varying confounding.</i></p>	
<p>1.4. <u>If N or PN to 1.2 or 1.3</u>: Did the authors use an appropriate analysis method that adjusted for all the critically important confounding variables at baseline?</p> <p><i>Go to 1.5</i></p>	
<p>1.5. Were confounders that were adjusted for measured validly and reliably by the variables available in this study?</p> <p><i>Go to 1.6</i></p>	
<p>1.6. Did the authors avoid adjusting for post-exposure variables?</p> <p><i>(Skip to Bias due to confounding: Risk of bias judgement)</i></p>	
<i>Questions related to baseline and time-varying confounding</i>	
<p>1.7. <u>If Y or PY to 1.3</u>: Did the authors use an appropriate analysis method that adjusted for all the critically important confounding variables, including baseline and time-varying confounding?</p> <p><i>If N or PN to 1.7, skip to Bias due to confounding: Risk of bias judgement.</i></p> <p><i>If Y or PY to 1.7, answer question 1.8.</i></p>	
<p>1.8. <u>If Y or PY to 1.3 and Y or PY to 1.7</u>: Were confounders that were adjusted for measured validly and reliably by the variables available in this study?</p>	
<b>Bias due to confounding: Risk of bias judgement</b>	

Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)	No confounding expected.
Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) Confounding expected, all known important confounding domains appropriately measured and controlled for; <i>and</i> (ii) Reliability and validity of measurement of important domains were sufficient, such that we do not expect serious residual confounding.
Serious risk of bias (the study has some important problems)	(i) At least one key confounder was not appropriately measured, or not controlled for; <i>or</i> (ii) Reliability or validity of measurement of a key confounder was low enough that we expect serious residual confounding.
Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)	(i) Confounding is inherently not controllable; <i>or</i> (ii) The use of negative controls strongly suggests unmeasured confounding.
No information on which to base a judgement about risk of bias for this domain	No information on whether confounding might be present.

### Bias in selection of participants into the study

2.1. Was selection of participants into the study *or* into the analysis based on participant characteristics observed after the start of exposure?

*If N or PN, go to 2.4 (skip 2.2 and 2.3).*

*If Y or PY, go to 2.2 and 2.3.*

2.2. *If Y or PY to 2.1:* Were the post-exposure variables that influenced selection of participants (into the study or analysis) associated with exposure?

*Go to 2.3*

2.3. *If Y or PY to 2.1:* Were the post-exposure variables that influenced selection of participants (into the study or analysis) associated with the outcome?

*Go to 2.4*

2.4. Do start of follow-up and start of exposure coincide for most participants?

*If N or PN to 2.4, answer 2.5.*

*If Y or PY to 2.4, go to Bias in selection of participants into the study: Risk of bias judgement.*

2.5 *If Y or PY to 2.2 and 2.3, or N or PN to 2.4:* Were adjustment techniques that were likely to correct for the presence of selection biases used?

*Go to Bias in selection of participants into the study: Risk of bias judgement.*

### Bias in selection of participants into the study: Risk of bias judgement

<p>Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)</p>	<p>(i) All participants who would have been eligible for the target trial were included in the study; <i>and</i> (ii) For each participant, start of follow up and start of exposure coincided.</p>
<p>Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)</p>	<p>(i) Selection into the study may have been related to exposure and outcome; <i>and</i> The authors used appropriate methods to adjust for the selection bias; <i>or</i> (ii) Start of follow up and start of exposure do not coincide for all participants; <i>and</i> (a) the proportion of participants for which this was the case was too low to induce important bias; <i>or</i> (b) the authors used appropriate methods to adjust for the selection bias; <i>or</i> (c) the review authors are confident that the rate (hazard) ratio for the effect of exposure remains constant over time.</p>
<p>Serious risk of bias (the study has some important problems)</p>	<p>(i) Selection into the study was related (but not very strongly) to exposure and outcome; <i>and</i> This could not be adjusted for in analyses; <i>or</i> (ii) Start of follow up and start of exposure do not coincide; <i>and</i> A potentially important amount of follow-up time is missing from analyses; <i>and</i> The rate ratio is not constant over time.</p>
<p>Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)</p>	<p>(i) Selection into the study was very strongly related to exposure and outcome; <i>and</i> This could not be adjusted for in analyses; <i>Or</i> (ii) A substantial amount of follow-up time is likely to be missing from analyses; <i>and</i> The rate ratio is not constant over time.</p>
<p>No information on which to base a judgement about risk of bias for this domain</p>	<p>No information is reported about selection of participants into the study or whether start of follow up and start of exposure coincide.</p>

**Bias in classification of exposures**

3.1. Is the exposure that was assessed clearly defined?

3.2. Does the exposure that was assessed represent the exposure of interest?

3.3. Were the methods used to assess the exposure clearly described?

3.4. Were the methods used to measure the exposure valid and/or reliable?	
3.5. Were the same methods used to assess the exposure status for all participants/groups?	
3.6. Were the methods used to define exposure status for participants/groups clearly described?	
3.7. Were the methods used to define exposure status for participants/groups likely to result in minimal random or systematic exposure misclassification?	
3.8. Could classification of exposure status been affected by the presence of the outcome, knowledge of the outcome or risk of the outcome?	
<i>If Y or PY, there may be serious risk of bias.</i>	
<i>Go to Bias in classification of exposures: Risk of bias judgement.</i>	
<b>Bias in classification of exposures: Risk of bias judgement</b>	
Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)	(i) The exposure and the methods used to assess the exposure were well defined and represent the exposure of interest; <i>and</i> (ii) Methods were valid, reliable, the same across groups, and likely to result in <u>minimal</u> random or systematic exposure misclassification. <i>and</i> (iii) Exposure status was not affected by the presence of the outcome, knowledge of the outcome or risk of the outcome
Moderate risk of bias (the study is sound for a, observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) The exposure and the methods used to assess the exposure are defined and represent the exposure of interest; <i>and</i> (ii) Methods were valid, reliable, the same across groups, and likely to result in <u>minimal</u> random or systematic exposure misclassification. <i>or</i> Exposure status was not affected by the presence of the outcome, knowledge of the outcome or risk of the outcome
Serious risk of bias (the study has some important problems)	(i) Exposure status or the methods used to assess the exposure are <u>not</u> well defined or do not represent the exposure of interest; <i>and</i> (ii) Methods were not valid and reliable, the same across groups, or were likely to result in <u>some</u> degree of random or systematic exposure misclassification. <i>or</i> Exposure status was affected by the presence of the outcome, knowledge of the outcome or risk of the outcome
Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)	(i) Exposure status and the methods used to assess the exposure are <u>not</u> well defined or do not represent the exposure of interest; <i>and</i> (ii) Methods were not valid and reliable, were not the same across groups, and were likely to result in <u>substantial</u> random or systematic exposure misclassification. <i>and</i> (iii) Exposure status was affected by the presence of the outcome, knowledge of the outcome or risk of the outcome
No information on which to base a judgement about risk of bias for this domain	No definition of exposure or no explanation of the source of information about exposure status is reported.

**Bias due to departures from intended exposures**

4.1. Is there concern that changes in exposure status occurred among participants that were unbalanced across groups and likely to impact the outcome?	
4.2. Were any critical co-exposures that occurred unbalanced between exposure groups and likely to impact the outcome?	
4.3. <i>If Y or PY to 4.1, or 4.2:</i> Were adjustment techniques that are likely to correct for these issues (i.e., changes in exposure status and/or unbalanced co-exposures) used?	
<i>Go to Bias due to departures from intended exposures: Risk of bias judgement.</i>	
<b>Bias due to departures from intended exposures: Risk of bias judgement</b>	
Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)	There were no changes in the exposure status that were likely to impact the outcome, and any important co-exposures were balanced across intervention groups.
Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) There were changes in exposures status <i>or</i> important co-exposures were not balanced across groups <i>and</i> (ii) the impact on the outcome is expected to be slight <i>or</i> measurement and/or adjustment techniques were used to correct for the issues
Serious risk of bias (the study has some important problems)	(i) There were changes in exposure status <i>or</i> important co-exposures were not balanced across groups that were likely to impact the outcome, <i>and</i> (ii) no or inappropriate measurement and/or adjustment techniques were used to correct for the issues
Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)	(i) There were substantial changes in exposures status, or important co-exposures were not balanced across groups, that were likely to impact the outcome, <i>and</i> (ii) no or inappropriate measurement and/or adjustment techniques were used to correct for the issues.
No information on which to base a judgement about risk of bias for this domain	No information is reported on whether there is deviation from the intended exposure.

<b>Bias due to missing data</b>	
5.1. Were there missing outcome data?	
5.2. Were participants excluded due to missing data on exposure status?	
5.3. Were participants excluded due to missing data on other variables (besides outcome data and exposure status) needed for the analysis?	
5.4. <i>If Y or PY to 5.1, 5.2 or 5.3:</i> Are the proportion of participants and reasons for missing data similar across exposure groups?	
5.5. <i>If Y or PY to 5.1, 5.2 or 5.3:</i> Were appropriate statistical methods used to account for missing data?	
<i>Go to Bias due to missing data: Risk of bias judgement</i>	
<b>Bias due to missing data: Risk of bias judgement</b>	
Low risk of bias (the study is comparable to a well-performed	(i) Data were reasonably complete; <i>or</i>



randomized trial with regard to this domain)	(ii) Proportions of and reasons for missing participants were similar across exposure groups; <i>or</i> (iii) The analysis addressed missing data and is likely to have removed any risk of bias.
Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) Proportions of and reasons for missing participants differ slightly across exposure groups; <i>and</i> (ii) The analysis is unlikely to have removed the risk of bias arising from the missing data.
Serious risk of bias (the study has some important problems)	(i) Proportions of missing participants differ substantially across exposures; <i>or</i> Reasons for missingness differ substantially across exposures; <i>and</i> (ii) The analysis is unlikely to have removed the risk of bias arising from the missing data; <i>or</i> Missing data were addressed inappropriately in the analysis; <i>or</i> The nature of the missing data means that the risk of bias cannot be removed through appropriate analysis.
Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)	(i) (Unusual) There were critical differences between exposures in participants with missing data; <i>and</i> (ii) Missing data were not, or could not, be addressed through appropriate analysis.
No information on which to base a judgement about risk of bias for this domain	No information is reported about missing data or the potential for data to be missing.

### Bias in measurement of outcomes

6.1. Could the outcome measure have been influenced by knowledge of the exposure received?

6.2. Were outcome assessors aware of the exposure received by study participants?

6.3. Were the methods of outcome assessment the same across exposure groups?

6.4. Were any systematic errors during measurement of the outcome related to exposure received?

*Go to Bias in measurement of outcomes: Risk of bias judgement*

### Bias in measurement of outcomes: Risk of bias judgement

Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)

(i) The methods of outcome assessment were comparable across exposure groups;  
*and*  
(ii) The outcome measure was unlikely to be influenced by knowledge of the exposure received by study participants (i.e. is objective) or the outcome assessors were unaware of the exposure received by study participants;

	<i>and</i> (iii) Any error in measuring the outcome is unrelated to exposure status.
Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) The methods of outcome assessment were comparable across exposure groups; <i>and</i> (ii) The outcome measure is only minimally influenced by knowledge of the exposure received by study participants; <i>and</i> (iii) Any error in measuring the outcome is only minimally related to exposure status.
Serious risk of bias (the study has some important problems)	(i) The methods of outcome assessment were not comparable across exposure groups; <i>or</i> (ii) The outcome measure was subjective (i.e. vulnerable to influence by knowledge of the exposure received by study participants); <i>and</i> The outcome was assessed by assessors aware of the exposure received by study participants; <i>or</i> (iii) Error in measuring the outcome was related to exposure status.
Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)	The methods of outcome assessment were so different that they cannot reasonably be compared across intervention groups.
No information on which to base a judgement about risk of bias for this domain	No information is reported about the methods of outcome assessment.

<b>Bias in selection of reported result</b>	
7.1. Is the reported effect estimate likely to be selected on the basis of the results from multiple <i>outcome measurements</i> within the outcome domain?	
7.2. Is the reported effect estimate likely to be selected on the basis of the results from multiple <i>analyses</i> of the exposure-outcome relationship?	
7.3. Is the reported effect estimate likely to be selected on the basis of the results from different <i>subgroups</i> ?	
<i>Go to Bias in selection of reported result: Risk of bias judgement</i>	
<b>Bias in selection of reported result: Risk of bias judgement</b>	
Low risk of bias (the study is comparable to a well-performed randomized trial with regard to this domain)	There is clear evidence (usually through examination of a pre-registered protocol or statistical analysis plan) that all reported results correspond to all intended outcomes, analyses and sub-cohorts.
Moderate risk of bias (the study is sound for an observational study with regard to this domain but cannot be considered comparable to a well-performed randomized trial)	(i) The outcome measurements and analyses are consistent with an <i>a priori</i> plan; or are clearly defined and both internally and externally consistent; <i>and</i> (ii) There is no indication of selection of the reported analysis from among multiple analyses; <i>and</i> (iii) There is no indication of selection of the cohort or subgroups for analysis and reporting on the basis of the results.

<p>Serious risk of bias (the study has some important problems)</p>	<p>(i) Outcomes are defined in different ways in the methods and results sections, or in different publications of the study; <i>or</i> (ii) There is a high risk of selective reporting from among multiple analyses; <i>or</i> (iii) The cohort or subgroup is selected from a larger study for analysis and appears to be reported on the basis of the results.</p>
<p>Critical risk of bias (the study is too problematic to provide any useful evidence on the effects of intervention)</p>	<p>(i) There is evidence or strong suspicion of selective reporting of results; <i>and</i> (ii) The unreported results are likely to be substantially different from the reported results.</p>
<p>No information on which to base a judgement about risk of bias for this domain.</p>	<p>There is too little information to make a judgement (for example if only an abstract is available for the study).</p>

\*NESR created the RoB-NObs by making modifications to the ROBINS-I and a preliminary instrument designed to assess risk of bias in non-randomized studies of exposures.\*<sup>†</sup> These modifications were made to ensure that the tool was applicable to observational studies of food, nutrition, and public health.<sup>‡§</sup>

\* Morgan, R.L., Thayer, K.A., Santesso, N., Holloway, A.C., Blain, R., Eftim, S.E., Goldstone, A.E., Ross, P., Guyatt, G., Schunemann, H.J., 2018a. Evaluation of the risk of bias in non-randomized studies of interventions (ROBINS-I) and the 'target experiment' concept in studies of exposures: rationale and preliminary instrument development. *Environ. Int.* 120, 382–387.

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‡ Hörnell A, Berg C, Forsum E, Larsson C, Sonestedt E, Åkesson A, Lachat C, Hawwash D, Kolsteren P, Byrnes G, De Keyzer W, Van Camp J, Cade JE, Greenwood DC, Slimani N, Cevallos M, Egger M, Huybrechts I, Wirfält E. Perspective: An Extension of the STROBE Statement for Observational Studies in Nutritional Epidemiology (STROBE-nut): Explanation and Elaboration. *Adv Nutr.* 2017;8(5):652-678. PMID: [28916567](https://pubmed.ncbi.nlm.nih.gov/28916567/)

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## Appendix 1-a: Literature search strategy for the rapid review on income and food prices

Database: PubMed  
Vendor: National Library of Medicine  
Date of Search: February 8, 2021  
Limits Used: Filters: Language English; Publication Dates 1995 - 2021  
Total = 4,265

Search #	Concept	Search String	N
#1	Food/Beverages	"Food and Beverages"[Mesh] OR food*[tiab] OR vegetable*[tiab] OR fruit*[tiab] OR meat*[tiab] OR seafood*[tiab] OR poultry[tiab] OR beans[tiab] OR rice[tiab] OR legumes[tiab] OR cereal*[tiab] OR grain*[tiab] OR dairy[tiab] OR eggs[tiab] OR beverage*[tiab] OR milk[tiab] OR "Diet, Healthy"[Mesh] OR "healthy diet"[tiab] OR "unhealthy diet"[tiab]	1,376,771
#2	Price/Cost	"Costs and Cost Analysis"[Mesh] OR cost*[tiab] OR price*[tiab] OR affordab*[tiab] OR expense*[tiab] OR expenditure*[tiab] OR budget*[tiab] OR purchas*[tiab] OR cash[tiab] OR money[tiab] OR monetary[tiab] OR monies[tiab]	918,203
	Income/social economic factors	"Socioeconomic Factors"[Mesh] OR socioeconomic*[tiab] OR socio-economic*[tiab] OR "social factor"[tiab] OR "social condition"[tiab] OR poverty[tiab] OR "Residence Characteristics"[Mesh] OR "Vulnerable Populations"[Mesh] OR "vulnerable population"[tiab] OR "underserved population"[tiab] OR "disadvantaged population"[tiab] OR "Income"[Mesh] OR income*[tiab] OR "Race Factors"[Mesh] OR "race factor"[tiab] OR "Ethnic Groups"[Mesh] OR "ethnic group"[tiab] OR "ethnic population"[tiab] OR "Cross-Cultural Comparison"[Mesh] OR "cross-cultural"[tiab] OR transcultural[tiab] OR "Cultural Characteristics"[Mesh] OR "cultural characteristic"[tiab] OR "Cultural Diversity"[Mesh] OR "culturally diverse"[tiab] OR "Food Supply"[Mesh] OR "food desert"[tiab] OR "food insecurity"[tiab] OR "food environment"[tiab] OR "food access"[tiab] OR "corner store"[tiab] OR bodega*[tiab] OR "food cooperative"[tiab] OR "food store"[tiab] OR "food market"[tiab] OR grocer*[tiab] OR supermarket*[tiab] OR "convenient store"[tiab] OR "food outlet"[tiab] OR "farmers market"[tiab]	873,818
#3		#1 AND #2 AND #3	11,345
#4	Non-United States	#1 AND #2 AND #3 NOT ("Developing Countries"[Mesh] OR "developing countr*" OR "Under Developed Nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC[tiab] OR "Europe"[Mesh] OR "Australia"[Mesh] OR "Asia"[Mesh] OR "Africa"[Mesh])	5,916

		OR "Mexico"[Mesh] OR "Islands"[Mesh] OR "Central America"[Mesh] OR "Latin America"[Mesh] OR "South America"[Mesh])	
#4	Publication Excludes	NOT (letter[ptyp] OR editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR editorial[tiab] OR commentary[tiab] OR "conference abstract"[tiab] OR "systematic review"[ti] OR "meta-analysis"[ptyp] OR "meta-analysis"[ti] OR "meta-analyses"[ti] OR "Review"[Publication Type] OR "Systematic Review"[Publication Type] OR "conference proceeding"[tiab] OR "retracted publication"[ptyp] OR "retraction of publication"[ptyp] OR "retraction of publication"[tiab] OR "retraction notice"[ti] OR "retracted publication"[tiab] OR "Published Erratum"[Publication Type] OR corrigenda[tiab] OR corrigendum[tiab] OR errata[tiab] OR erratum[tiab] OR protocol[ti] OR protocols[ti] OR "case report"[ti] OR "case series"[ti] OR "Case Reports" [Publication Type])	4,766
#5	Animal Excludes	NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))	4,570
#6	Limits: Language/Dates	Filters: English, from 1995 - 2021	4,265

**Database: Cochrane Central Register of Controlled Trials (CENTRAL)**

**Vendor: John Wiley & Sons, Inc.**

**Date of Search: February 9, 2021**

**Limits Used: Filters: Trials; Publication Dates 1995 - 2021**

**Total = 847**

Search #	Concept	Search String	N
#1	Food/Beverages	[mh "Food and Beverages"] OR food* OR vegetable* OR fruit* OR meat* OR seafood* OR poultry OR beans OR rice OR legumes OR cereal* OR grain* OR dairy OR eggs OR beverage* OR milk OR [mh "Diet, Healthy"] OR "healthy diet*" OR "unhealthy diet"	96,092
#2	Price/Cost	[mh "Costs and Cost Analysis"] OR cost* OR price* OR affordab* OR expense* OR expenditure* OR budget* OR purchas* OR cash OR money OR monetary OR monies	99,584
#3	Income/social economic factors	[mh "Socioeconomic Factors"] OR socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR poverty OR [mh "Residence Characteristics"] OR [mh "Vulnerable Populations"] OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR [mh "Income"] OR income* OR [mh "Race Factors"] OR "race factor*" OR [mh "Ethnic Groups"] OR "ethnic group*" OR "ethnic population*" OR [mh "Cross-Cultural Comparison"] OR "cross-cultural" OR transcultural OR [mh "Cultural Characteristics"] OR	32,995

		"cultural characteristic*" OR [mh "Cultural Diversity"] OR "culturally diverse" OR [mh "Food Supply"] OR "food desert*" OR "food insecurity*" OR "food environment*" OR "food access" OR "corner store*" OR bodega* OR "food cooperative*" OR "food store*" OR "food market*" OR grocer* OR supermarket* OR "convenient store*" OR "food outlet*" OR "farmers market*"	
#4		#1 AND #2 AND #3	1,879
#5	Non-United States	[mh "Developing Countries"] OR "developing countr*" OR "under developed nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC OR [mh "Europe"] OR [mh "Australia"] OR [mh "Asia"] OR [mh "Africa"] OR [mh "Mexico"] OR [mh "Islands"] OR [mh "Central America"] OR [mh "Latin America"] OR [mh "South America"]	5,916
#6		#4 NOT #5" with Publication Year from 1995 to 2021, in Trials (Word variations have been searched)	847

Database: Business Source Premier

Vendor: EBSCO

Date of Search: February 9, 2021

Limits Used: Filters: Language English, Peer Reviewed, Academic Journal; Publication, Geographic United States, Dates 1995 - 2021

Total = 471

Search #	Concept	Search String	N
#S1	Food/Beverages	(DE "BEVERAGE consumption") OR (DE "FOOD consumption forecasting") OR (DE "FOOD consumption statistics") OR food* OR vegetable* OR fruit* OR meat* OR seafood* OR poultry OR beans OR rice OR legumes OR cereal* OR grain* OR dairy OR eggs OR beverage* OR milk OR "healthy diet*" OR "unhealthy diet*" <p>Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 19950101-20211231; Publication Type: Academic Journal; Document Type: Article</p>	115,0411
#S2	Price/Cost	(DE "FOOD prices") OR cost* OR price* OR affordab* OR expense* OR expenditure* OR budget* OR purchas* OR cash OR money OR monetary OR monies <p>Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 19950101-20211231; Publication Type: Academic Journal; Document Type: Article</p>	526,897
#S3	Income/social economic factors	(DE "SOCIOECONOMIC factors") OR socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR (DE "POVERTY") OR poverty OR "vulnerable population*" OR	200,523

		"underserved population*" OR "disadvantaged population*" OR (DE "INCOME") OR income* OR "race factor*" OR (DE "ECONOMIC conditions of ethnic groups") OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR (DE "FOOD supply") OR "food desert*" OR "food insecurity*" OR "food environment*" OR "food access" OR "corner store*" OR bodega* OR "food cooperative*" OR "food store*" OR "food market*" OR grocer* OR supermarket* OR "convenient store*" OR "food outlet*" OR "farmers market"	
		Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 19950101-20211231; Publication Type: Academic Journal; Document Type: Article	
#S3		S1 AND S2 AND S3	6,977
#S4	Non-United States	S1 AND S2 AND S3  Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 19950101-20211231; Publication Type: Academic Journal; Document Type: Article <b>Geographic:</b> - united states	471

Database: Web of Science: Core Collection

Vendor: Clarivate Analytics

Date of Search: February 9, 2021

Limits Used: Filters: Language English; Publication Dates 1995 - 2021

Total = 4,040

Search #	Concept	Search String	N
#1	Food & Beverages	(TS=(food* OR vegetable* OR fruit* OR meat* OR seafood* OR poultry OR beans OR rice OR legumes OR cereal* OR grain* OR dairy OR eggs OR beverage* OR milk OR "healthy diet*" OR "unhealthy diet*" ) )	2,246,131
#2	Price/Cost	(TS=(cost* OR price* OR affordab* OR expense* OR expenditure* OR budget* OR purchas* OR cash OR money OR monetary OR monies ) )	1,902,030
#3	Income/social economic factors	(TS=(socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR poverty OR "residence characteristics" OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR income* OR "race factor*" OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR "food desert*" OR "food insecurity*" OR "food environment*" OR "food access" OR "corner store*" OR bodega* OR "food cooperative*" OR "food store*" OR "food market*" OR grocer* OR supermarket* OR "convenient store*" OR "food outlet*" OR "farmers market*" )	562,183
#4		#1 AND #2 AND #3	17,069
#5	Non-United States	CU=("developing countr*" OR "under developed nation*" OR "low income countr*" OR "middle income	2,281,865



		countr*" OR "low-middle income countr*" OR LMIC OR Europe OR Australia OR Asia OR Africa OR Mexico OR Isl ands OR "Central America" OR "Latin America" OR "South Am erica")	
#6		#4 NOT #5	15,059
#7	Publication Excludes	TS=(editorial OR commentary OR "conference abstract*" OR "c onference proceeding*" [tiab] OR "retraction of publication" OR " retracted publication" OR corrigenda [tiab] OR corrigendum [tiab] OR errata OR erratum OR "case reports" ) OR TI=("systematic review*" OR "meta-analysis"  OR "meta analyses" OR protocol OR protocols OR "retraction notice" OR "case report" OR "case series")	731,825
#8	Language/Dates	#6 NOT #7 AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Refined by: COUNTRIES/REGIONS: (USA)  Indexes=SCI-EXPANDED, SSCI Timespan=1995-2021	4040

### **Grey literature Search**

#### **Database: Google Scholar**

(Food AND beverages OR "food basket" OR groceries) (Price OR cost OR expenditure OR budget OR money OR "exact price index")  
AND (Income OR Poverty OR socioeconomic OR neighborhood OR city OR county)

Limits:

Date Searched: 4/26/2021

Results: 130, limited to 13 pages

#### **Database: Google**

site:.gov pdf AND (Food AND beverages OR "food basket" OR groceries) (Price OR cost OR expenditure OR budget OR money OR  
"exact price index") AND (Income OR Poverty OR socioeconomic OR neighborhood OR city OR county)

Limits:

Date Searched: 4/26/2021

Results: 30, limited to 3 pages

#### **Database: AgEcon**

##### **Search A**

Any of the words: food beverage basket grocer\*

AND

Any of the words: cost price

AND

Any of the words: income

Limits:

Date Searched: 4/27/2021

Results: 100, limited to 10 pages

##### **Search B**

Any of the words: food beverage basket grocer\*

AND



Any of the words: cost price  
AND  
Any of the words: neighborhood  
Limits:  
Date Searched: 4/27/2021  
Results: 40, limited to 4 pages

**Search C**

Any of the words: food beverage basket grocer\*  
AND  
Any of the words: cost price  
AND  
Any of the words: poverty  
Limits:  
Date Searched: 4/27/2021  
Results: 110, limited to 11 pages

**Search D**

Any of the words: food beverage basket grocer\*  
AND  
Any of the words: cost price  
AND  
Any of the words: socioeconomic  
Limits:  
Date Searched: 4/27/2021  
Results: 60, limited to 6 pages

## Appendix 1-b: Excluded articles for the rapid review on income and food prices

The following table lists the articles excluded after full-text screening for this rapid review question. At least 1 reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

	Citation	Reason for exclusion
1.	CONSUMER EXPENDITURES -2019. 2020.	Outcome
2.	Vermont Basic Needs Budgets and Livable Wage. 2021.	Study Design
3.	LONG-TERM BENEFITS OF THE SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM. 2015.	Outcome
4.	Milwaukee Fresh Food Access Report. 2019. 86.	Outcome
5.	USDA Food Plans: Cost of Food Reports (monthly reports)   USDA-FNS. 2021.	Intervention/Exposure
6.	NC DHHS: Food and Nutrition Services Food Stamps. 2021.	Study Design
7.	Ollinger, M, Guthrie,. Volume of Purchases and Regional Location Have Strong Effects on Food Costs for School Meals. 2019. April 2019. doi:10.22004/ag.econ.302701.	Intervention/Exposure
8.	Aaron, GJ, Keim, NL, Drewnowski, A, Townsend, MS. Estimating dietary costs of low-income women in California: a comparison of 2 approaches. Am J Clin Nutr. 2013. 97:835-41. doi:10.3945/ajcn.112.044453.	Intervention/Exposure
9.	Aggarwal, A, Cook, AJ, Jiao, J, Seguin, RA, Vernez Moudon, A, Hurvitz, PM, Drewnowski, A. Access to supermarkets and fruit and vegetable consumption. Am J Public Health. 2014. 104:917-23. doi:10.2105/ajph.2013.301763.	Outcome
10.	Aggarwal, A, Monsivais, P, Cook, AJ, Drewnowski, A. Does diet cost mediate the relation between socioeconomic position and diet quality? Eur J Clin Nutr. 2011. 65:1059-66. doi:10.1038/ejcn.2011.72.	Outcome
11.	Aggarwal, A, Monsivais, P, Cook, AJ, Drewnowski, A. Positive attitude toward healthy eating predicts higher diet quality at all cost levels of supermarkets. J Acad Nutr Diet. 2014. 114:266-72. doi:10.1016/j.jand.2013.06.006.	Outcome
12.	Aggarwal, A, Monsivais, P, Drewnowski, A. Nutrient intakes linked to better health outcomes are associated with higher diet costs in the US. PLoS One. 2012. 7:e37533. doi:10.1371/journal.pone.0037533.	Outcome
13.	Aggarwal, A, Rehm, CD, Monsivais, P, Drewnowski, A. Importance of taste, nutrition, cost and convenience in relation to diet quality: Evidence of nutrition resilience among US adults using National Health and Nutrition Examination Survey (NHANES) 2007-2010. Prev Med. 2016. 90:184-92. doi:10.1016/j.ypmed.2016.06.030.	Intervention/Exposure
14.	Alemu, R, Block, SA, Headey, D, Bai, Y, Masters, WA. Why are nutritious foods so expensive? Economic development and the cost of nutritious diets. 2018. 32. doi:10.22004/ag.econ.281163.	Country



15.	Allcott, H, Diamond, R, Dubé, J-P, Handbury, J, Rahko vs.ky, I, Schnell, M. Food Deserts and the Causes of Nutritional Inequality. <i>Quarterly Journal of Economics</i> . 2019. 134:1793-1844. doi:10.1093/qje/qjz015.	Intervention/Exposure
16.	Alston, JM, Pardey, PG. Agricultural R&D, Food Prices, Poverty and Malnutrition Redux. 2014. 45. doi:10.22004/ag.econ.162413.	Study Design
17.	Anderson, K, Cockburn, J, Martin, W. Agricultural price distortions, inequality, and poverty. 2010.	Outcome
18.	Andrews, M, Kantar, LS, Lino, M, Ripplinger, D. Using the USDA's Thrifty Food Plan to assess food availability and affordability. 24. 2001. 45-53.	Comparator
19.	Andreyeva, T, Luedicke, J, Middleton, AE, Long, MW, Schwartz, MB. Positive influence of the revised Special Supplemental Nutrition Program for Women, Infants, and Children food packages on access to healthy foods. <i>J Acad Nutr Diet</i> . 2012. 112:850-8. doi:10.1016/j.jand.2012.02.019.	Intervention/Exposure
20.	Anekwe, TD, Rahko vs.ky, I. The association between food prices and the blood glucose level of US adults with type 2 diabetes. <i>Am J Public Health</i> . 2014. 104:678-85. doi:10.2105/ajph.2013.301661.	Intervention/Exposure
21.	Appelhans, BM, Milliron, BJ, Woolf, K, Johnson, TJ, Pagoto, SL, Schneider, KL, Whited, MC, Ventrelle, JC. Socioeconomic status, energy cost, and nutrient content of supermarket food purchases. <i>Am J Prev Med</i> . 2012. 42:398-402. doi:10.1016/j.amepre.2011.12.007.	Outcome
22.	Ard, JD, Fitzpatrick, S, Desmond, RA, Sutton, BS, Pisu, M, Allison, DB, Franklin, F, Baskin, ML. The impact of cost on the availability of fruits and vegetables in the homes of schoolchildren in Birmingham, Alabama. <i>Am J Public Health</i> . 2007. 97:367-72. doi:10.2105/ajph.2005.080655.	Intervention/Exposure
23.	Askelson, NM, Meier, C, Baquero, B, Friberg, J, Montgomery, D, Hradek, C. Understanding the Process of Prioritizing Fruit and Vegetable Purchases in Families With Low Incomes: "A Peach May Not Fill You Up as Much as Hamburger". <i>Health Educ Behav</i> . 2018. 45:817-823. doi:10.1177/1090198117752790.	Outcome
24.	Basu, S, Wimer, C, Seligman, H. Moderation of the Relation of County-Level Cost of Living to Nutrition by the Supplemental Nutrition Assistance Program. <i>Am J Public Health</i> . 2016. 106:2064-2070. doi:10.2105/ajph.2016.303439.	Intervention/Exposure
25.	Beheshti, R, Igusa, T, Jones-Smith, J. Simulated Models Suggest That Price per Calorie Is the Dominant Price Metric That Low-Income Individuals Use for Food Decision Making. <i>J Nutr</i> . 2016. 146:2304-2311. doi:10.3945/jn.116.235952.	Outcome
26.	Berkowitz, SA, Basu, S, Meigs, JB, Seligman, HK. Food Insecurity and Health Care Expenditures in the United States, 2011-2013. <i>Health Serv Res</i> . 2018. 53:1600-1620. doi:10.1111/1475-6773.12730.	Outcome
27.	Bertoni, AG, Foy, CG, Hunter, JC, Quandt, SA, Vitolins, MZ, Whitt-Glover, MC. A multilevel assessment of barriers to adoption of Dietary Approaches to Stop Hypertension (DASH) among African Americans of low socioeconomic status. <i>J Health Care Poor Underserved</i> . 2011. 22:1205-20. doi:10.1353/hpu.2011.0142.	Comparator



28.	Beydoun, MA, Fanelli-Kuczmariski, MT, Allen, A, Beydoun, HA, Popkin, BM, Evans, MK, Zonderman, AB. Monetary Value of Diet Is Associated with Dietary Quality and Nutrient Adequacy among Urban Adults, Differentially by Sex, Race and Poverty Status. PLoS One. 2015. 10:e0140905. doi:10.1371/journal.pone.0140905.	Intervention/Exposure
29.	Beydoun, MA, Nkodo, A, Fanelli-Kuczmariski, MT, Maldonado, AI, Beydoun, HA, Popkin, BM, Evans, MK, Zonderman, AB. Longitudinal Associations between Monetary Value of the Diet, DASH Diet Score and the Allostatic Load among Middle-Aged Urban Adults. Nutrients. 2019. 11:doi:10.3390/nu11102360.	Outcome
30.	Blecher, E, Liber, AC, Drope, JM, Nguyen, B, Stoklosa, M. Global Trends in the Affordability of Sugar-Sweetened Beverages, 1990-2016. Preventing Chronic Disease. 2017. 14:doi:10.5888/pcd14.160406.	Comparator
31.	Blisard, N, Stewart, H, Jolliffe, D. Low-income households' expenditures on fruits and vegetables. 2004.	Other Exclude
32.	Blisard, N, Smallwood, D, Lutz, S. Food Cost Indexes for Low-Income Households and the General Population. 1999. 29. doi:10.22004/ag.econ.156813.	Intervention/Exposure
33.	Blisard, N, Stewart, H. How Low-Income Households Allocate Their Food Budget Relative to the Cost of the Thrifty Food Plan. 2006. 29. doi:10.22004/ag.econ.7239.	Comparator
34.	Blisard, N, Stewart, H. Food Spending in American Households, 2003-04. 2007. 108. doi:10.22004/ag.econ.59033.	Comparator
35.	Blitstein, JL, Snider, J, Evans, WD. Perceptions of the food shopping environment are associated with greater consumption of fruits and vegetables. Public Health Nutr. 2012. 15:1124-9. doi:10.1017/s1368980012000523.	Outcome
36.	Bluthenthal, RN, Cohen, DA, Farley, TA, Scribner, R, Beighley, C, Schonlau, M, Robinson, PL. Alcohol availability and neighborhood characteristics in Los Angeles, California and southern Louisiana. J Urban Health. 2008. 85:191-205. doi:10.1007/s11524-008-9255-1.	Outcome
37.	Boehm, R, Ver Ploeg, M, Wilde, PE, Cash, SB. Greenhouse gas emissions, total food spending and diet quality by share of household food spending on red meat: results from a nationally representative sample of US households. Public Health Nutr. 2019. 22:1794-1806. doi:10.1017/s136898001800407x.	Outcome
38.	Breck, A, Kiszko, KM, Abrams, C, Elbel, B. Spending at mobile fruit and vegetable carts and using SNAP benefits to pay, Bronx, New York, 2013 and 2014. Prev Chronic Dis. 2015. 12:E87. doi:10.5888/pcd12.140542.	Outcome
39.	Breyer, B, Voss-Andreae, A. Food mirages: geographic and economic barriers to healthful food access in Portland, Oregon. Health Place. 2013. 24:131-9. doi:10.1016/j.healthplace.2013.07.008.	Intervention/Exposure
40.	Brinkley, C, Chrisinger, B, Hillier, A. Tradition of healthy food access in low-income neighborhoods: Price and variety of curbside produce vending compared to conventional retailers. J Agric Food Syst Community Dev. 2013. 4:155-169. doi:10.5304/jafscd.2013.041.011.	Intervention/Exposure
41.	Bronchetti, ET, Christensen, G, Hoynes, HW. Local food prices, SNAP purchasing power, and child health. J Health Econ. 2019. 68:102231. doi:10.1016/j.jhealeco.2019.102231.	Intervention/Exposure



42.	Brown, C. Consumers' preferences for locally produced food: A study in southeast Missouri. <i>American Journal of Alternative Agriculture</i> . 2003. 18:213-224. doi:10.1079/ajaa200353.	Comparator
43.	Budd, N, Cuccia, A, Jeffries, JK, Prasad, D, Frick, KD, Powell, L, Katz, FA, Gittelsohn, J. B'More Healthy: Retail Rewards--design of a multi-level communications and pricing intervention to improve the food environment in Baltimore City. <i>BMC Public Health</i> . 2015. 15:283. doi:10.1186/s12889-015-1616-6.	Study Design
44.	Burns, C, Cook, K, Mavoa, H. Role of expendable income and price in food choice by low income families. <i>Appetite</i> . 2013. 71:209-17. doi:10.1016/j.appet.2013.08.018.	Country
45.	Buszkiewicz, J, House, C, Aggarwal, A, Long, M, Drewnowski, A, Otten, JJ. The Impact of a City-Level Minimum Wage Policy on Supermarket Food Prices by Food Quality Metrics: A Two-Year Follow Up Study. <i>Int J Environ Res Public Health</i> . 2019. 16:doi:10.3390/ijerph16010102.	Intervention/Exposure
46.	Byker Shanks, C, Ahmed, S, Smith, T, Houghtaling, B, Jenkins, M, Margetts, M, Schultz, D, Stephens, L. Availability, Price, and Quality of Fruits and Vegetables in 12 Rural Montana Counties, 2014. <i>Prev Chronic Dis</i> . 2015. 12:E128. doi:10.5888/pcd12.150158.	Outcome
47.	Cakir, M, Beatty, TKM, Boland, MA, Park, TA, Snyder, S, Wang, YH. SPATIAL AND TEMPORAL VARIATION IN THE VALUE OF THE WOMEN, INFANTS, AND CHILDREN PROGRAM'S FRUIT AND VEGETABLE VOUCHER. <i>American Journal of Agricultural Economics</i> . 2018. 100:691-706. doi:10.1093/ajae/aay002.	Intervention/Exposure
48.	Canto, Amber, Brown, LE, Deller, SC. Rural Poverty, Food Access, and Public Health Outcomes. 2014. 29:5. doi:10.22004/ag.econ.182113.	Comparator
49.	Carlson, A, Page, E, Mentzer RM. USDA's Purchase to Plate Price Tool Estimates Food Costs for National Food Intake Data. 2020. 2020:doi:10.22004/ag.econ.307281.	Comparator
50.	Carnahan, LR, Zimmermann, K, Peacock, NR. What Rural Women Want the Public Health Community to Know About Access to Healthful Food: A Qualitative Study, 2011. <i>Prev Chronic Dis</i> . 2016. 13:E57. doi:10.5888/pcd13.150583.	Intervention/Exposure
51.	Caspi, CE, Pelletier, JE, Harnack, LJ, Erickson, DJ, Lenk, K, Laska, MN. Pricing of Staple Foods at Supermarkets versus Small Food Stores. <i>Int J Environ Res Public Health</i> . 2017. 14:doi:10.3390/ijerph14080915.	Comparator
52.	Caswell, JA, Yaktine, AL. On Examination of the Adequacy of Food Resources, Snap Allotments, Committee, Board, Food, Nutrition, On National Statistics, Committee, Of Medicine, Institute, Council, National Research. Individual, Household, and Environmental Factors Affecting Food Choices and Access. <i>Supplemental Nutrition Assistance Program: Examining the Evidence to Define Benefit Adequacy</i> . 2013.	Study Design
53.	Cavanaugh, E, Mallya, G, Brensinger, C, Tierney, A, Glanz, K. Nutrition environments in corner stores in Philadelphia. <i>Prev Med</i> . 2013. 56:149-51. doi:10.1016/j.ypmed.2012.12.007.	Comparator
54.	Cerin, E, Frank, LD, Sallis, JF, Saelens, BE, Conway, TL, Chapman, JE, Glanz, K. From neighborhood design and food options to residents' weight status. <i>Appetite</i> . 2011. 56:693-703. doi:10.1016/j.appet.2011.02.006.	Intervention/Exposure
55.	Chea, M, Mobley, AR. Factors Associated with Identification and Consumption of Whole-Grain Foods in a Low-Income Population. <i>Curr Dev Nutr</i> . 2019. 3:nzz064. doi:10.1093/cdn/nzz064.	Intervention/Exposure



56.	Chen, D, Jaenicke, EC, Volpe, RJ. Food Environments and Obesity: Household Diet Expenditure Versus Food Deserts. <i>Am J Public Health</i> . 2016. 106:881-8. doi:10.2105/ajph.2016.303048.	Outcome
57.	Choi, HJ, Wohlgenant, MK, Zheng, XY. Household-Level Welfare Effects of Organic Milk Introduction. <i>American Journal of Agricultural Economics</i> . 2013. 95:1009-1028. doi:10.1093/ajae/aat021.	Outcome
58.	Chouinard, HH, Davis, DE, LaFrance, JT, Perloff, JM. Milk Marketing Order Winners and Losers. <i>Applied Economic Perspectives and Policy</i> . 2010. 32:59-76. doi:10.1093/aep/ppp002.	Intervention/Exposure
59.	Clauson, AL. Despite Higher Food Prices, Percent of U.S. Income Spent on Food Remains Constant. 2008. 1. doi:10.22004/ag.econ.124033.	Comparator
60.	Cliff, BQ, Townsend, T, Wolfson, JA. Examining Household Changes in Produce Purchases Among New Parents. <i>J Nutr Educ Behav</i> . 2019. 51:798-805. doi:10.1016/j.jneb.2019.04.010.	Outcome
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262.	Wiig, K, Smith, C. The art of grocery shopping on a food stamp budget: factors influencing the food choices of low-income women as they try to make ends meet. <i>Public Health Nutr</i> . 2009. 12:1726-34. doi:10.1017/s1368980008004102.	Outcome
263.	Wilde, PE, Andrews, MS. The Food Stamp Program in an Era of Welfare Reform: Electronic Benefits and Changing Sources of Cash Income. <i>Journal of Consumer Affairs</i> . 2000. 34:31. doi:10.1111/j.1745-6606.2000.tb00082.x.	Outcome
264.	Winham, DM, Knoblauch, ST, Heer, MM, Thompson, SV, Der Ananian, C. African-American Views of Food Choices and Use of Traditional Foods. <i>Am J Health Behav</i> . 2020. 44:848-863. doi:10.5993/ajhb.44.6.9.	Outcome
265.	Winicki, J, Gundersen, C, Jolliffe, D. ISSUES IN FOOD ASSISTANCE - HOW DO FOOD ASSISTANCE PROGRAMS IMPROVE THE WELL-BEING OF LOW-INCOME FAMILIES? 2002. 4. doi:10.22004/ag.econ.262255.	Outcome
266.	Yen, ST, Lin, B-H, Smallwood, DM, Andrews, M. Demand for Nonalcoholic Beverages: The Case of Low-Income Households. <i>Agribusiness</i> . 2004. 20:309-321. doi:10.1002/agr.20015.	Outcome
267.	Young, CM, Batch, BC, Svetkey, LP. Effect of socioeconomic status on food availability and cost of the Dietary Approaches to Stop Hypertension (DASH) dietary pattern. <i>J Clin Hypertens (Greenwich)</i> . 2008. 10:603-11. doi:10.1111/j.1751-7176.2008.08199.x.	Intervention/Exposure
268.	Zeballos, E, Sinclair, W. Average Share of Income Spent on Food in the United States Remained Relatively Steady From 2000 to 2019. 2020. doi:10.22004/ag.econ.307278.	Comparator
269.	Zenk, SN, Schulz, AJ, Israel, BA, James, SA, Bao, S, Wilson, ML. Fruit and vegetable access differs by community racial composition and socioeconomic position in Detroit, Michigan. <i>Ethn Dis</i> . 2006. 16:275-280.	Intervention/Exposure
270.	Zenk, SN, Schulz, AJ, Lachance, LL, Mentz, G, Kannan, S, Ridella, W, Galea, S. Multilevel correlates of satisfaction with neighborhood availability of fresh fruits and vegetables. <i>Ann Behav Med</i> . 2009. 38:48-59. doi:10.1007/s12160-009-9106-7.	Outcome
271.	Zhang, G, You, W, Carlson, A, Lin, B-H. The Impact of Regional Food Cost Differences on the TFP Recommendations. 2010. 2. doi:10.22004/ag.econ.61643.	Comparator
272.	Zhang, Q, Chen, Z, Diawara, N, Wang, Y. Prices of unhealthy foods, Food Stamp Program participation, and body weight status among U.S. low-income women. <i>J Fam Econ Issues</i> . 2011. 32:245-256. doi:10.1007/s10834-010-9228-x.	Comparator
273.	Zhang, Q, Jones, S, Ruhm, CJ, Andrews, M. Higher food prices may threaten food security status among American low-income households with children. <i>J Nutr</i> . 2013. 143:1659-65. doi:10.3945/jn.112.170506.	Outcome



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Agriculture

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Intervention/Exposure

274. Zhao, AW, McGowan, CC, Zenk, SN, Kershaw, KN. Associations of the consumer food environment with eating behaviours and BMI. *Public Health Nutr.* 2020. 23:3197-3203. doi:10.1017/s1368980020002633.
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## Appendix 2-a: Literature search strategy for the rapid review on income and HEI

Database: PubMed  
Vendor: National Library of Medicine  
Date of Search: 5/11/2021  
Limits Used: Filters: Language English Publication Dates 2008 - 2021  
Total = 4,718

Search #	Concept	Search String	N
#1	Income	("Socioeconomic Factors"[Mesh] OR socioeconomic*[tiab] OR socio-economic*[tiab] OR "social factor**"[tiab] OR "social condition**"[tiab] OR poverty[tiab] OR "Residence Characteristics"[Mesh] OR "Vulnerable Populations"[Mesh] OR "vulnerable population**"[tiab] OR "underserved population**"[tiab] OR "disadvantaged population**"[tiab] OR "Income"[Mesh] OR income*[tiab] OR "Race Factors"[Mesh] OR "race factor**"[tiab] OR "Ethnic Groups"[Mesh] OR "ethnic group**"[tiab] OR "ethnic population**"[tiab] OR "Cross-Cultural Comparison"[Mesh] OR "cross-cultural"[tiab] OR transcultural[tiab] OR "Cultural Characteristics"[Mesh] OR "cultural characteristic**"[tiab] OR "Cultural Diversity"[Mesh] OR "culturally diverse"[tiab] OR "Food Supply"[Mesh] OR "food desert**"[tiab] OR "food insecure**"[tiab] OR "food environment**"[tiab] OR "food access"[tiab] OR "corner store**"[tiab] OR bodega*[tiab] OR "food cooperative**"[tiab] OR "food store**"[tiab] OR "food market**"[tiab] OR grocer*[tiab] OR supermarket*[tiab] OR "convenience store**"[tiab] OR "food outlet**"[tiab] OR "farmers market**"[tiab] OR Urban[tiab] OR Rural[tiab] OR neighborhood[tiab] OR "Census tract"[tiab] OR "census block"[tiab] OR "food assistance"[MeSH Terms] OR "food assistance"[Tiab])	1,087,878
#2	Dietary Patterns	("dietary pattern**"[tiab] OR "diet pattern**"[tiab] OR "eating pattern**"[tiab] OR "food pattern**"[tiab] OR "diet quality"[tiab] OR "dietary quality"[tiab] OR "diet divers**"[tiab] OR "dietary divers**"[tiab] OR "diet variety"[tiab] OR "dietary variety"[tiab] OR "varied diet"[tiab] OR "dietary guideline**"[tiab] OR "dietary recommendation**"[tiab] OR "dietary intake**"[tiab] OR "eating style**"[tiab] OR "Diet, Mediterranean"[Mesh] OR "Mediterranean Diet**"[tiab] OR "Dietary Approaches To Stop Hypertension"[Mesh] OR "Dietary Approaches To Stop Hypertension Diet**"[tiab] OR "DASH diet**"[tiab] OR "Diet, Gluten-Free"[Mesh] OR "Gluten Free diet**"[tiab] OR "prudent diet**"[tiab] OR "Diet, Paleolithic"[Mesh] OR "Paleolithic Diet**"[tiab] OR "Diet, Vegetarian"[Mesh] OR "vegetarian diet**"[tiab] OR "vegan diet**"[tiab] OR "Diet, Healthy"[Mesh] OR "plant based diet**"[tiab] OR "Diet, Western"[Mesh] OR "western diet**"[tiab] OR "Nordic Diet**"[tiab] OR "Diet, Fat-Restricted"[Mesh] OR "Diet, High-Fat"[Mesh] OR "high-fat diet**"[tiab] OR "low fat diet**"[tiab] OR ("Guideline Adherence"[Mesh] OR "guideline adherence**"[tiab])AND (diet[tiab] OR dietary[tiab] OR food[tiab] OR beverage*[tiab] OR nutrition*[tiab])) OR "diet score**"[tiab] OR "diet quality score**"[tiab] OR "diet quality index**"[tiab] OR kidmed[tiab] OR "diet index**"[tiab] OR "dietary index**"[tiab] OR "food score**"[tiab] OR MedDietScore[tiab] OR "healthy eating index"[tiab] )	113,841

#4	Publication, Geography, and species excludes	<p>#1 AND #2 NOT</p> <p>(letter[ptyp] OR editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR editorial[tiab] OR commentary[tiab] OR "conference abstract"[tiab] OR "systematic review"[ti] OR "meta-analysis"[ptyp] OR "meta-analysis"[ti] OR "meta-analyses"[ti] OR "Review"[Publication Type] OR "Systematic Review"[Publication Type] OR "conference proceeding"[tiab] OR "retracted publication"[ptyp] OR "retraction of publication"[ptyp] OR "retraction of publication"[tiab] OR "retraction notice"[ti] OR "retracted publication"[tiab] OR "Published Erratum"[Publication Type] OR corrigenda[tiab] OR corrigendum[tiab] OR errata[tiab] OR erratum[tiab] OR protocol[ti] OR protocols[ti] OR "case report"[ti] OR "case series"[ti] OR "Case Reports"[Publication Type])</p> <p>NOT</p> <p>("Developing Countries"[Mesh] OR "developing countr*" OR "Under Developed Nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC[tiab] OR "Europe"[Mesh] OR "Australia"[Mesh] OR "Asia"[Mesh] OR "Africa"[Mesh] OR "Mexico"[Mesh] OR "Islands"[Mesh] OR "Central America"[Mesh] OR "Latin America"[Mesh] OR "South America"[Mesh])</p> <p>NOT</p> <p>("Animals"[Mesh] NOT</p> <p>("Animals"[Mesh] AND "Humans"[Mesh])</p> <p>)</p>	6,174
#6	Filters	Filters: Language: English; Publication Dates: 2008-2021	4,718

Database: Business Source Premier

Vendor: EBSCO

Date of Search: 5/11/2021

Limits Used: Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English

Total = 1,044

Search #	Concept	Search String	N
#1	Income	(DE "SOCIOECONOMIC factors") OR socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR (DE "POVERTY") OR poverty OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR (DE "INCOME") OR income* OR "race factor*" OR (DE "ECONOMIC conditions of ethnic groups") OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR (DE "FOOD supply") OR "food desert*" OR "food insecurit*" OR "food environment*" OR "food access" OR "corner store*" OR bodega* OR DE "FOOD cooperatives" OR "food cooperative*" OR "food store*" OR "food market*" OR (DE "GROCERY shopping") OR (DE "GROCERY industry") OR grocer* OR (DE "SUPERMARKETS") OR supermarket* OR (DE "CONVENIENCE	1,403,085



		stores") OR "convenience store*" OR "food outlet*" OR (DE "FARMERS' markets") OR "farmers market*"OR (DE "METROPOLITAN areas") OR Urban OR Rural OR neighborhood OR "Census tract" OR "census block" OR "food assistance"	
#2	Dietary Patterns	"dietary pattern*" OR "diet pattern*" OR "eating pattern*" OR "food pattern*" OR "diet quality" OR "dietary quality" OR "diet divers*" OR "dietary divers*"OR "diet variety" OR "dietary variety" OR "varied diet" OR "dietary guideline*" OR "dietary recommendation*" OR "dietary intake*" OR "eating style*" OR "Mediterranean Diet*" OR "Dietary Approaches To Stop Hypertension" OR "DASH diet*" OR "Gluten Free diet*" OR "prudent diet*" OR "Paleolithic Diet*" OR "vegetarian diet*" OR "vegan diet*" OR "healthy diet" OR "plant based diet*" OR "western diet*" OR "Nordic Diet*" OR "high-fat diet*"OR "low fat diet*"OR ("guideline adherence*" AND (diet OR dietary OR food OR beverage* OR nutrition*)) OR "diet score*" OR "diet quality score*" OR "diet quality index*" OR kidmed OR "diet index*" OR "dietary index*" OR "food score*" OR "Med Diet Score" OR "healthy eating index"	13,149
#3	#1 AND #2		3,225
#4	Filters	Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English	1,044

Database: Web of Science: Core Collection

Vendor: Clarivate Analytics

Date of Search: 5/11/2021

Limits Used: Years: 2008-2021; Publication Types: Articles, Early Access; Language: English

Total = 7,300

Search #	Concept	Search String	N
#1	Income	TS=(socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR poverty OR "residence characteristics" OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR income* OR "race factor*" OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR "food desert*" OR "food insecurity*" OR "food environment*" OR "food access" OR "corner store*" OR bodega* OR "food cooperative*" OR "food store*" OR "food market*" OR grocer* OR supermarket* OR "convenience store*" OR "food outlet*" OR "farmers market*" OR Urban OR Rural OR neighborhood OR "Census tract" OR "census block" OR "food assistance")	1,036,318
#2	Dietary Patterns	TS= ("dietary pattern*" OR "diet pattern*" OR "eating pattern*" OR "food pattern*" OR "diet quality" OR "dietary quality" OR "diet divers*" OR "dietary divers*" OR "diet variety" OR "dietary variety" OR "varied diet" OR "dietary guideline*" OR "dietary recommendation*" OR "dietary intake*" OR "eating style*" OR "Mediterranean Diet*" OR "Dietary Approaches To Stop Hypertension" OR "DASH diet*" OR "Gluten Free diet*" OR "prudent diet*" OR "Paleolithic Diet*" OR "vegetarian diet*" OR "vegan diet*" OR "healthy diet" OR "plant based diet*" OR "western diet*" OR "Nordic Diet*" OR "high-fat diet*" OR "low fat diet*" OR ("guideline adherence*" AND (diet OR dietary OR food OR beverage* OR nutrition*)) OR "diet score*" OR "diet quality score*" OR "diet quality index*" OR kidmed OR "diet index*" OR "dietary	122,259



		index*" OR "food score*" OR "Med Diet Score" OR "healthy eating index")	
#3	#1 AND #2		11,878
#4	Non-United States Excludes	CU=("developing countr*" OR "under developed nation*" OR "low i ncome countr*" OR "middle income countr*" OR "low-middle income countr*" OR LMIC  OR Europe OR Australia OR Asia OR Africa OR Mexico OR Island s OR "Central America" OR "Latin America" OR "South America")	2,040,699
#5	#3 NOT #4		10,403
#6	Publication Excludes	TS=(editorial OR commentary OR "conference abstract*" OR "conf erence proceeding*" [tiab] OR "retraction of publication" OR "retract ed publication" OR corrigenda [tiab] OR corrigendum [tiab] OR errat a OR erratum OR "case reports" ) OR TI=("systematic review*" OR "meta-analysis"  OR "meta analyses" OR protocol OR protocols OR "retraction notice" OR "case report" OR "case series")	710,063
#7	#5 NOT #6		10,151
#8		Years: 2008-2021; Publication Types: Articles, Early Access; Language: English	7,300

## Grey Literature Search

### Google Scholar

Google Scholar's search has a character limit of 256. To accommodate all of the unique terms in this search strategy, the search has been split and run as three searches.

### Search A

(Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("dietary pattern" OR "food pattern" OR "diet quality" OR "dietary diversity" OR "diet variety" OR "dietary guideline" OR "dietary recommendation" OR "dietary intake" OR "eating style")

Limits: Date Published: 2008-2021;

Date Searched: 5/17/2021

Results: 80, limited to 8 pages

### Search B

(Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("Mediterranean Diet" OR "Dietary Approaches To Stop Hypertension" OR "DASH diet" OR "western diet" OR "Nordic diet")

Limits: Date Published: 2008-2021;

Date Searched: 5/17/2021

Results: 20, limited to 2 pages

### Search C

(Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("Gluten Free diet" OR "prudent diet" OR "Paleolithic Diet" OR "vegetarian diet" OR "vegan diet" OR "healthy diet" OR "plant based diet")

Limits: Date Published: 2008-2021;

Date Searched: 5/17/2021

Results: 20, limited to 2 pages

Total: 120

### Google

Google limits queries to 32 words (from Google notification, 5/17/21). To accommodate all of the unique terms in this search strategy, the search has been split and run as three searches.

#### Search A

site:.gov AND (Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("dietary pattern" OR "food pattern" OR "diet quality" OR "dietary diversity" OR "diet variety" OR "dietary guideline" OR "dietary recommendation" OR "dietary intake" OR "eating style")

Limits: Similar results omitted

Date Searched: 5/17/2021

Results: 12

#### Search B

site:.gov AND (Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("Mediterranean Diet" OR "Dietary Approaches To Stop Hypertension" OR "DASH diet" OR "western diet" OR "Nordic diet")

Limits: Similar results omitted

Date Searched: 5/17/2021

Results: 10, limited to 1 page

#### Search C

site:.gov AND (Income OR resources OR poverty OR socioeconomic OR urban OR neighborhood) AND ("Gluten Free diet" OR "prudent diet" OR "Paleolithic Diet" OR "vegetarian diet" OR "vegan diet" OR "healthy diet" OR "plant based diet")

Limits: Similar results omitted

Date Searched: 5/17/2021

Results: 20, limited to 2 pages

Total: 42

### AgEcon

Any of the words: Income resources poverty socioeconomic urban neighborhood  
AND

Any of the words: "dietary pattern" "food pattern" "diet quality" "dietary diversity" "diet variety" "dietary guideline" "dietary recommendation" "dietary intake" "eating style" "Mediterranean Diet" "Dietary Approaches To Stop Hypertension" "DASH diet" "western diet" "Nordic diet" OR "Gluten Free diet" "prudent diet" "Paleolithic Diet" "vegetarian diet" "vegan diet" "healthy diet" "plant based diet"

Limits: added since 2008

Date Searched: 5/17/2021

Results: 50, results are limited to 5 pages

Results after Deduplication:

- Google Scholar: 120
- Google: 40
- AgEcon: 59

## Appendix 2-b: Excluded articles for the rapid review on income and HEI

The following table lists the articles excluded after full-text screening for this rapid review question. At least 1 reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

#	Citation	Exclusion rationale
1	. Access to Foods that Support Healthy Eating Patterns   Healthy People 2020. 2021.	Study design
2	. Appendix E-2.37   health.gov. 2021.	Study design
3	. Eating Vegetarian   Nutrition.gov. 2021.	Study design
4	. Food Pattern Modeling   Dietary Guidelines for Americans. 2021.	Study design; Publication Status
5	. Multicultural Healthy Diet to Reduce Cognitive Decline & Alzheimer's Disease Risk   National Institute on Aging. 2021.	Study design; Publication Status
6	. Promote Healthy Diet and Physical Activity Behavior   Performance.gov. 2021.	Study design
7	. The Mediterranean Eating Plan   Evidence-Based Cancer Control Programs (EBCCP). 2021.	Study design
8	. USDA ERS - Diet Quality & Nutrition. 2021.	Study design
9	. Vegetarian Diet. 2021.	Intervention/ Exposure; Study design
10	. Vegetarian Nutrition   Food and Nutrition Information Center   NAL   USDA. 2021.	Study design
11	Aggarwal, A.,Drewnowski, A.. Plant- and animal-protein diets in relation to sociodemographic drivers, quality, and cost: findings from the Seattle Obesity Study. Am J Clin Nutr. 2019. 110:451-460	Intervention/ Exposure
12	Aggarwal, A.,Monsivais, P.,Cook, A. J.,Drewnowski, A.. Does diet cost mediate the relation between socioeconomic position and diet quality?. Eur J Clin Nutr. 2011. 65:1059-66	Outcome
13	Alexis, T. D.,Unruh, D.,Wang, W.,Dave, J. M.,Miketinas, D. C.,Chen, T. A.,Moore, C. E.. Implementation of a food scholarship program improves nutrient intake and dietary quality of college students. J Am Coll Health. 2020. :1-8	Intervention/ Exposure
14	Anderson, S. E.,Kaye, G.,Andridge, R.,Smathers, C.,Peng, J.,Pirie, P.. Interrelationships of More Healthful and Less Healthful Aspects of Diet Quality in a Low-Income Community Sample of Preschool-Aged Children. Matern Child Health J. 2015. 19:2663-72	Intervention/ Exposure
15	Anderson, S. E.,Ramsden, M.,Kaye, G.. Diet qualities: healthy and unhealthy aspects of diet quality in preschool children. Am J Clin Nutr. 2016. 103:1507-13	Data date range
16	Andreyeva, T.,Tripp, A. S.. The healthfulness of food and beverage purchases after the federal food package revisions: The case of two New England states. Prev Med. 2016. 91:204-210	Outcome
17	Appelhans, B. M.,French, S. A.,Tangney, C. C.,Powell, L. M.,Wang, Y.. To what extent do food purchases reflect shoppers' diet quality and nutrient intake?. Int J Behav Nutr Phys Act. 2017; 14 (1):46.	Outcome
18	Arimond, Mary ,Wiesmann, Doris,Becquey, Elodie ,Carriquiry, Alicia ,Daniels, Melissa ,Deitchler, Megan ,Fanou, Nadia,Ferguson, Elaine ,Joseph, Maria ,Kennedy, Gina ,Martin-Prével, Yves ,Elin Torheim, Liv . Dietary Diversity as a Measure of the Micronutrient Adequacy of Women's Diets in Resource-Poor Areas: Summary of Results from Five Sites. 2011.	Country
19	Auchincloss, A. H.,Riolo, R. L.,Brown, D. G.,Cook, J.,Diez Roux, A. V.. An agent-based model of income inequalities in diet in the context of residential segregation. Am J Prev Med. 2011. 40:303-11	Outcome

#	Citation	Exclusion rationale
20	Baraldi, L. G.,Martinez Steele, E.,Canella, D. S.,Monteiro, C. A.. Consumption of ultra-processed foods and associated sociodemographic factors in the USA between 2007 and 2012: evidence from a nationally representative cross-sectional study. <i>BMJ Open</i> . 2018. 8:e020574	Outcome
21	Basu, S.,Gardner, C. D.,White, J. S.,Rigdon, J.,Carroll, M. M.,Akers, M.,Seligman, H. K.. Effects Of Alternative Food Voucher Delivery Strategies On Nutrition Among Low-Income Adults. <i>Health Aff (Millwood)</i> . 2019. 38:577-584	Intervention/ Exposure
22	Bauer, K. W.,Widome, R.,Himes, J. H.,Smyth, M.,Rock, B. H.,Hannan, P. J.,Story, M.. High food insecurity and its correlates among families living on a rural American Indian Reservation. <i>Am J Public Health</i> . 2012. 102:1346-52	Data date range
23	Beasley, J. M.,Sevick, M. A.,Kirshner, L.,Mangold, M.,Chodosh, J.. Congregate Meals: Opportunities to Help Vulnerable Older Adults Achieve Diet and Physical Activity Recommendations. <i>J Frailty Aging</i> . 2018. 7:182-186	Outcome
24	Bedrick, B. S.,Eskew, A. M.,Chavarro, J. E.,Jungheim, E. S.. Dietary Patterns, Physical Activity, and Socioeconomic Associations in a Midwestern Cohort of Healthy Reproductive-Age Women. <i>Matern Child Health J</i> . 2020. 24:1299-1307	Intervention/ Exposure
25	Bergmans, R. S.,Palta, M.,Robert, S. A.,Berger, L. M.,Ehrenthal, D. B.,Malecki, K. M.. Associations between Food Security Status and Dietary Inflammatory Potential within Lower-Income Adults from the United States National Health and Nutrition Examination Survey, Cycles 2007 to 2014. <i>Journal of the Academy of Nutrition and Dietetics</i> . 2018. 118:994-1005	Intervention/ Exposure
26	Bernstein, A. M.,Bloom, D. E.,Rosner, B. A.,Franz, M.,Willett, W. C.. Relation of food cost to healthfulness of diet among US women. <i>American Journal of Clinical Nutrition</i> . 2010. 92:1197-1203	Data date range
27	Beydoun, M. A.,Wang, Y.. Do nutrition knowledge and beliefs modify the association of socio-economic factors and diet quality among US adults?. <i>Prev Med</i> . 2008. 46:145-53	Data date range
28	Beydoun, M. A.,Wang, Y.. How do socio-economic status, perceived economic barriers and nutritional benefits affect quality of dietary intake among US adults?. <i>Eur J Clin Nutr</i> . 2008. 62:303-13	Data date range
29	Bishop, N. J.,Zuniga, K. E.,Ramirez, C. M.. Latent profile analysis of dietary intake in a community-dwelling sample of older Americans. <i>Public Health Nutr</i> . 2020. 23:243-253	Outcome
30	Blake, C. E.,Wethington, E.,Farrell, T. J.,Bisogni, C. A.,Devine, C. M.. Behavioral contexts, food-choice coping strategies, and dietary quality of a multiethnic sample of employed parents. <i>J Am Diet Assoc</i> . 2011. 111:401-7	Intervention/ Exposure; Data date range
31	Bleiweiss-Sande, R.,Sacheck, J. M.,Chui, K.,Goldberg, J. P.,Bailey, C.,Evans, E. W.. Processed food consumption is associated with diet quality, but not weight status, in a sample of low-income and ethnically diverse elementary school children. <i>Appetite</i> . 2020. 151:104696	Comparator
32	Bodnar, L. M.,Simhan, H. N.,Parker, C. B.,Meier, H.,Mercer, B. M.,Grobman, W. A.,Haas, D. M.,Wing, D. A.,Hoffman, M. K.,Parry, S.,Silver, R. M.,Saade, G. R.,Wapner, R.,Iams, J. D.,Wadhwa, P. D.,Elovitz, M.,Peaceman, A. M.,Esplin, S.,Barnes, S.,Reddy, U. M.. Racial or Ethnic and Socioeconomic Inequalities in Adherence to National Dietary Guidance in a Large Cohort of US Pregnant Women. <i>J Acad Nutr Diet</i> . 2017. 117:867-877.e3	Intervention/ Exposure
33	Boehm, R.,Ver Ploeg, M.,Wilde, P. E.,Cash, S. B.. Greenhouse gas emissions, total food spending and diet quality by share of household food spending on red meat: results from a nationally representative sample of US households. <i>Public Health Nutr</i> . 2019. 22:1794-1806	Intervention/ Exposure
34	Boone-Heinonen, J.,Gordon-Larsen, P.,Kiefe, C. I.,Shikany, J. M.,Lewis, C. E.,Popkin, B. M.. Fast food restaurants and food stores: longitudinal associations with diet in young to middle-aged adults: the CARDIA study. <i>Arch Intern Med</i> . 2011. 171:1162-70	Data date range
35	Bottino, C. J.,Fleegler, E. W.,Cox, J. E.,Rhodes, E. T.. The Relationship Between Housing Instability and Poor Diet Quality Among Urban Families. <i>Acad Pediatr</i> . 2019. 19:891-898	Intervention/ Exposure
36	Boutté, A. K.,Turner-McGrievy, G. M.,Eberth, J. M.,Wilcox, S.,Liu, J.,Kaczynski, A. T.. Healthy Food Density is Not Associated With Diet Quality Among Pregnant Women With Overweight/Obesity in South Carolina. <i>J Nutr Educ Behav</i> . 2021. 53:120-129	Intervention/ Exposure

#	Citation	Exclusion rationale
37	Boynton, A., Neuhouser, M. L., Sorensen, B., McTiernan, A., Ulrich, C. M.. Predictors of diet quality among overweight and obese postmenopausal women. <i>J Am Diet Assoc.</i> 2008. 108:125-30	Data date range
38	Brantley, K. D., Hartman, T. J., Patel, A. V., Gapstur, S. M., Flanders, W. D., McCullough, M. L.. Test-Retest Reproducibility of Adult-Reported High School Diet Varies among Racially and Ethnically Diverse US Men and Women. <i>J Nutr.</i> 2018. 148:599-606	Intervention/ Exposure
39	Brewster, P. J., Durward, C. M., Hurdle, J. F., Stoddard, G. J., Guenther, P. M.. The Grocery Purchase Quality Index-2016 Performs Similarly to the Healthy Eating Index-2015 in a National Survey of Household Food Purchases. <i>J Acad Nutr Diet.</i> 2019. 119:45-56	Outcome (Purchase data)
40	Bruening, M., McClain, D., Moramarco, M., Reifsnider, E.. The Role of SNAP in Home Food Availability and Dietary Intake among WIC Participants Facing Unstable Housing. <i>Public Health Nurs.</i> 2017. 34:219-228	Outcome
41	Bruening, M., van Woerden, I., Todd, M., Laska, M. N.. Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. <i>Int J Behav Nutr Phys Act.</i> 2018. 15:9	Outcome
42	Camacho-Rivera, M., Rosenbaum, E., Yama, C., Chambers, E.. Low-Income Housing Rental Assistance, Perceptions of Neighborhood Food Environment, and Dietary Patterns among Latino Adults: the AHOME Study. <i>J Racial Ethn Health Disparities.</i> 2017. 4:346-353	Outcome
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104	French, S. A.,Tangney, C. C.,Crane, M. M.,Wang, Y.,Appelhans, B. M.. Nutrition quality of food purchases varies by household income: the SHoPPER study. <i>BMC Public Health</i> . 2019. 19:231	Outcome (Purchase data)
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111	Greenfield, Russell. The DASH Diet. 2020	Study design
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113	Guenther, P. M.,Luick, B. R.. Improved Overall Quality of Diets Reported by Expanded Food and Nutrition Education Program Participants in the Mountain Region. <i>J Nutr Educ Behav</i> . 2015. 47:421-6.e1	Intervention/ Exposure; Comparator
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121	Hattori, A.,An, R.,Sturm, R.. Neighborhood food outlets, diet, and obesity among California adults, 2007 and 2009. <i>Prev Chronic Dis</i> . 2013. 10:E35	Outcome
122	Hidaka, B. H.,Kerling, E. H.,Thodosoff, J. M.,Sullivan, D. K.,Colombo, J.,Carlson, S. E.. Dietary patterns of early childhood and maternal socioeconomic status in a unique prospective sample from a randomized controlled trial of Prenatal DHA Supplementation. <i>BMC Pediatr</i> . 2016. 16:191	Intervention/ Exposure
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127	Hurley, K. M.,Black, M. M.. Commercial Baby Food Consumption and Dietary Variety in a Statewide Sample of Infants Receiving Benefits from the Special Supplemental Nutrition Program for Women, Infants, and Children. <i>Journal of the American Dietetic Association.</i> 2010. 110:1537-1541	Outcome
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129	Iacobucci, Dawn. Part II: The Marketing Research Perspective: Chapter 2: Marketing Research: Consumer Behavior--Food Purchasing and Consumption: 2.1: Grocery Shopping. <i>Foundations &amp; Trends in Marketing.</i> 2019. 13:91-112	Study design
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131	Jansen, E. C.,Kasper, N.,Lumeng, J. C.,Brophy Herb, H. E.,Horodynski, M. A.,Miller, A. L.,Contreras, D.,Peterson, K. E.. Changes in household food insecurity are related to changes in BMI and diet quality among Michigan Head Start preschoolers in a sex-specific manner. <i>Soc Sci Med.</i> 2017. 181:168-176	Intervention/ Exposure
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136	Jun, S.,Catellier, D. J.,Eldridge, A. L.,Dwyer, J. T.,Eicher-Miller, H. A.,Bailey, R. L.. Usual Nutrient Intakes from the Diets of US Children by WIC Participation and Income: Findings from the Feeding Infants and Toddlers Study (FITS) 2016. <i>J Nutr.</i> 2018. 148:1567s-1574s	Outcome
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142	Kang, M.,Park, S. Y.,Shvetsov, Y. B.,Wilkins, L. R.,Marchand, L. L.,Boushey, C. J.,Paik, H. Y.. Sex differences in sociodemographic and lifestyle factors associated with diet quality in a multiethnic population. <i>Nutrition</i> . 2019. 66:147-152	Intervention/ Exposure
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145	Karpyn, A.,Young, C. R.,Collier, Z.,Glanz, K.. Correlates of Healthy Eating in Urban Food Desert Communities. <i>Int J Environ Res Public Health</i> . 2020. 17	Intervention/ Exposure
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148	Keita, A. D.,Casazza, K.,Thomas, O.,Fernandez, J. R.. Neighborhood-level disadvantage is associated with reduced dietary quality in children. <i>J Am Diet Assoc</i> . 2009. 109:1612-6	Outcome
149	Kell, K. P.,Judd, S. E.,Pearson, K. E.,Shikany, J. M.,Fern�ndez, J. R.. Associations between socio-economic status and dietary patterns in US black and white adults. <i>Br J Nutr</i> . 2015. 113:1792-9	Data date range
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151	Kilanowski, J. F.,Moore, L. C.. Food security and dietary intake in midwest migrant farmworker children. <i>J Pediatr Nurs</i> . 2010. 25:360-6	Data date range
152	Kilanowski, J. F.. Patterns and correlates of nutrition among migrant farm-worker children. <i>West J Nurs Res</i> . 2012. 34:396-416	Intervention/ Exposure
153	Kolodinsky, Jane M.,Sitaker, Marilyn,Morgan, Emily H.,Connor, Leah M.,Hanson, Karla L.,Becot, Florence,Pitts, Stephanie B. Jilcott,Ammerman, Alice S.,Seguin, Rebecca A.. Can CSA Cost-Offset Programs Improve Diet Quality for Limited Resource Families?. 2017. 32:10	Study design
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159	LeDoux, T. F.,Vojnovic, I.. Examining the role between the residential neighborhood food environment and diet among low-income households in Detroit, Michigan. <i>Applied Geography.</i> 2014. 55:9-18	Outcome
160	Lee, J.,Kubik, M. Y.,Fulkerson, J. A.. Diet Quality and Fruit, Vegetable, and Sugar-Sweetened Beverage Consumption by Household Food Insecurity among 8- to 12-Year-Old Children during Summer Months. <i>J Acad Nutr Diet.</i> 2019. 119:1695-1702	Intervention/ Exposure
161	Lee, Jonq-Ying. Food Assistance Programs and Healthy Diet among Low-Income Individuals. 2009. :5	Data date range
162	Lee, R.,Zhai, F.,Han, W. J.,Brooks-Gunn, J.,Waldfogel, J.. "Head Start and Children's Nutrition, Weight, and Health Care Receipt". <i>Early Child Res Q.</i> 2013. 28	Data date range
163	Leung, C. W.,Cluggish, S.,Villamor, E.,Catalano, P. J.,Willett, W. C.,Rimm, E. B.. Few changes in food security and dietary intake from short-term participation in the Supplemental Nutrition Assistance Program among low-income Massachusetts adults. <i>J Nutr Educ Behav.</i> 2014. 46:68-74	Outcome
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166	Leung, C. W.,Wolfson, J. A.,Lahne, J.,Barry, M. R.,Kasper, N.,Cohen, A. J.. Associations between Food Security Status and Diet-Related Outcomes among Students at a Large, Public Midwestern University. <i>J Acad Nutr Diet.</i> 2019. 119:1623-1631	Outcome
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168	Lin, Biing-Hwan. Diet Quality Usually Varies by Income Status. 2005. :2	
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170	Link, L. B.,Jacobson, J. S.. Factors affecting adherence to a raw vegan diet. <i>Complement Ther Clin Pract.</i> 2008. 14:53-9	Data date range
171	Lipsky, L. M.,Nansel, T. R.,Haynie, D. L.,Liu, D.,Li, K.,Pratt, C. A.,Iannotti, R. J.,Dempster, K. W.,Simons-Morton, B.. Diet quality of US adolescents during the transition to adulthood: changes and predictors. <i>Am J Clin Nutr.</i> 2017. 105:1424-1432	Intervention/ Exposure
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173	Liu, J.,Micha, R.,Li, Y.,Mozaffarian, D.. Trends in Food Sources and Diet Quality Among US Children and Adults, 2003-2018. <i>JAMA Netw Open.</i> 2021. 4:e215262	Outcome
174	Liu, Y.,Zhang, Y.,Remley, D. T.,Eicher-Miller, H. A.. Frequency of Food Pantry Use Is Associated with Diet Quality among Indiana Food Pantry Clients. <i>J Acad Nutr Diet.</i> 2019. 119:1703-1712	Intervention/ Exposure
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176	Ma, C.,Ho, S. K. M.,Singh, S.,Choi, M. Y.. Gender Disparities in Food Security, Dietary Intake, and Nutritional Health in the United States. <i>Am J Gastroenterol.</i> 2021. 116:584-592	Outcome



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178	Mancino, Lisa ,Gregory, Christian A.. Food-Insecure Households Score Lower on Diet Quality Compared to Food-Secure Households. 2020; March 2020 (02)	Outcome
179	Mancino, Lisa, Guthrie, Joanne. SNAP Households Must Balance Multiple Priorities To Achieve a Healthful Diet. 2014; (10):1.	Outcome
180	Marmash, D.,Ha, K.,Sakaki, J. R.,Gorski, I.,Rule, B.,Foster, J.,Puglisi, M.,Chun, O. K.. Diet Quality, Nutritional Adequacy, and Sociodemographic Characteristics of Mobile Food Pantry Users in Northeastern Connecticut. <i>Nutrients.</i> 2021. 13	Outcome
181	Mayne, S. L.,Virudachalam, S.,Fiks, A. G.. Clustering of unhealthy behaviors in a nationally representative sample of U.S. children and adolescents. <i>Prev Med.</i> 2020. 130:105892	Intervention/ Exposure; Outcome; Comparator
182	McClain, A. C.,Tucker, K. L.,Falcon, L. M.,Mattei, J.. Food insecurity and dietary intake by Supplemental Nutrition Assistance Program participation status among mainland US Puerto Rican adults after the 2009 American Recovery and Reinvestment Act. <i>Public Health Nutrition.</i> 2019. 22:2989-2998	Outcome
183	Merhout, F.,Doyle, J.. Socioeconomic Status and Diet Quality in College Students. <i>J Nutr Educ Behav.</i> 2019. 51:1107-1112	Outcome
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191	Moore, L. V.,Diez Roux, A. V.,Nettleton, J. A.,Jacobs, D. R., Jr.. Associations of the local food environment with diet quality--a comparison of assessments based on surveys and geographic information systems: the multi-ethnic study of atherosclerosis. <i>Am J Epidemiol.</i> 2008. 167:917-24	Data date range
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193	Muhammad, J. N.,Fernandez, J. R.,Clay, O. J.,Saag, M. S.,Overton, E. T.,Willig, A. L.. Associations of food insecurity and psychosocial measures with diet quality in adults aging with HIV. <i>AIDS Care.</i> 2019. 31:554-562	Intervention/ Exposure

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195	Mullany, B.,Neault, N.,Tsingine, D.,Powers, J.,Lovato, V.,Clitso, L.,Massey, S.,Talgo, A.,Speakman, K.,Barlow, A.. Food insecurity and household eating patterns among vulnerable American-Indian families: associations with caregiver and food consumption characteristics. <i>Public Health Nutr.</i> 2013. 16:752-60	Outcome
196	Mullie, P.,Clarys, P.,Hulens, M.,Vansant, G.. Dietary patterns and socioeconomic position. <i>Eur J Clin Nutr.</i> 2010. 64:231-8	Country; Data date range
197	Newby, P. K.,Noel, S. E.,Grant, R.,Judd, S.,Shikany, J. M.,Ard, J.. Race and region have independent and synergistic effects on dietary intakes in black and white women. <i>Nutr J.</i> 2012. 11:25	Outcome
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200	Nnakwe, Nweze E.. Dietary Patterns and Prevalence of Food Insecurity Among Low-Income Families Participating in Community Food Assistance Programs in a Midwest Town. <i>Family &amp; Consumer Sciences Research Journal.</i> 2008. 36:229-242	Data date range
201	Of Health, Mississippi State Department. Nutrition, Weight Loss and Healthy Eating - Mississippi State Department of Health. 2021.	Study design
202	Ozcan, B. A.,Yesilkay, B.,Yaldiz, N.,Pehliva, M.. Factors affecting diet quality in adolescents: the effect of sociodemographic characteristics and meal consumption. <i>Progress in Nutrition.</i> 2020. 22:8	Country
203	Palmer, S. M.,Knoblauch, S. T.,Winham, D. M.,Hiller, M. B.,Shelley, M. C.. Putting Knowledge into Practice: Low-Income Women Talk about Food Choice Decisions. <i>Int J Environ Res Public Health.</i> 2020. 17	Outcome
204	Park, S. Y.,Shvetsov, Y. B.,Kang, M.,Setiawan, V. W.,Wilkens, L. R.,Le Marchand, L.,Boushey, C. J.. Changes in Diet Quality over 10 Years Are Associated with Baseline Sociodemographic and Lifestyle Factors in the Multiethnic Cohort Study. <i>J Nutr.</i> 2020. 150:1880-1888	Intervention/ Exposure
205	Park, Y.,Neckerman, K.,Quinn, J.,Weiss, C.,Jacobson, J.,Rundle, A.. Neighbourhood immigrant acculturation and diet among Hispanic female residents of New York City. <i>Public Health Nutr.</i> 2011. 14:1593-600	Data date range
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207	Perkins, S.,Daley, A.,Yerxa, K.,Therrien, M.. The Effectiveness of the Expanded Food and Nutrition Education Program (EFNEP) on Diet Quality as Measured by the Healthy Eating Index. <i>Am J Lifestyle Med.</i> 2020. 14:316-325	Comparator
208	Pfledderer, C. D.,Gren, L. H.,Metos, J.,Brusseau, T. A.,O'Toole, K.,Buys, S. S.,Daly, M. B.,Frost, C. J.. Mothers' Diet and Family Income Predict Daughters' Healthy Eating. <i>Prev Chronic Dis.</i> 2021. 18:E24	Country
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210	Poskute, A. S.,Nzesi, A.,Geliebter, A.. Changes in food intake during the COVID-19 pandemic in New York City. <i>Appetite.</i> 2021. 163:105191	Outcome
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213	Rawal, R.,Kuczmariski, M. F.,Cotugna, N.,Brewer, B. C.,Beydoun, M. A.,Hughes, V. C.,Zonderman, A. B.,Evans, M. K.. Aspects of Dietary Diversity Changes across Adulthood in Racially Diverse Adults. <i>Nutrients</i> . 2020; 12 (8)	Outcome
214	Rehm, C. D.,Monsivais, P.,Drewnowski, A.. Relation between diet cost and Healthy Eating Index 2010 scores among adults in the United States 2007-2010. <i>Prev Med</i> . 2015. 73:70-5	Intervention/ Exposure
215	Rex, S. M.,Kopetsky, A.,Bodt, B.,Robson, S. M.. Relationships Among the Physical and Social Home Food Environments, Dietary Intake, and Diet Quality in Mothers and Children. <i>J Acad Nutr Diet</i> . 2021.	Intervention/ Exposure
216	Richardson, A. S.,Collins, R. L.,Ghosh-Dastidar, B.,Ye, F.,Hunter, G. P.,Baird, M. D.,Schwartz, H.,Sloan, J. C.,Nugroho, A.,Beckman, R.,Troxel, W. M.,Gary-Webb, T. L.,Dubowitz, T.. Improvements in Neighborhood Socioeconomic Conditions May Improve Resident Diet. <i>Am J Epidemiol</i> . 2021. 190:798-806	Comparator
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218	Rivera, R. L.,Zhang, Y.,Wang, Q.,Maulding, M. K.,Tooze, J. A.,Wright, B. N.,Craig, B. A.,Bailey, R. L.,Eicher-Miller, H. A.. Diet Quality and Associations with Food Security among Women Eligible for Indiana Supplemental Nutrition Assistance Program-Education. <i>J Nutr</i> . 2020. 150:2191-2198	Intervention/ Exposure
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220	Rose, D.,Heller, M. C.,Willits-Smith, A. M.,Meyer, R. J.. Carbon footprint of self-selected US diets: nutritional, demographic, and behavioral correlates. <i>Am J Clin Nutr</i> . 2019. 109:526-534	Intervention/ Exposure; Outcome
221	Rossen, L. M.,Kobernik, E. K.. Food insecurity and dietary intake among US youth, 2007-2010. <i>Pediatr Obes</i> . 2016. 11:187-93	Outcome
222	Rummo, P. E.,Meyer, K. A.,Boone-Heinonen, J.,Jacobs, D. R., Jr.,Kiefe, C. I.,Lewis, C. E.,Steffen, L. M.,Gordon-Larsen, P.. Neighborhood availability of convenience stores and diet quality: findings from 20 years of follow-up in the coronary artery risk development in young adults study. <i>Am J Public Health</i> . 2015. 105:e65-73	Data date range
223	Sanjeevi, N.,Freeland-Graves, J. H.. Association of Grocery Expenditure Relative to Thrifty Food Plan Cost with Diet Quality of Women Participating in the Supplemental Nutrition Assistance Program. <i>J Acad Nutr Diet</i> . 2018. 118:2315-2323	Comparator
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225	Sanjeevi, N.,Freeland-Graves, J.. Monthly Variations in Dietary Intake of Women Participating in the Supplemental Nutrition Assistance Program. <i>J Acad Nutr Diet</i> . 2019. 119:261-271	Intervention/ Exposure
226	Saxe-Custack, A.,LaChance, J.,Hanna-Attisha, M.,Ceja, T.. Fruit and Vegetable Prescriptions for Pediatric Patients Living in Flint, Michigan: A Cross-Sectional Study of Food Security and Dietary Patterns at Baseline. <i>Nutrients</i> . 2019. 11	Intervention/ Exposure; Outcome
227	Shah, B. S.,Freeland-Graves, J. H.,Cahill, J. M.,Lu, H.,Graves, G. R.. Diet quality as measured by the healthy eating index and the association with lipid profile in low-income women in early postpartum. <i>J Am Diet Assoc</i> . 2010. 110:274-9	Data date range
228	Sharkey, J. R.,Nalty, C.,Johnson, C. M.,Dean, W. R.. Children's very low food security is associated with increased dietary intakes in energy, fat, and added sugar among Mexican-origin children (6-11 y) in Texas border Colonias. <i>BMC Pediatr</i> . 2012. 12:16	Outcome

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230	Shiao, S. P. K.,Grayson, J.,Lie, A.,Yu, C. H.. Predictors of the Healthy Eating Index and Glycemic Index in Multi-Ethnic Colorectal Cancer Families. <i>Nutrients.</i> 2018. 10	Intervention/ Exposure
231	Shin, Dayeon, Lee, Kyung Won, Song, Won O.. Pre-Pregnancy Weight Status Is Associated with Diet Quality and Nutritional Biomarkers during Pregnancy. <i>Nutrients.</i> 2016; 8 (3):162.	Outcome
232	Silveira, B. K. S.,de Novaes, J. F.,Vieira, S. A.,Rocha, Dmup,Leal, A. C. G.,Hermsdorff, H. H. M.. Sociodemographic characteristics and dietary patterns in cardiometabolic risk subjects. <i>British Food Journal.</i> 2019. 121:2780-2790	Country
233	Spees, C. K.,Clark, J. E.,Hooker, N. H.,Watowicz, R. P.,Taylor, C. A.. Dietary Intake Contributions of Food and Beverages by Source and Food Security Status in US Adults. <i>J Nutr Educ Behav.</i> 2017. 49:667-673.e1	Intervention/ Exposure
234	Stein, C.,Cunha-Cruz, J.,Hugo, F. N.. Is dietary pattern a mediator of the relationship between socioeconomic status and dental caries?. <i>Clin Oral Investig.</i> 2021. :	Intervention/ Exposure
235	Stephenson, B. J. K.,Sotres-Alvarez, D.,Siega-Riz, A. M.,Mossavar-Rahmani, Y.,Daviglius, M. L.,Van Horn, L.,Herring, A. H.,Cai, J.. Empirically Derived Dietary Patterns Using Robust Profile Clustering in the Hispanic Community Health Study/Study of Latinos. <i>J Nutr.</i> 2020. 150:2825-2834	Intervention/ Exposure
236	Surkan, P. J.,Coutinho, A. J.,Christiansen, K.,Dennisuk, L. A.,Suratkar, S.,Mead, E.,Sharma, S.,Gittelsohn, J.. Healthy food purchasing among African American youth: associations with child gender, adult caregiver characteristics and the home food environment. <i>Public Health Nutrition.</i> 2011. 14:670-677	Outcome
237	Taillie, L. S.,Ng, S. W.,Xue, Y.,Harding, M.. Deal or no deal? The prevalence and nutritional quality of price promotions among U.S. food and beverage purchases. <i>Appetite.</i> 2017. 117:365-372	Outcome
238	Tan, M. L.,Laraia, B.,Madsen, K. A.,Au, L. E.,Frongillo, E. A.,Ritchie, L. D.. Child Food Insecurity Is Associated with Energy Intake among Fourth- and Fifth-Grade Girls. <i>J Acad Nutr Diet.</i> 2019. 119:1722-1731.e2	Intervention/ Exposure
239	Taylor, Christopher A.,Spees, Colleen K.,Markwordt, Alayna M.,Watowicz, Rosanna P.,Clark, Jill K.,Hooker, Neal H.. Differences in US Adult Dietary Patterns by Food Security Status. <i>Journal of Consumer Affairs.</i> 2017. 51:549-565	Intervention/ Exposure
240	Teufel-Shone, N. I.,Jiang, L. H.,Beals, J.,Henderson, W. G.,Zhang, L. J.,Acton, K. J.,Roubideaux, Y.,Manson, S. M.. Demographic characteristics and food choices of participants in the Special Diabetes Program for American Indians Diabetes Prevention Demonstration Project. <i>Ethnicity &amp; Health.</i> 2015. 20:327-340	Data date range
241	Thompson, T. L.,Singleton, C. R.,Springfield, S. E.,Thorpe, R. J., Jr.,Odoms-Young, A.. Differences in Nutrient Intake and Diet Quality Between Non-Hispanic Black and Non-Hispanic White Men in the United States. <i>Public Health Rep.</i> 2020. 135:334-342	Comparator
242	Thomson, J. L.,Onufrak, S. J.,Connell, C. L.,Zoellner, J. M.,Tussing-Humphreys, L. M.,Bogle, M. L.,Yadrick, K.. Food and beverage choices contributing to dietary guidelines adherence in the Lower Mississippi Delta. <i>Public Health Nutr.</i> 2011. 14:2099-109	Data date range
243	Thomson, J. L.,Zoellner, J. M.,Tussing-Humphreys, L. M.,Goodman, M. H.. Moderators of intervention dose effects on diet quality and physical activity changes in a church-based, multicomponent, lifestyle study: Delta Body and Soul III. <i>Health Educ Res.</i> 2016. 31:339-49	Intervention/ Exposure
244	Todd, Jessica E.. Changes in Eating Patterns and Diet Quality Among Working-Age Adults, 2005-2010. 2014	Outcome
245	Torres-Aguilar, P.,Teran-Garcia, M.,Wiley, A.,Raffaelli, M.,Morales, M.. Factors Correlated to Protective and Risk Dietary Patterns in Immigrant Latino Mothers in Non-metropolitan Rural Communities. <i>J Immigr Minor Health.</i> 2016. 18:652-659	Outcome



#	Citation	Exclusion rationale
246	Townsend, M. S., Aaron, G. J., Monsivais, P., Keim, N. L., Drewnowski, A.. Less-energy-dense diets of low-income women in California are associated with higher energy-adjusted diet costs. <i>Am J Clin Nutr.</i> 2009. 89:1220-6	Data date range
247	Tran, L. T., Brewster, P. J., Chidambaram, V., Hurdle, J. F.. Towards Measuring the Food Quality of Grocery Purchases: an Estimation Model of the Healthy Eating Index-2010 Using only Food Item Counts. <i>Procedia Food Sci.</i> 2015. 4:148-159	Intervention/ Exposure
248	Trapp, C. M., Burke, G., Gorin, A. A., Wiley, J. F., Hernandez, D., Crowell, R. E., Grant, A., Beaulieu, A., Cloutier, M. M.. The relationship between dietary patterns, body mass index percentile, and household food security in young urban children. <i>Child Obes.</i> 2015. 11:148-55	Outcome
249	Treviño, R. P., Vasquez, L., Shaw-Ridley, M., Mosley, D., Jechow, K., Piña, C.. Outcome of a food observational study among low-income preschool children participating in a family-style meal setting. <i>Health Educ Behav.</i> 2015. 42:240-8	Intervention/ Exposure; Outcome; Comparator
250	Trude, A. C. B., Black, M. M., Surkan, P. J., Hurley, K. M., Wang, Y.. Maternal anxiety and diet quality among mothers and toddlers from low-income households. <i>Matern Child Nutr.</i> 2020. 16:e12992	Comparator
251	Truesdale, K. P., Matheson, D. M., JaKa, M. M., McAleer, S., Sommer, E. C., Pratt, C. A.. Baseline diet quality of predominantly minority children and adolescents from households characterized by low socioeconomic status in the Childhood Obesity Prevention and Treatment Research (COPTTR) Consortium. <i>BMC Nutr.</i> 2019. 5:38	Intervention/ Exposure
252	Vadiveloo, M. K., Parker, H. W., Juul, F., Parekh, N.. Sociodemographic Differences in the Dietary Quality of Food-at-Home Acquisitions and Purchases among Participants in the U.S. Nationally Representative Food Acquisition and Purchase Survey (FoodAPS). <i>Nutrients.</i> 2020. 12:	Outcome (Purchase data)
253	Vadiveloo, M., Guan, X., Parker, H. W., Perraud, E., Buchanan, A., Atlas, S., Thorndike, A. N.. Effect of Personalized Incentives on Dietary Quality of Groceries Purchased: A Randomized Crossover Trial. <i>JAMA Netw Open.</i> 2021. 4:e2030921	Intervention/ Exposure
254	Vadiveloo, M., Perraud, E., Parker, H. W., Juul, F., Parekh, N.. Geographic Differences in the Dietary Quality of Food Purchases among Participants in the Nationally Representative Food Acquisition and Purchase Survey (FoodAPS). <i>Nutrients.</i> 2019. 11:	Outcome (Purchase data)
255	Ver Ploeg, Michele, Rahko vs.ky, Ilya. Recent Evidence on the Effects of Food Store Access on Food Choice and Diet Quality. 2016. :1	Outcome; Study design
256	Wang, D. D., Leung, C. W., Li, Y., Ding, E. L., Chiuve, S. E., Hu, F. B., Willett, W. C.. Trends in dietary quality among adults in the United States, 1999 through 2010. <i>JAMA Intern Med.</i> 2014. 174:1587-95	Outcome
257	Wang, Y., Chen, X.. How much of racial/ethnic disparities in dietary intakes, exercise, and weight status can be explained by nutrition- and health-related psychosocial factors and socioeconomic status among US adults?. <i>J Am Diet Assoc.</i> 2011. 111:1904-11	Data date range
258	Wang, Y., Jahns, L., Tussing-Humphreys, L., Xie, B., Rockett, H., Liang, H., Johnson, L.. Dietary intake patterns of low-income urban african-american adolescents. <i>J Am Diet Assoc.</i> 2010. 110:1340-5	Intervention/ Exposure
259	Weinfield, N. S., Borger, C., Au, L. E., Whaley, S. E., Berman, D., Ritchie, L. D.. Longer Participation in WIC Is Associated with Better Diet Quality in 24-Month-Old Children. <i>J Acad Nutr Diet.</i> 2020. 120:963-971	Intervention/ Exposure
260	Wen, X., Kong, K. L., Eiden, R. D., Sharma, N. N., Xie, C.. Sociodemographic differences and infant dietary patterns. <i>Pediatrics.</i> 2014. 134:e1387-98	Data date range
261	Whiteman, E. D., Chrisinger, B. W., Hillier, A.. Diet Quality Over the Monthly Supplemental Nutrition Assistance Program Cycle. <i>Am J Prev Med.</i> 2018. 55:205-212	Outcome (Purchase data)
262	Wilson, Magdalena M., Reedy, Jill, Krebs-Smith, Susan M.. American Diet Quality: Where It Is, Where It Is Heading, and What It Could Be. <i>Journal of the Academy of Nutrition and Dietetics.</i> 2016. 116:302-310.e1	Intervention/ Exposure

#	Citation	Exclusion rationale
263	Woodruff, R. C.,Haardörfer, R.,Raskind, I. G.,Hermstad, A.,Kegler, M. C.. Comparing food desert residents with non-food desert residents on grocery shopping behaviours, diet and BMI: results from a propensity score analysis. <i>Public Health Nutr.</i> 2020. 23:806-811	Outcome
264	Wright, B. N.,Bailey, R. L.,Craig, B. A.,Mattes, R. D.,McCormack, L.,Stluka, S.,Franzen-Castle, L.,Henne, B.,Mehrlé, D.,Remley, D.,Eicher-Miller, H. A.. Daily Dietary Intake Patterns Improve after Visiting a Food Pantry among Food-Insecure Rural Midwestern Adults. <i>Nutrients.</i> 2018. 10:	Intervention/ Exposure
265	Wright, B. N.,Tooze, J. A.,Bailey, R. L.,Liu, Y.,Rivera, R. L.,McCormack, L.,Stluka, S.,Franzen-Castle, L.,Henne, B.,Mehrlé, D.,Remley, D.,Eicher-Miller, H. A.. Dietary Quality and Usual Intake of Underconsumed Nutrients and Related Food Groups Differ by Food Security Status for Rural, Midwestern Food Pantry Clients. <i>J Acad Nutr Diet.</i> 2020. 120:1457-1468	Intervention/ Exposure
266	Wright, B. N.,Vasquez-Mejia, C. M.,Guenther, P. M.,McCormack, L.,Stluka, S.,Franzen-Castle, L.,Henne, B.,Mehrlé, D.,Remley, D.,Eicher-Miller, H. A.. Fruit and Vegetable Healthy Eating Index Component Scores of Distributed Food Bags Were Positively Associated with Client Diet Scores in a Sample of Rural, Midwestern Food Pantries. <i>J Acad Nutr Diet.</i> 2021. 121:74-83	Intervention/ Exposure
267	Young, C. M.,Batch, B. C.,Svetkey, L. P.. Effect of socioeconomic status on food availability and cost of the Dietary Approaches to Stop Hypertension (DASH) dietary pattern. <i>J Clin Hypertens (Greenwich).</i> 2008. 10:603-11	Data date range
268	Zarnowiecki, D.,Ball, K.,Parletta, N.,Dollman, J.. Describing socioeconomic gradients in children's diets - does the socioeconomic indicator used matter?. <i>Int J Behav Nutr Phys Act.</i> 2014. 11:44	Country
269	Zhang, Q.,Wang, Y. F.. Socioeconomic and Racial/Ethnic Disparity in Americans' Adherence to Federal Dietary Recommendations. <i>Journal of the Academy of Nutrition and Dietetics.</i> 2012. 112:614-616	Study design
270	Zimmer, M. C.,Rubio, V.,Kintziger, K. W.,Barroso, C.. Racial/Ethnic Disparities in Dietary Intake of U.S. Children Participating in WIC. <i>Nutrients.</i> 2019. 11	Outcome
271	Zimmer, M. C.,Vernarelli, J. A.. Select Food Group Intake of US Children Aged 2 to 4 Years by WIC Participation Status and Income. <i>J Acad Nutr Diet.</i> 2020. 120:2032-2038.e1	Outcome

## Appendix 3-a: Literature search strategy for the rapid review on diet cost and HEI

Database: PubMed  
Vendor: National Library of Medicine  
Date of Search: June 18, 2021  
Limits Used: Filters: Language English; Publication Dates 2008 - 2021  
Total = 1,152

Search #	Concept	Search String	N
#1	Diet	"Food and Beverages"[Mesh] OR food*[tiab] OR "Diet, Healthy"[Mesh] OR "healthy diet*[tiab] OR "unhealthy diet*[tiab] OR diet[tiab]	1,283,793
#2	Price/Cost	"Costs and Cost Analysis"[Mesh] OR cost*[tiab] OR price*[tiab] OR pricing*[tiab] OR affordab*[tiab] OR expense*[tiab] OR expenditure*[tiab] OR budget*[tiab] OR purchas*[tiab] OR cash[tiab] OR money[tiab] OR monetary[tiab] OR monies[tiab]	945,938
#3	HEI (including dietary patterns terms)	HEI OR "healthy eating index" OR "diet quality"[tiab] OR "dietary quality"[tiab] OR "dietary guidelines" OR "dietary recommendation*[tiab] OR "dietary intake*[tiab] OR "dietary consumption"[tiab] OR "eating style*[tiab] OR "Guideline Adherence"[Mesh] OR "guideline adherence*[tiab] OR "diet score*[tiab] OR "diet quality score*[tiab] OR "diet quality index*[tiab] OR "diet index*[tiab] OR "dietary index*[tiab] OR "food score*[tiab] OR "dietary pattern*[tiab] OR "diet pattern*[tiab] OR "eating pattern*[tiab] OR "food pattern*[tiab]	88,968
#4		#1 AND #2 AND #3	3,188
#5	Non-United States	#1 AND #2 AND #3 NOT ("Developing Countries"[Mesh] OR "developing countr*" OR "Under Developed Nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC[tiab] OR "Europe"[Mesh] OR "Australia"[Mesh] OR "Asia"[Mesh] OR "Africa"[Mesh] OR "Mexico"[Mesh] OR "Islands"[Mesh] OR "Central America"[Mesh] OR "Latin America"[Mesh] OR "South America"[Mesh])	2,146
#6	Publication Excludes	NOT (letter[ptyp] OR editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR editorial[tiab] OR commentary[tiab] OR "conference abstract*[tiab] OR "systematic review*[ti] OR "meta-analysis"[ptyp] OR "meta-analysis"[ti] OR "meta-analyses"[ti] OR "Review"[Publication Type] OR "Systematic Review"[Publication Type] OR "conference proceeding*[tiab] OR "retracted publication"[ptyp] OR "retraction of publication"[ptyp] OR "retraction of publication"[tiab] OR "retraction notice"[ti] OR "retracted publication"[tiab] OR "Published Erratum"[Publication Type] OR corrigenda[tiab] OR	1,657

		corrigendum[tiab] OR errata[tiab] OR erratum[tiab] OR protocol[ti] OR protocols[ti] OR "case report"[ti] OR "case series"[ti] OR "Case Reports" [Publication Type])	
#7	Animal Excludes	NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh]))	1,562
#8	Limits: Language/Dates	Filters: English, from 2008 - 2021	1,152

**Database: Business Source Premier**

**Vendor: EBSCO**

**Date of Search: June 18, 2021**

**Limits Used: Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English**

**Total = 887**

Search #	Concept	Search String	N
#1	Diet	(DE "BEVERAGE consumption") OR (DE "FOOD consumption forecasting") OR (DE "FOOD consumption statistics") OR food* OR "healthy diet*" OR "unhealthy diet"	704,148
#2	Price/Cost	(DE "FOOD prices") OR cost* OR price* OR pricing OR affordab* OR expense* OR expenditure* OR budget* OR purchas* OR cash OR money OR monetary OR monies	3,680,852
#3	HEI (including dietary patterns terms)	HEI OR "healthy eating index" OR "diet quality" OR "dietary quality" OR "dietary guidelines" OR "dietary recommendation*" OR "dietary intake*" OR "dietary consumption" OR "eating style*" OR "guideline adherence*" OR "diet score*" OR "diet quality score*" OR "diet quality index*" OR "diet index*" OR "dietary index*" OR "food score*" OR "dietary pattern*" OR "diet pattern*" OR "eating pattern*" OR "food pattern"	11,319
#4		#1 AND #2 AND #3	2,269
#5	Filters	Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English	887

**Database: Web of Science: Core Collection**

**Vendor: Clarivate Analytics**

**Date of Search: 6/18/2021**

**Limits Used: Years: 2008-2021; Publication Types: Articles, Early Access; Language: English**

**Total = 2,022**

Search #	Concept	Search String	N
#1	Diet	(TS=(food* OR "healthy diet*" OR "unhealthy diet*" )	824,277

#2	Price/Cost	(TS=(cost* OR price* OR affordab* OR expense* OR expenditure* OR budget* OR purchas* OR cash OR money OR monetary OR monies ) )	1,873,881
#3	HEI	(TS=( HEI OR "healthy eating index" OR "diet quality" OR "dietary quality" OR "dietary guidelines" OR "dietary recommendation*" OR "dietary intake*" OR "dietary consumption" OR "eating style*" OR "guideline adherence*" OR "diet score*" OR "diet quality score*" OR "diet quality index*" OR "diet index*" OR "dietary index*" OR "food score*" OR "dietary pattern*" OR "diet pattern*" OR "eating pattern*" OR "food pattern*"))	64,270
#4	#1 AND #2 AND #3		3,559
#5	Non-United States Excludes	CU=("developing countr*" OR "under developed nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle income countr*" OR LMIC OR Europe OR Australia OR Asia OR Africa OR Mexico OR Islands OR "Central America" OR "Latin America" OR "South America")	2,061,484
#6	#4 NOT #5		3,137
#7	Publication Excludes	TS=(editorial OR commentary OR "conference abstract*" OR "conference proceeding*" [tiab] OR "retraction of publication" OR "retracted publication" OR corrigenda [tiab] OR corrigendum [tiab] OR errata OR erratum OR "case reports" ) OR TI=("systematic review" OR "meta-analysis" OR "meta analyses" OR protocol OR protocols OR "retraction notice" OR "case report" OR "case series")	721,284
#8	#6 NOT #7		3,054
#9		Years: 2008-2021; Publication Types: Articles, Early Access; Language: English	2,022

### Grey Literature Search:

#### Google Scholar

(Food OR diet) AND (Price OR cost OR budget OR money) AND (HEI OR "healthy eating index" OR dietary)

Limits: Date Published: 2008-2021;

Date Searched: 6/18/2021

Results: 50, limited to 5 pages

#### Google

site:.gov AND (diet OR food) AND (cost OR price) AND "healthy eating index"

Limits:

Date Searched: 6/18/2021

Results: Date Published: 30, limited to 3 pages

#### AgEcon

Any of the words: food diet

AND

Any of the words: cost price

AND

Any of the words: HEI "healthy eating index" dietary

Limits: Added/Modified since: 2008;

Date Searched: 6/21/2021

Results: Date Published: 40, limited to 4 pages

## Appendix 3-b: Excluded articles for the rapid review on diet cost and HEI

The following table lists the articles excluded after full-text screening for this rapid review question. At least 1 reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

#	Bibliography	Exclusion rationale
1	affordable healthy food: Topics by Science.gov, 2021	Publication status
2	Federal Register, Volume 85 Issue 228 (Wednesday, November 25, 2020). 2020	Publication status
3	Healthy Eating Index (HEI)   USDA-FNS. 2021	Publication status
4	Research Rundown: USDA School Nutrition and Meal Cost Study. 2019;	Publication status
5	TFCO Access to Healthy Affordable Food	Outcome, Study design
6	Acheampong, I.,Haldeman, L. Are nutrition knowledge, attitudes, and beliefs associated with obesity among low-income Hispanic and African American women caretakers?. <i>J Obes.</i> 2013; 2013 :123901. doi: 10.1155/2013/123901.	Intervention/Exposure, Outcome
7	Aggarwal, A.,Drewnowski, A. Plant- and animal-protein diets in relation to sociodemographic drivers, quality, and cost: findings from the Seattle Obesity Study. <i>Am J Clin Nutr.</i> 2019; 110 (2):451-460. doi: 10.1093/ajcn/nqz064.	Outcome
8	Aggarwal, A.,Monsivais, P.,Cook, A. J.,Drewnowski, A. Does diet cost mediate the relation between socioeconomic position and diet quality?. <i>Eur J Clin Nutr.</i> 2011; 65 (9):1059-66. doi: 10.1038/ejcn.2011.72.	Outcome
9	Aggarwal, A.,Monsivais, P.,Cook, A. J.,Drewnowski, A. Positive attitude toward healthy eating predicts higher diet quality at all cost levels of supermarkets. <i>J Acad Nutr Diet.</i> 2014; 114 (2):266-72. doi: 10.1016/j.jand.2013.06.006.	Outcome
10	Aggarwal, A.,Monsivais, P.,Drewnowski, A. Nutrient intakes linked to better health outcomes are associated with higher diet costs in the US. <i>PLoS One.</i> 2012; 7 (5):e37533. doi: 10.1371/journal.pone.0037533.	Outcome
11	Aggarwal, A.,Rehm, C. D.,Monsivais, P.,Drewnowski, A. Importance of taste, nutrition, cost and convenience in relation to diet quality: Evidence of nutrition resilience among US adults using National Health and Nutrition Examination Survey (NHANES) 2007-2010. <i>Prev Med.</i> 2016; 90 :184-92. doi: 10.1016/j.ypmed.2016.06.030.	Intervention/Exposure
12	Amenyenu, Anonya,Tegegne, Fisseha,Singh, Surendra P.,Ekanem, Enefiok. Knowledge of 2005 Dietary Guidelines and Food Consumption Habits of African-Americans in Tennessee. <i>Journal of Food Distribution Research.</i> 2010; 41 (1):1-4.	Intervention/Exposure, Data date range
13	Appelhans, B. M.,French, S. A.,Tangney, C. C.,Powell, L. M.,Wang, Y. To what extent do food purchases reflect shoppers' diet quality and nutrient intake?. <i>Int J Behav Nutr Phys Act.</i> 2017; 14 (1):46. doi: 10.1186/s12966-017-0502-2.	Intervention/Exposure
14	Appelhans, B. M.,Milliron, B. J.,Woolf, K.,Johnson, T. J.,Pagoto, S. L.,Schneider, K. L.,Whited, M. C.,Ventrelle, J. C. Socioeconomic status, energy cost, and nutrient content of supermarket food purchases. <i>Am J Prev Med.</i> 2012; 42 (4):398-402. doi: 10.1016/j.amepre.2011.12.007.	Outcome
15	Appelhans, B. M.,Tangney, C. C.,French, S. A.,Crane, M. M.,Wang, Y. Delay discounting and household food purchasing decisions: The SHoPPER study. <i>Health Psychol.</i> 2019; 38 (4):334-342. doi: 10.1037/hea0000727.	Intervention/Exposure
16	Basu, S.,Gardner, C. D.,White, J. S.,Rigdon, J.,Carroll, M. M.,Akers, M.,Seligman, H. K. Effects Of Alternative Food Voucher Delivery Strategies On Nutrition Among Low-Income Adults. <i>Health Aff (Millwood).</i> 2019; 38 (4):577-584. doi: 10.1377/hlthaff.2018.05405.	Intervention/Exposure
17	Basu, S.,Seligman, H.,Bhattacharya, J. Nutritional policy changes in the supplemental nutrition assistance program: a microsimulation and cost-effectiveness analysis. <i>Med Decis Making.</i> 2013; 33 (7):937-48. doi: 10.1177/0272989X13493971.	Intervention/Exposure



#	Bibliography	Exclusion rationale
18	Baudry, J.,Pointereau, P.,Seconda, L.,Vidal, R.,Taupier-Letage, B.,Langevin, B.,Alles, B.,Galan, P.,Herberg, S.,Amiot, M. J.,Boizot-Szantai, C.,Hamza, O.,Cravedi, J. P.,Debrauwer, L.,Soler, L. G.,Lairon, D.,Kesse-Guyot, E. Improvement of diet sustainability with increased level of organic food in the diet: findings from the BioNutriNet cohort. <i>American Journal of Clinical Nutrition</i> . 2019; 109 (4):1173-1188. doi: 10.1093/ajcn/nqy361.	Country
19	Beheshti, R.,Jones-Smith, J. C.,Igusa, T. Taking dietary habits into account: A computational method for modeling food choices that goes beyond price. <i>PLoS One</i> . 2017; 12 (5):e0178348. doi: 10.1371/journal.pone.0178348.	Outcome, Data date range
20	Bernstein, A. M.,Bloom, D. E.,Rosner, B. A.,Franz, M.,Willett, W. C. Relation of food cost to healthfulness of diet among US women. <i>Am J Clin Nutr</i> . 2010; 92 (5):1197-203. doi: 10.3945/ajcn.2010.29854.	Data date range
21	Bessesms, Kmhh,Linssen, E.,Lomme, M.,Van Assema, P. The Effectiveness of the Good Affordable Food Intervention for Adults with Low Socioeconomic Status and Small Incomes. <i>International Journal of Environmental Research and Public Health</i> . 2020; 17 (7) doi: 10.3390/ijerph17072535.	Outcome
22	Beydoun, M. A.,Nkodo, A.,Fanelli-Kuczmariski, M. T.,Maldonado, A. I.,Beydoun, H. A.,Popkin, B. M.,Evans, M. K.,Zonderman, A. B. Longitudinal Associations between Monetary Value of the Diet, DASH Diet Score and the Allostatic Load among Middle-Aged Urban Adults. <i>Nutrients</i> . 2019; 11 (10) doi: 10.3390/nu11102360.	Outcome
23	Beydoun, M. A.,Powell, L. M.,Chen, X.,Wang, Y. Food prices are associated with dietary quality, fast food consumption, and body mass index among U.S. children and adolescents. <i>J Nutr</i> . 2011; 141 (2):304-11. doi: 10.3945/jn.110.132613.	Intervention/Exposure, Data date range
24	Beydoun, M. A.,Powell, L. M.,Wang, Y. Reduced away-from-home food expenditure and better nutrition knowledge and belief can improve quality of dietary intake among US adults. <i>Public Health Nutr</i> . 2009; 12 (3):369-81. doi: 10.1017/S1368980008002140.	Intervention/Exposure, Data date range
25	Beydoun, M. A.,Powell, L. M.,Wang, Y. The association of fast food, fruit and vegetable prices with dietary intakes among US adults: is there modification by family income?. <i>Soc Sci Med</i> . 2008; 66 (11):2218-29. doi: 10.1016/j.socscimed.2008.01.018.	Intervention/Exposure, Data date range
26	Beydoun, M. A.,Wang, Y. How do socio-economic status, perceived economic barriers and nutritional benefits affect quality of dietary intake among US adults?. <i>Eur J Clin Nutr</i> . 2008; 62 (3):303-13. doi: 10.1038/sj.ejcn.1602700.	Data date range
27	Bouis, H. E.,Eozenou, P.,Rahman, A. Food prices, household income, and resource allocation: Socioeconomic perspectives on their effects on dietary quality and nutritional status. <i>Food and Nutrition Bulletin</i> . 2011; 32 (1):S14-S23. doi: 10.1177/15648265110321S103.	Country
28	Brewster, P. J.,Durward, C. M.,Hurdle, J. F.,Stoddard, G. J.,Guenther, P. M. The Grocery Purchase Quality Index-2016 Performs Similarly to the Healthy Eating Index-2015 in a National Survey of Household Food Purchases. <i>J Acad Nutr Diet</i> . 2019; 119 (1):45-56. doi: 10.1016/j.jand.2018.08.165.	Intervention/Exposure
29	Brewster, P. J.,Guenther, P. M.,Jordan, K. C.,Hurdle, J. F. The Grocery Purchase Quality Index-2016: An innovative approach to assessing grocery food purchases. <i>Journal of Food Composition and Analysis</i> . 2017; 64 :119-126. doi: 10.1016/j.jfca.2017.07.012.	Intervention/Exposure
30	Carlson, A.,Dong, D. S.,Lino, M. Association between Total Diet Cost and Diet Quality Is Limited. <i>Journal of Agricultural and Resource Economics</i> . 2014; 39 (1):47-68.	Data date range
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118	Sheldon, M.,Gans, K. M.,Tai, R.,George, T.,Lawson, E.,Pearlman, D. N. Availability, affordability, and accessibility of a healthful diet in a low-income community, Central Falls, Rhode Island, 2007-2008. <i>Prev Chronic Dis.</i> 2010; 7 (2):A43.	Outcome
119	Silver, L. D.,Ng, S. W.,Ryan-Ibarra, S.,Taillie, L. S.,Induni, M.,Miles, D. R.,Poti, J. M.,Popkin, B. M. Changes in prices, sales, consumer spending, and beverage consumption one year after a tax on sugar-sweetened beverages in Berkeley, California, US: A before-and-after study. <i>PLoS Med.</i> 2017; 14 (4):e1002283. doi: 10.1371/journal.pmed.1002283.	Outcome
120	Smith, T. A.,Valizadeh, P.,Lin, B. H.,Coats, E. What is driving increases in dietary quality in the United States?. <i>Food Policy.</i> 2019; 86 doi: 10.1016/j.foodpol.2019.05.003.	Intervention/Exposure
121	Sogari, Giovanni,Velez-Argumedo, Catalina,Gómez, Miguel I.,Mora, Cristina. College Students and Eating Habits: A Study Using An Ecological Model for Healthy Behavior. . . 2019; doi: 10.22004/ag.econ.300040.	Outcome
122	Sturm, R.,Datar, A. Regional price differences and food consumption frequency among elementary school children. <i>Public Health.</i> 2011; 125 (3):136-41. doi: 10.1016/j.puhe.2010.11.016.	Outcome

#	Bibliography	Exclusion rationale
123	Surkan, P. J., Coutinho, A. J., Christiansen, K., Dennisuk, L. A., Suratkar, S., Mead, E., Sharma, S., Gittelsohn, J. Healthy food purchasing among African American youth: associations with child gender, adult caregiver characteristics and the home food environment. <i>Public Health Nutrition</i> . 2011; 14 (4):670-677. doi: 10.1017/S136898001000251X.	Outcome
124	Tiwari, A., Aggarwal, A., Tang, W., Drewnowski, A. Cooking at Home: A Strategy to Comply With U.S. Dietary Guidelines at No Extra Cost. <i>Am J Prev Med</i> . 2017; 52 (5):616-624. doi: 10.1016/j.amepre.2017.01.017.	Comparator
125	Tran, L. T., Brewster, P. J., Chidambaram, V., Hurdle, J. F. Towards Measuring the Food Quality of Grocery Purchases: an Estimation Model of the Healthy Eating Index-2010 Using only Food Item Counts. <i>Procedia Food Sci</i> . 2015; 4 :148-159. doi: 10.1016/j.profoo.2015.06.020.	Intervention/Exposure
126	Vadiveloo, M. K., Parker, H. W., Juul, F., Parekh, N. Sociodemographic Differences in the Dietary Quality of Food-at-Home Acquisitions and Purchases among Participants in the U.S. Nationally Representative Food Acquisition and Purchase Survey (FoodAPS). <i>Nutrients</i> . 2020; 12 (8) doi: 10.3390/nu12082354.	Intervention/Exposure
127	Vadiveloo, M., Guan, X., Parker, H. W., Perraud, E., Buchanan, A., Atlas, S., Thorndike, A. N. Effect of Personalized Incentives on Dietary Quality of Groceries Purchased: A Randomized Crossover Trial. <i>JAMA Netw Open</i> . 2021; 4 (2):e2030921. doi: 10.1001/jamanetworkopen.2020.30921.	Intervention/Exposure, Outcome
128	Vadiveloo, M., Perraud, E., Parker, H. W., Juul, F., Parekh, N. Geographic Differences in the Dietary Quality of Food Purchases among Participants in the Nationally Representative Food Acquisition and Purchase Survey (FoodAPS). <i>Nutrients</i> . 2019; 11 (6) doi: 10.3390/nu11061233.	Intervention/Exposure
129	Vilaro, M. J., Barnett, T. E., Mathews, A., Pomeranz, J., Curbow, B. Income differences in social control of eating behaviors and food choice priorities among southern rural women in the US: A qualitative study. <i>Appetite</i> . 2016; 107 :604-612. doi: 10.1016/j.appet.2016.09.003.	Outcome
130	Vogel, C., Ntani, G., Inskip, H., Barker, M., Cummins, S., Cooper, C., Moon, G., Baird, J. Education and the Relationship Between Supermarket Environment and Diet. <i>Am J Prev Med</i> . 2016; 51 (2):e27-e34. doi: 10.1016/j.amepre.2016.02.030.	Country
131	Volpe, Richard, Cai, Xiaowei, Schroeter, Christiane, Mancino, Lisa. Adherence to Dietary Recommendations and Food Retail Market Structure: Is There a Connection?. <i>Journal of Agricultural &amp; Food Industrial Organization</i> . 2020; :1. doi: 10.1515/jafio-2019-0035.	Outcome
132	Wang, M., Levi, R., Seligman, H. New SNAP Eligibility in California Associated With Improved Food Security and Health. <i>Prev Chronic Dis</i> . 2021; 18 :E28. doi: 10.5888/pcd18.200587.	Intervention/Exposure, Outcome
133	Weatherspoon, D. D., Miller, S. R., Steele, M. E., Newkirk, C. J., Santiago, O., Dembele, A. S., Hoerr, S. L. What Social, Program, and Behavioral Factors Influence the Healthy Eating Index for EFNEP and SNAP-Ed Adult Participants?. <i>Am J Lifestyle Med</i> . 2017; 11 (4):344-353. doi: 10.1177/1559827615607194.	Intervention/Exposure
134	Whiteman, E. D., Chrisinger, B. W., Hillier, A. Diet Quality Over the Monthly Supplemental Nutrition Assistance Program Cycle. <i>Am J Prev Med</i> . 2018; 55 (2):205-212. doi: 10.1016/j.amepre.2018.04.027.	Intervention/Exposure, Outcome
135	Wilcox, S., Sharpe, P. A., Liese, A. D., Dunn, C. G., Hutto, B. Socioeconomic factors associated with diet quality and meeting dietary guidelines in disadvantaged neighborhoods in the Southeast United States. <i>Ethn Health</i> . 2020; 25 (8):1115-1131. doi: 10.1080/13557858.2018.1493434.	Intervention/Exposure
136	Wilde, Parke E., Llobrera, Joseph. Using the Thrifty Food Plan to Assess the Cost of a Nutritious Diet. <i>Journal of Consumer Affairs</i> . 2009; 43 (2):274-304. doi: 10.1111/j.1745-6606.2009.01140.x.	Outcome

#	Bibliography	Exclusion rationale
137	Willits-Smith, A., Aranda, R., Heller, M. C., Rose, D. Addressing the carbon footprint, healthfulness, and costs of self-selected diets in the USA: a population-based cross-sectional study. <i>Lancet Planet Health</i> . 2020; 4 (3):e98-e106. doi: 10.1016/S2542-5196(20)30055-3.	Intervention/Exposure
138	You, W., Zhang, G., Davy, B. M., Carlson, A., Lin, B. H. Food consumed away from home can be a part of a healthy and affordable diet. <i>J Nutr</i> . 2009; 139 (10):1994-9. doi: 10.3945/jn.109.107615.	Data date range
139	Young, C. M., Batch, B. C., Svetkey, L. P. Effect of socioeconomic status on food availability and cost of the Dietary Approaches to Stop Hypertension (DASH) dietary pattern. <i>J Clin Hypertens (Greenwich)</i> . 2008; 10 (8):603-11. doi: 10.1111/j.1751-7176.2008.08199.x.	Outcome, Multiple food groups



## Appendix 4-a: Literature search strategy for the rapid review on income and time spent on food-at-home-related activities

Database: PubMed  
Vendor: National Library of Medicine  
Date of Search: 5/3/2021  
Limits Used: Filters: Language English Publication Dates 2008 - 2021  
Total = 2,401

Search #	Concept	Search String	N
#1	Income	( "Income"[Mesh] OR income*[tiab] OR "Socioeconomic Factors"[Mesh] OR socioeconomic*[tiab] OR socio-economic*[tiab] OR "social factor*" [tiab] OR "social condition*" [tiab] OR poverty [tiab] OR "Residence Characteristics"[Mesh] OR "Vulnerable Populations"[Mesh] OR "vulnerable population*" [tiab] OR "underserved population*" [tiab] OR "disadvantaged population*" [tiab] OR "Race Factors"[Mesh] OR "race factor*" [tiab] OR "Ethnic Groups"[Mesh] OR "ethnic group*" [tiab] OR "ethnic population*" [tiab] OR "Cross-Cultural Comparison"[Mesh] OR "cross-cultural" [tiab] OR transcultural [tiab] OR "Cultural Characteristics"[Mesh] OR "cultural characteristic*" [tiab] OR "Cultural Diversity"[Mesh] OR "culturally diverse" [tiab] OR "Food Supply"[Mesh] OR "food desert*" [tiab] OR "food insecurity*" [tiab] OR "food environment*" [tiab] OR "food access" [tiab] OR Urban [tiab] OR Rural [tiab] OR neighborhood [tiab] OR "Census tract" [tiab] OR "census block" [tiab] OR "food assistance" [MeSH Terms] OR "food assistance" [Tiab])	1,082,156
#2	Time	("Time Factors"[MeSH] OR "Time Management"[MeSH] OR Time [tiab])	4,181,306
#3	Food Related Activities	(home*[tiab] OR domestic [tiab] OR family [tiab] OR families [tiab] OR house*[tiab]) AND ("Feeding Behavior"[Mesh] OR cooking [MeSH] OR Eating [MeSH] OR Food [MeSH] OR cook*[tiab] OR eat [tiab] OR eats [tiab] OR eating [tiab] OR eaten [tiab] OR Food [tiab] OR meal*[tiab] OR kitchen [tiab] OR clean*[tiab] OR dishwasher*[tiab] OR (wash*[tiab] AND (dish [tiab] OR dishes [tiab])))	74,178
#4	#1 AND #2 AND #3		3,718
#5	Publication, Geography, and species excludes	#1 AND #2 AND #3 NOT ( (letter [ptyp] OR editorial [ptyp] OR comment [ptyp] OR news [ptyp] OR "Congress" [Publication Type] OR "Consensus Development Conference" [Publication Type] OR editorial [tiab] OR commentary [tiab] OR "conference abstract*" [tiab] OR "systematic review*" [ti] OR "meta-analysis" [ptyp] OR "meta-analysis" [ti] OR	3,465



		<p>"meta-analyses"[ti] OR "Review"[Publication Type] OR "Systematic Review"[Publication Type] OR "conference proceeding"[tiab] OR "retracted publication"[ptyp] OR "retraction of publication"[ptyp] OR "retraction of publication"[tiab] OR "retraction notice"[ti] OR "retracted publication"[tiab] OR "Published Erratum"[Publication Type] OR corrigenda[tiab] OR corrigendum[tiab] OR errata[tiab] OR erratum[tiab] OR protocol[ti] OR protocols[ti] OR "case report"[ti] OR "case series"[ti] OR "Case Reports" [Publication Type])</p> <p>NOT</p> <p>("Developing Countries"[Mesh] OR "developing countr*" OR "Under Developed Nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC[tiab] OR "Europe"[Mesh] OR "Australia"[Mesh] OR "Asia"[Mesh] OR "Africa"[Mesh] OR "Mexico"[Mesh] OR "Islands"[Mesh] OR "Central America"[Mesh] OR "Latin America"[Mesh] OR "South America"[Mesh])</p> <p>)</p> <p>NOT</p> <p>("Animals"[Mesh] NOT</p> <p>("Animals"[Mesh] AND "Humans"[Mesh])</p> <p>)</p>	
#6	Filters	Filters: Language: English; Publication Dates: 2008-2021	2,401

Database: Business Source Premier

Vendor: EBSCO

Date of Search: 5/3/2021

Limits Used: Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English

Total = 950

Search #	Concept	Search String	N
#1	Income	(DE "SOCIOECONOMIC factors") OR socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR (DE "POVERTY") OR poverty OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR (DE "INCOME") OR income* OR "race factor*" OR (DE "ECONOMIC conditions of ethnic groups") OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR (DE "FOOD supply") OR "food desert*" OR "food insecurit*" OR "food environment*" OR "food access" OR (DE "METROPOLITAN areas") OR Urban OR Rural OR neighborhood OR "Census tract" OR "census block" OR "food assistance"	1,177,425
#2	Time	(DE "TIME management" OR Time)	1,359,692

#3	Food Related Activities	((home* OR domestic OR family OR families OR house*) AND (DE "FOOD safety" OR cook* OR eat* OR Food OR meal* OR kitchen OR clean* OR dishwasher* OR (wash* AND (dish OR dishes))))	127,582
#4	#1 AND #2 AND #3		1,856
#5	Filters	Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English	950

Database: Web of Science: Core Collection

Vendor: Clarivate Analytics

Date of Search: 5/3/2021

Limits Used:

Total = 3,545

Search #	Concept	Search String	N
#1	Income	TS=(socioeconomic* OR socio-economic* OR "social factor*" OR "social condition*" OR poverty OR "residence characteristics" OR "vulnerable population*" OR "underserved population*" OR "disadvantaged population*" OR income* OR "race factor*" OR "ethnic group*" OR "ethnic population*" OR "cross-cultural" OR transcultural OR "cultural characteristic*" OR "culturally diverse" OR "food desert*" OR "food insecurity*" OR Urban OR Rural OR neighborhood OR "Census tract" OR "census block" OR "food assistance")	1,019,047
#2	Time	TS=time	6,476,056
#3	Food Related Activities	TS=((home* OR domestic OR family OR families OR house*) AND ("FOOD safety" OR cook* OR eat* OR Food OR meal* OR kitchen OR clean* OR dishwasher* OR (wash* AND (dish OR dishes))))	119,957
#4	#1 AND #2 AND #3		5,569
#5	Non-United States	CU=("developing countr*" OR "under developed nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle income countr*" OR LMIC  OR Europe OR Australia OR Asia OR Africa OR Mexico OR Islands OR "Central America" OR "Latin America" OR "South America")	2,037,499
#6	#4 NOT #5		4,920
#7	Publication Excludes	TS=(editorial OR commentary OR "conference abstract*" OR "conference proceeding*" [tiab] OR "retraction of publication" OR "retracted publication" OR corrigenda [tiab] OR corrigendum [tiab] OR errata OR erratum OR "case reports" ) OR TI=("systematic review*" OR "meta-analysis")	708,261

		OR "meta analyses" OR protocol OR protocols OR "retraction notice" OR "case report" OR "case series")	
#8	#6 NOT #5		4,920
#9		Years: 2008-2021; Publication Types: Articles, Early Access	3,545

## **Grey Literature Search**

### **Google Scholar**

(Income OR resources OR poverty OR socioeconomic) AND time AND ((home OR domestic OR family OR house) AND (eating OR meals OR cooking OR cleaning OR washing dishes))

Limits: Date published: 2008-2021;

Date Searched: 5/14/2021

Results: 40, limited to 4 pages

### **Google**

site:.gov AND (Income OR resources OR poverty OR socioeconomic) AND (time OR time spent) AND ((home OR domestic OR family) AND (meal preparation OR meals OR cooking OR cleaning))

Limits: Include Omitted results

Date Searched: 5/14/2021

Results: 10, limited to 1 page

### **Ag Econ**

Any of the words: Income resources poverty socioeconomic  
AND

Any of the words: Time

AND

Any of the words: "Food at home" "at home meals" "meals at home" "cooking at home" "family cooking" "family meals" "meal preparation" "food preparation"

Limits: added since 2008

Date Searched: 5/14/2021

Results: 60, limited to 6 pages

## Appendix 4-b: Excluded articles for the rapid review on income and time spent on food-at-home-related activities

The following table lists the articles excluded after full-text screening for this rapid review question. At least 1 reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

Bibliography	Rationale for exclusion
1 Álvarez, Begoña, Miles-Touya, Daniel. Gender imbalance in housework allocation: a question of time?. <i>Review of Economics of the Household</i> . 2019. 17. doi: 10.1007/s11150-019-09467-w.	Country; Outcome
2 Archer, E., Shook, R. P., Thomas, D. M., Church, T. S., Katzmarzyk, P. T., Hébert, J. R., McIver, K. L., Hand, G. A., Lavie, C. J., Blair, S. N.. 45-Year trends in women's use of time and household management energy expenditure. <i>PLoS One</i> . 2013. 8. doi: 10.1371/journal.pone.0056620.	Comparator; Outcome
3 Beatty, T. K., Nanney, M. S., Tuttle, C.. Time to eat? The relationship between food security and food-related time use. <i>Public Health Nutr</i> . 2014. 17. doi: 10.1017/s1368980012005599.	Exposure
4 Beshara, M., Hutchinson, A., Wilson, C.. Preparing meals under time stress. The experience of working mothers. <i>Appetite</i> . 2010. 55. doi: 10.1016/j.appet.2010.10.003.	Country
5 Biddle, Jeff E., Hamermesh, Daniel S.. Income, wages and household production theory. <i>Economics Letters</i> . 2020. 192. doi: 10.1016/j.econlet.2020.109188.	Date; Outcome
6 Blitstein, Jonathan L., Frentz, Florentine, Jilcott Pitts, Stephanie B.. A Mixed-method Examination of Reported Benefits of Online Grocery Shopping in the United States and Germany: Is Health a Factor?. <i>Journal of Food Products Marketing</i> . 2020. 26. doi: 10.1080/10454446.2020.1754313.	Exposure
7 Bostic, S. M., McClain, A. C.. Older adults' cooking trajectories: shifting skills and strategies. <i>British Food Journal</i> . 2017. 119. doi: 10.1108/bfj-09-2016-0436.	Outcome
8 Bowen, Sarah, Elliott, Sinikka, Brenton, Joslyn. The Joy of Cooking?. <i>Contexts</i> . 2014. 13. doi: 10.1177/1536504214545755.	Comparator
9 Carpio, C. E., Kalenkoski, C. M., Moyeda-Carabaza, A. F., Murimi, M.. The effect of time use and food cost on dietary quality. <i>Public Health Nutrition</i> . 2020. 23. doi: 10.1017/s1368980020001615.	Comparator
10 Cason-Wilkerson, R., Goldberg, S., Albright, K., Allison, M., Haemer, M.. Factors influencing healthy lifestyle changes: a qualitative look at low-income families engaged in treatment for overweight children. <i>Child Obes</i> . 2015. 11. doi: 10.1089/chi.2014.0147.	Outcome
11 Cawley, J., Liu, F.. Maternal employment and childhood obesity: a search for mechanisms in time use data. <i>Econ Hum Biol</i> . 2012. 10. doi: 10.1016/j.ehb.2012.04.009.	Exposure; Date
12 Christian, T. J.. Trade-offs between commuting time and health-related activities. <i>J Urban Health</i> . 2012. 89. doi: 10.1007/s11524-012-9678-6.	Date; Comparator
13 Connelly, Rachel, Kimmel, Jean. Spousal Economic Factors in ATUS Parents' Time Choices. <i>Social Indicators Research</i> . 2009. 93. doi: 10.1007/s11205-008-9403-8.	Date; Outcome
14 Connelly, Rachel, Kimmel, Jean. Spousal influences on parents' non-market time choices. <i>Review of Economics of the Household</i> . 2009. 7. doi: 10.1007/s11150-009-9060-y.	Date; Outcome
15 Daniels, S., Glorieux, I., Minnen, J., van Tienoven, T. P., Weenas, D.. Convenience on the menu? A typological conceptualization of family food expenditures and food-related time patterns. <i>Soc Sci Res</i> . 2015. 51. doi: 10.1016/j.ssresearch.2014.09.010.	Date; Country
16 Datar, A., Nicosia, N., Shier, V.. Maternal work and children's diet, activity, and obesity. <i>Soc Sci Med</i> . 2014. 107. doi: 10.1016/j.socscimed.2013.12.022.	Exposure; Outcome
17 Davis, G. C., You, W.. The Thrifty Food Plan is not thrifty when labor cost is considered. <i>J Nutr</i> . 2010. 140. doi: 10.3945/jn.109.119594.	Date; Study Design; Outcome

Bibliography	Rationale for exclusion
18 Davis, G. C.,You, W.. Estimates of returns to scale, elasticity of substitution, and the thrifty food plan meal poverty rate from a direct household meal production function. Food Policy. 2013. 43. doi: 10.1016/j.foodpol.2013.09.002.	Date
19 Davis, G. C.,You, W.. Not enough money or not enough time to satisfy the Thrifty Food Plan? A cost difference approach for estimating a money-time threshold. Food Policy. 2011. 36. doi: 10.1016/j.foodpol.2010.09.001.	Date; Exposure; Outcome
20 Davis, George C.,You, Wen. The time cost of food at home: general and food stamp participant profiles. Applied Economics. 2010. 42. doi: 10.1080/00036840801964468.	Date; Exposure
21 De Backer, Charlotte J. S.. Family meal traditions. Comparing reported childhood food habits to current food habits among university students. Appetite. 2013. 69. doi: https://doi.org/10.1016/j.appet.2013.05.013.	Outcome; Country
22 Devine, C. M.,Farrell, T. J.,Blake, C. E.,Jastran, M.,Wethington, E.,Bisogni, C. A.. Work Conditions and the Food Choice Coping Strategies of Employed Parents. Journal of Nutrition Education and Behavior. 2009. 41. doi: 10.1016/j.jneb.2009.01.007.	Outcome
23 Do, B.,Wang, S. D.,Naya, C. H.,Dunton, G. F.,Mason, T. B.. Momentary and personal characteristics predicting maternal fruit and vegetable preparation for children using ecological momentary assessment. Eat Behav. 2021. 41. doi: 10.1016/j.eatbeh.2021.101492.	Outcome
24 Dong, K. R.,Tang, A. M.,Stopka, T. J.,Beckwith, C. G.,Must, A.. Food acquisition methods and correlates of food insecurity in adults on probation in Rhode Island. PLoS One. 2018. 13. doi: 10.1371/journal.pone.0198598.	Outcome
25 Dunaway, L. F.,Carton, T.,Ma, P.,Mundorf, A. R.,Keel, K.,Theall, K. P.. Beyond Food Access: The Impact of Parent-, Home-, and Neighborhood-Level Factors on Children's Diets. International Journal of Environmental Research and Public Health. 2017. 14. doi: 10.3390/ijerph14060662.	Outcome
26 Escoto, K. H.,Laska, M. N.,Larson, N.,Neumark-Sztainer, D.,Hannan, P. J.. Work Hours and Perceived Time Barriers to Healthful Eating Among Young Adults. American Journal of Health Behavior. 2012. 36. doi: 10.5993/ajhb.36.6.6.	Exposure
27 Farmer, N.,Wallen, G. R.,Yang, L.,Middleton, K. R.,Kazmi, N.,Powell-Wiley, T. M.. Household Cooking Frequency of Dinner Among Non-Hispanic Black Adults is Associated with Income and Employment, Perceived Diet Quality and Varied Objective Diet Quality, HEI (Healthy Eating Index): NHANES Analysis 2007-2010. Nutrients. 2019. 11. doi: 10.3390/nu11092057.	Outcome
28 Fisher, Kimberly,Robinson, John. Average Weekly Time Spent in 30 Basic Activities Across 17 Countries. Social Indicators Research. 2009. 93. doi: 10.1007/s11205-008-9372-y.	Exposure
29 Gelber, Alexander M.,Mitchell, Joshua W.. Taxes and Time Allocation: Evidence from Single Women and Men. Review of Economic Studies. 2012. 79. doi: 10.1093/restud/rdr041.	Date
30 Gershuny, Jonathan,Harms, Teresa Attracta. Housework Now Takes Much Less Time: 85 Years of US Rural Women's Time Use. Social Forces. 2016. 95. doi: 10.1093/sf/sow073.	Exposure
31 Graesch, Anthony. Material Indicators of Family Busyness. Social Indicators Research. 2009. 93. doi: 10.1007/s11205-008-9408-3.	Outcome
32 Gupta, Nabanita Datta,Stratton, Leslie S.. Examining the impact of alternative power measures on individual time use in American and Danish couple households. Review of Economics of the Household. 2010. 8. doi: 10.1007/s11150-009-9073-6.	Date; Exposure
33 Gupta, Sanjiv,Ash, Michael. Whose money, whose time? A nonparametric approach to modeling time spent on housework in the United States. Feminist Economics. 2008. 14. doi: 10.1080/13545700701716664.	Date; Outcome
34 Henry, J. L.,Trude, A. C. B.,Surkan, P. J.,Steeves, E. A.,Hopkins, L. C.,Gittelsohn, J.. Psychosocial Determinants of Food Acquisition and Preparation in Low-Income, Urban African American Households. Health Education & Behavior. 2018. 45. doi: 10.1177/1090198118760686.	Outcome
35 Hobbes, Marieke,De Groot, Wouter T.,Van Der Voet, Ester,Sarkhel, Sukanya. Freely Disposable Time: A Time and Money Integrated Measure of Poverty and Freedom. World Development. 2011. 39. doi: 10.1016/j.worlddev.2011.04.005.	Country; Study Design



Bibliography	Rationale for exclusion
36 Horning, M. L., Fulkerson, J. A., Friend, S. E., Story, M.. Reasons Parents Buy Prepackaged, Processed Meals: It Is More Complicated Than "I Don't Have Time". <i>J Nutr Educ Behav.</i> 2017. 49. doi: 10.1016/j.jneb.2016.08.012.	Outcome
37 Jarrett, R. L., Bahar, O. S., Kersh, R. T.. "When We Do Sit Down Together": Family Meal Times in Low-Income African American Families With Preschoolers. <i>Journal of Family Issues.</i> 2016. 37. doi: 10.1177/0192513x14547417.	Outcome
38 Kant, A. K., Graubard, B. I.. Family income and education were related with 30-year time trends in dietary and meal behaviors of American children and adolescents. <i>J Nutr.</i> 2013. 143. doi: 10.3945/jn.112.165258.	Date; Comparator; Outcome
39 Kolodinsky, J. M., Goldstein, A. B.. Time use and food pattern influences on obesity. <i>Obesity (Silver Spring).</i> 2011. 19. doi: 10.1038/oby.2011.130.	Exposure
40 Kolpashnikova, Kamila. American Househusbands: New Time Use Evidence of Gender Display, 2003-2016. <i>Social Indicators Research.</i> 2018. 140. doi: 10.1007/s11205-017-1813-z.	Exposure
41 Kornides, M. L., Nansel, T. R., Quick, V., Haynie, D. L., Lipsky, L. M., Laffel, L. M., Mehta, S. N.. Associations of family meal frequency with family meal habits and meal preparation characteristics among families of youth with type 1 diabetes. <i>Child Care Health Dev.</i> 2014. 40. doi: 10.1111/cch.12078.	Outcome
42 Kornrich, S., Roberts, A.. Household Income, Women's Earnings, and Spending on Household Services, 1980-2010. <i>Journal of Marriage and Family.</i> 2018. 80. doi: 10.1111/jomf.12450.	Date; Outcome
43 Landefeld, J. Steven, Fraumeni, Barbara M., Vojtech, Cindy M.. ACCOUNTING FOR HOUSEHOLD PRODUCTION: A PROTOTYPE SATELLITE ACCOUNT USING THE AMERICAN TIME USE SURVEY. <i>Review of Income &amp; Wealth.</i> 2009. 55. doi: 10.1111/j.1475-4991.2009.00319.x.	Date; Comparator
44 Ly, D. P., Jena, A. B.. Sex Differences in Time Spent on Household Activities and Care of Children Among US Physicians, 2003-2016. <i>Mayo Clin Proc.</i> 2018. 93. doi: 10.1016/j.mayocp.2018.02.018.	Exposure; Comparator
45 Martell, Michael E., Roncolato, Leanne. Share of Household Earnings and Time Use of Women in Same-Sex and Different-Sex Households. <i>Eastern Economic Journal.</i> 2020. 46. doi: 10.1057/s41302-019-00145-4.	Outcome; Date
46 McGuirt, J. T., Wu, Q., Laska, M. N., Truesdale, K. P., Rafferty, A. P., Bell, R. A., Ammerman, A. S., Jilcott Pitts, S. B.. Associations between shopping patterns, dietary behaviours and geographic information system-assessed store accessibility among small food store customers. <i>Public Health Nutr.</i> 2020. . doi: 10.1017/s1368980020005017.	Exposure; Comparator
47 Milkie, Melissa A., Raley, Sara B., Bianchi, Suzanne M.. Taking on the Second Shift: Time Allocations and Time Pressures of U.S. Parents with Preschoolers. <i>Social Forces.</i> 2009. 88. doi: 10.1353/sof.0.0268.	Date; Outcome
48 Mills, Susanna, Brown, Heather, Wrieden, Wendy, White, Martin, Adams, Jean. Frequency of eating home cooked meals and potential benefits for diet and health: cross-sectional analysis of a population-based cohort study. <i>International Journal of Behavioral Nutrition and Physical Activity.</i> 2017. 14. doi: 10.1186/s12966-017-0567-y.	Country; Outcome
49 Nepper, M. J., Chai, W.. Parents' barriers and strategies to promote healthy eating among school-age children. <i>Appetite.</i> 2016. 103. doi: 10.1016/j.appet.2016.04.012.	Outcome
50 Neumark-Sztainer, D., MacLehose, R., Loth, K., Fulkerson, J. A., Eisenberg, M. E., Berge, J.. What's for dinner? Types of food served at family dinner differ across parent and family characteristics. <i>Public Health Nutrition.</i> 2014. 17. doi: 10.1017/s1368980012004594.	Comparator; Outcome
51 Neumark-Sztainer, D., Wall, M., Fulkerson, J. A., Larson, N.. Changes in the frequency of family meals from 1999 to 2010 in the homes of adolescents: trends by sociodemographic characteristics. <i>J Adolesc Health.</i> 2013. 52. doi: 10.1016/j.jadohealth.2012.06.004.	Outcome
52 Oleschuk, Merin. Expanding the joys of cooking: How class shapes the emotional experience of family foodwork. <i>Gender, Work &amp; Organization.</i> 2020. . doi: 10.1111/gwao.12599.	Country
53 Pailhé, Ariane, Solaz, Anne, Stanfors, Maria. The Great Convergence: Gender and Unpaid Work in Europe and the United States. <i>Population &amp; Development Review.</i> 2021. 47. doi: 10.1111/padr.12385.	Date



<b>Bibliography</b>	<b>Rationale for exclusion</b>
54 Pelletier, J. E.,Laska, M. N.. Balancing healthy meals and busy lives: associations between work, school, and family responsibilities and perceived time constraints among young adults. <i>J Nutr Educ Behav.</i> 2012. 44. doi: 10.1016/j.jneb.2012.04.001.	Outcome
55 Pepin, Joanna R.,Sayer, Liana C.,Casper, Lynne M.. Marital Status and Mothers' Time Use: Childcare, Housework, Leisure, and Sleep. <i>Demography (Springer Nature).</i> 2018. 55. doi: 10.1007/s13524-018-0647-x.	Exposure; Outcome
56 Quick, B. L.,Fiese, B. H.,Anderson, B.,Koester, B. D.,Marlin, D. W.. A formative evaluation of shared family mealtime for parents of toddlers and young children. <i>Health Commun.</i> 2011. 26. doi: 10.1080/10410236.2011.561920.	Comparator; Outcome
57 Rogus, S.. Examining the influence of perceived and objective time constraints on the quality of household food purchases. <i>Appetite.</i> 2018. 130. doi: 10.1016/j.appet.2018.08.025.	Outcome
58 Schneider, Daniel,Hastings, Orestes P.. Income Inequality and Household Labor. <i>Social Forces.</i> 2017. 96. doi: 10.1093/sf/sox061.	Outcome; Date
59 Sen, Shuvro,Antara, Neel,Sen, Shusmita. Factors influencing consumers' to Take Ready-made Frozen Food. <i>Current Psychology.</i> 2019. . doi: 10.1007/s12144-019-00201-4.	Country
60 Smith, L. P.,Ng, S. W.,Popkin, B. M.. Trends in US home food preparation and consumption: analysis of national nutrition surveys and time use studies from 1965-1966 to 2007-2008. <i>Nutr J.</i> 2013. 12. doi: 10.1186/1475-2891-12-45.	Date; Comparator
61 Sonnevile, K. R.,La Pelle, N.,Taveras, E. M.,Gillman, M. W.,Prosser, L. A.. Economic and other barriers to adopting recommendations to prevent childhood obesity: results of a focus group study with parents. <i>BMC Pediatr.</i> 2009. 9. doi: 10.1186/1471-2431-9-81.	Date; Outcome
62 Starmer, A. J.,Frintner, M. P.,Matos, K.,Somberg, C.,Freed, G.,Byrne, B. J.. Gender Discrepancies Related to Pediatrician Work-Life Balance and Household Responsibilities. <i>Pediatrics.</i> 2019. 144. doi: 10.1542/peds.2018-2926.	Exposure; Outcome
63 Taillie, L. S.. Who's cooking? Trends in US home food preparation by gender, education, and race/ethnicity from 2003 to 2016. <i>Nutr J.</i> 2018. 17. doi: 10.1186/s12937-018-0347-9.	Comparator; Outcome
64 Tao, Hung-Lin. Informational Ambiguity and Survey Bias: Husbands' and Wives' Reports on Their Contribution to Their Families. <i>Social Indicators Research.</i> 2013. 111. doi: 10.1007/s11205-012-0029-5.	Country
65 Tashiro, S.,Lo, C. P.. Gender Difference in the Allocation of Time PREPARING FOOD COOKED AT HOME VERSUS PURCHASING PREPARED FOOD. <i>Food Culture &amp; Society.</i> 2012. 15. doi: 10.2752/175174412x13276629246000.	Date
66 Tashiro, Sanae. Differences in Food Preparation by Race and Ethnicity: Evidence from the American Time Use Survey. <i>Review of Black Political Economy.</i> 2009. 36. doi: 10.1007/s12114-009-9045-3.	Date
67 Taveras, E. M.,McDonald, J.,O'Brien, A.,Haines, J.,Sherry, B.,Bottino, C. J.,Troncoso, K.,Schmidt, M. E.,Koziol, R.. Healthy Habits, Happy Homes: methods and baseline data of a randomized controlled trial to improve household routines for obesity prevention. <i>Prev Med.</i> 2012. 55. doi: 10.1016/j.ypmed.2012.08.016.	Exposure; Outcome
68 Tiedje, K.,Wieland, M. L.,Meiers, S. J.,Mohamed, A. A.,Formea, C. M.,Ridgeway, J. L.,Asiedu, G. B.,Boyum, G.,Weis, J. A.,Nigon, J. A.,Patten, C. A.,Sia, I. G.. A focus group study of healthy eating knowledge, practices, and barriers among adult and adolescent immigrants and refugees in the United States. <i>Int J Behav Nutr Phys Act.</i> 2014. 11. doi: 10.1186/1479-5868-11-63.	Comparator; Outcome
69 Tiwari, A.,Aggarwal, A.,Tang, W.,Drewnowski, A.. Cooking at Home: A Strategy to Comply With US Dietary Guidelines at No Extra Cost. <i>American Journal of Preventive Medicine.</i> 2017. 52. doi: 10.1016/j.amepre.2017.01.017.	Outcome
70 Trofholz, A. C.,Tate, A.,Keithahn, H.,de Brito, J. N.,Loth, K.,Fertig, A.,Berge, J. M.. Family meal characteristics in racially/ethnically diverse and immigrant/refugee households by household food security status: A mixed methods study. <i>Appetite.</i> 2021. 157. doi: 10.1016/j.appet.2020.105000.	Outcome
71 Tuttle, Charlotte. Changes in Food-At-Home Spending by SNAP Participants After the Stimulus Act of 2009. . 2016. . doi: 10.22004/ag.econ.252645.	Outcome

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72 Virudachalam, S., Chung, P. J., Faerber, J. A., Pian, T. M., Thomas, K., Feudtner, C.. Quantifying parental preferences for interventions designed to improve home food preparation and home food environments during early childhood. <i>Appetite</i> . 2016. 98. doi: 10.1016/j.appet.2015.11.007.	Outcome
73 Virudachalam, S., Long, J. A., Harhay, M. O., Polsky, D. E., Feudtner, C.. Prevalence and patterns of cooking dinner at home in the USA: National Health and Nutrition Examination Survey (NHANES) 2007-2008. <i>Public Health Nutrition</i> . 2014. 17. doi: 10.1017/s1368980013002589.	Date; Outcome
74 Wolfson, J. A., Bleich, S. N., Smith, K. C., Frattaroli, S.. What does cooking mean to you?: Perceptions of cooking and factors related to cooking behavior. <i>Appetite</i> . 2016. 97. doi: 10.1016/j.appet.2015.11.030.	Outcome
75 Wolfson, J. A., Leung, C. W., Richardson, C. R.. More frequent cooking at home is associated with higher Healthy Eating Index-2015 score. <i>Public Health Nutrition</i> . 2020. 23. doi: 10.1017/s1368980019003549.	Outcome
76 Wulff Pabilonia, Sabrina, Younghwan, Song. Single Mothers' Time Preference, Smoking, and Enriching Childcare: Evidence from Time Diaries. <i>Eastern Economic Journal</i> . 2013. 39. doi: 10.1057/ej.2013.7.	Date
77 Yenerall, J., You, W., Hill, J.. Beyond the supermarket: analyzing household shopping trip patterns that include food at home and away from home retailers. <i>BMC Public Health</i> . 2020. 20. doi: 10.1186/s12889-020-09882-0.	Exposure; Outcome
78 You, W, Davis, G,C,. Household food expenditures, parental time allocation, and childhood overweight: An integrated two-stage collective model with an empirical application and test. <i>American Journal of Agricultural Economics</i> . 2010. 92. doi: 10.1093/ajae/aap031.	Date
79 Zeballos, Eliana, Restrepo, Brandon. Working From Home Leads to More Time Spent Preparing Food, Eating at Home. . 2021. 2020. doi: 10.22004/ag.econ.309609.	Exposure

## Appendix 5-a: Literature search strategy for the evidence scan on factors that influence the purchase and/or consumption of convenience foods

Database: PubMed  
Vendor: National Library of Medicine  
Date of Search: 5/20/2021  
Limits Used: Filters: Language English Publication Dates 2008 - 2021  
Total = 3,201

Search #	Concept	Search String	N
#1	Convenience Foods	<p>((("ready to eat"[tiab] OR "ready to heat"[tiab] OR "ready to cook"[tiab] OR "ready to bake"[tiab] OR "pre prepared"[tiab] OR preprepared[tiab] OR "pre made"[tiab] OR premade[tiab] OR "pre cooked"[tiab] OR precooked[tiab] OR "pre cut"[tiab] OR precut[tiab] OR "fresh cut"[tiab] OR boxed[tiab] OR frozen[tiab] OR canned[tiab] OR dehydrated[tiab] OR tinned[tiab] OR bagged[tiab] OR jarred[tiab] OR "ready made"[tiab] OR instant[tiab] OR prepackaged[tiab] OR "pre-packaged"[tiab] OR "shelf stable"[tiab] OR "single serve"[tiab] OR "single serving"[tiab] OR "pre washed"[tiab] OR prewashed[tiab] OR "partially prepared"[tiab] OR packaged[tiab] OR "easy to prepare"[tiab])</p> <p>AND</p> <p>(food[MeSH] OR food*[tiab] OR goods[tiab] OR meal*[tiab] OR snack*[tiab] OR fruit*[tiab] OR vegetable*[tiab]))</p> <p>OR</p> <p>("convenient food*" [tiab] OR "convenience food*" [tiab] OR "convenience meal*" [tiab] OR "ready meal" [tiab] OR "food at home" [tiab] OR "fresh cut produce" [tiab]))</p>	16,186
#2		<p>#1 NOT (letter[ptyp] OR editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR editorial[tiab] OR commentary[tiab] OR "conference abstract*" [tiab] OR "systematic review*" [ti] OR "meta-analysis" [ptyp] OR "meta-analysis" [ti] OR "meta-analyses" [ti] OR "Review" [Publication Type] OR "Systematic Review" [Publication Type] OR "conference proceeding*" [tiab] OR "retracted publication" [ptyp] OR "retraction of publication" [ptyp] OR "retraction of publication" [tiab] OR "retraction notice" [ti] OR "retracted publication" [tiab] OR "Published Erratum" [Publication Type] OR corrigenda[tiab] OR corrigendum[tiab] OR errata[tiab] OR erratum[tiab] OR protocol[ti] OR protocols[ti] OR "case report" [ti] OR "case series" [ti] OR "Case Reports" [Publication Type])</p>	3,201



		<p>NOT</p> <p>("Developing Countries"[Mesh] OR "developing countr*" OR "Under Developed Nation*" OR "low income countr*" OR "middle income countr*" OR "low-middle-income countr*" OR LMIC[tiab] OR "Europe"[Mesh] OR "Australia"[Mesh] OR "Asia"[Mesh] OR "Africa"[Mesh] OR "Mexico"[Mesh] OR "Islands"[Mesh] OR "Central America"[Mesh] OR "Latin America"[Mesh] OR "South America"[Mesh])</p> <p>)</p> <p>NOT</p> <p>("Animals"[Mesh] NOT</p> <p>("Animals"[Mesh] AND "Humans"[Mesh])</p> <p>) Filters: English, from 2008 - 2021</p>	
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Database: Business Source Premiere

Vendor: EBSCO

Date of Search: 5/20/2021

Limits Used: Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English

Total = 6,181

Search #	Concept	Search String	N
#1	Convenience Foods	<p>((("ready to eat" OR "ready to heat" OR "ready to cook" OR "ready to bake" OR "pre prepared" OR preprepared OR "pre made" OR premade OR "pre cooked" OR precooked OR "pre cut" OR precut OR "fresh cut" OR boxed OR frozen OR canned OR dehydrated OR tinned OR bagged OR jarred OR "ready made" OR instant OR prepackaged OR "pre-packaged" OR "shelf stable" OR "single serve" OR "single serving" OR "pre washed" OR prewashed OR "partially prepared" OR packaged OR "easy to prepare"))</p> <p>AND</p> <p>(food* OR goods OR meal* OR snack* OR fruit* OR vegetable*))</p> <p>OR</p> <p>("convenient food*" OR "convenience food*" OR "convenience meal*" OR "ready meal*" OR "food at home" OR "fresh cut produce"))</p>	107,790
#2		<p>Limiters - Scholarly (Peer Reviewed) Journals; Published Date: 20080101-20211231; Document Type: Article; Language: English</p>	6,181

Database: Scopus

Vendor: Elsevier

Date of Search: 5/19/2021

Limits Used: Year, Document Type, Source Type, Country/Territory:, Language: English

Total = 4,114

Search #	Concept	Search String	N
#1	Convenience Foods	TITLE-ABS-KEY ( "convenience food" OR "convenient food" OR "ready meal" OR "convenience meal" OR "food at home" OR "fresh cut produce" )  OR ( TITLE-ABS-KEY ( "ready to eat" OR "ready to heat" OR "ready to cook" OR "ready to bake" OR "pre prepared" OR preprepared OR "pre made" OR premade OR "pre cooked" OR precooked OR "pre cut" OR precut OR "fresh cut" OR boxed OR frozen OR canned OR dehydrated OR tinned OR bagged OR jarred OR "ready made" OR instant OR "pre packaged" OR prepackaged OR "shelf stable" OR "single serve" OR "single serving" OR "pre washed" OR prewashed OR "partially prepared" OR packaged OR "easy to prepare" )  AND TITLE-ABS-KEY ( food OR goods OR meal OR snack OR fruit OR vegetable ) )	40,946
#2	Limiters	( LIMIT-TO ( PUBYEAR , 2021 ) OR LIMIT-TO ( PUBYEAR , 2020 ) OR LIMIT-TO ( PUBYEAR , 2019 ) OR LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-TO ( PUBYEAR , 2013 ) OR LIMIT-TO ( PUBYEAR , 2012 ) OR LIMIT-TO ( PUBYEAR , 2011 ) OR LIMIT-TO ( PUBYEAR , 2010 ) OR LIMIT-TO ( PUBYEAR , 2009 ) OR LIMIT-TO ( PUBYEAR , 2008 ) )  AND ( LIMIT-TO ( DOCTYPE , "ar" ) )  AND ( LIMIT-TO ( AFFILCOUNTRY , "United States" ) OR LIMIT-TO ( AFFILCOUNTRY , "Undefined" ) )  AND ( LIMIT-TO ( SRCTYPE , "j" ) OR LIMIT-TO ( SRCTYPE , "Undefined" ) )  AND ( LIMIT-TO ( LANGUAGE , "English" ) )	4,114

## Grey Literature Search

### Google Scholar

Convenience "ready meal" OR "food at home" OR "fresh cut produce" OR "ready to eat" OR "ready to heat" OR "ready to cook" OR "ready to bake" OR "pre made" OR premade OR "pre cooked" OR "pre cut" OR precut OR "fresh cut" OR boxed OR frozen OR canned OR dehydrated OR tinned OR bagged OR jarred OR "ready made" OR instant OR "pre packaged" OR prepackaged OR "shelf stable" OR "single serve" OR "single serving" OR "pre washed" OR prewashed OR "partially prepared" OR packaged OR "easy to prepare"

Limits: Publication Date: 2008-2021;  
Date Searched: 5/26/2021  
Results: 110, limited to 11 pages

### Google

site:.gov AND Convenience AND "ready meal" OR "food at home" OR "fresh cut produce" OR "ready to eat" OR "ready to heat" OR "ready to cook" OR "ready to bake" OR "pre made" OR premade OR "pre cooked" OR "pre cut" OR precut OR "fresh cut" OR boxed OR frozen OR canned OR dehydrated OR tinned OR bagged OR jarred OR "ready made" OR instant OR "pre packaged" OR prepackaged OR "shelf stable" OR "single serve" OR "single serving" OR "pre washed" OR prewashed OR "partially prepared" OR packaged OR "easy to prepare"

Limits:  
Date Searched: 5/27/2021

Results: 30, limited to 3 pages

**Ag Econ**

Any of the words: "ready to eat" "ready to heat" "ready to cook" "ready to bake" "pre prepared" preprepared "pre made" premade "pre cooked" precooked "pre cut" precut "fresh cut" boxed frozen canned dehydrated tinned bagged jarred "ready made" instant "pre packaged" prepackaged "shelf stable" "single serve" "single serving" "pre washed" prewashed "partially prepared" packaged "easy to prepare"

AND

Any of the words: food goods meal snack fruit vegetable

OR

Any of the words: "convenience food" "convenient food" "ready meal" "convenience meal" "food at home" "fresh cut produce"

Limits: Added since 2008

Date Searched: 5/26/2021

Results: 120, limited to 12 pages

## Appendix 5-b: Excluded articles for the evidence scan on factors that influence the purchase and/or consumption of convenience foods

The following table lists the articles excluded after full-text screening for this evidence scan question. At least 1 reason for exclusion is provided for each article, though this may not reflect all possible reasons. Information about articles excluded after title and abstract screening is available upon request.

Citation	Reason for exclusion
1. . Are canned fruits and vegetables a healthy alternative to fresh produce? The Johns Hopkins medical letter health after 50. 2013. 25:7.	Outcome
2. . Convenience food and drink sector. Nutrition & Food Science. 2010. 40:173-178. doi:10.1108/nfs.2010.01740dab.022.	Country
3. . FASTLANE CONVENIENCE. 2021.	Outcome
4. . Fresh or frozen produce? The health benefit is all in the mix. Relying on a mix of fresh and frozen can help you get your five-to-nine daily servings of fruits and vegetables. Harvard men's health watch. 2014. 18:6.	Outcome
5. . From Other Blogs: National Immunization Awareness Month, convenience foods, disaster recovery & more. Live Healthy SC. 2018.	Study design
6. . International chefs' circle promotes quality ready meals. Food Australia. 2008. 60:94.	Country; Publication status
7. . ready-to-eat food samples: Topics by Science.gov. 2021.	Other
8. Ailawadi, K, Ma, Y, Grewal, D. The club store effect: Impact of shopping in warehouse club stores on consumers' packaged food purchases. Journal of Marketing Research. 2018. 55:193-207. doi:10.1509/jmr.16.0235.	Outcome
9. Albuquerque, P, Bronnenberg, BJ. Estimating demand heterogeneity using aggregated data: An application to the frozen pizza category. Marketing Science. 2009. 28:356-372. doi:10.1287/mksc.1080.0403.	Intervention/Exposure; Data date range
10. Alpaugh, M, Pope, L, Trubek, A, Skelly, J, Harvey, J. Cooking as a health behavior: Examining the role of cooking classes in a weight loss intervention. Nutrients. 2020. 12:1-13. doi:10.3390/nu12123669.	Outcome
11. Andrews, SandraL, O'Reilly, Donna . Storing Designer And Convenience Foods. Extension Bulletin E-2297 Cooperative Extension Service. 1991. 6.	Outcome
12. Anesbury, Zachary William, Talbot, Danielle, Day, Chanel Andrea, Bogomolov, Tim, Bogomolova, Svetlana. The fallacy of the heavy buyer: Exploring purchasing frequencies of fresh fruit and vegetable categories. Journal of Retailing & Consumer Services. 2020. 53:N.PAG-N.PAG. doi:10.1016/j.jretconser.2019.101976.	Intervention/Exposure
13. Anselmsson, Johan, Bondesson, Niklas Vestman, Johansson, Ulf. Brand image and customers' willingness to pay a price premium for food brands. Journal of Product & Brand Management. 2014. 23:90-102. doi:10.1108/JPBM-10-2013-0414.	Country
14. Arentz, L. Kidney-Friendly Frozen Meals Update: Quick and Convenient Options for Chronic Kidney Disease Patients. Journal of Renal Nutrition. 2016. 26:e15-e17. doi:10.1053/j.jrn.2016.02.004.	Outcome
15. Aviles, M Victoria, Naef, Elisa Fernanda, Abalos, Rosa Ana, Lound, Liliana H, Olivera, Daniela F, García-Segovia, Purificación. Effect of familiarity of ready-to-eat animal-based meals on consumers' perception and consumption motivation. International Journal of Gastronomy and Food Science. 2020. 21:100225.	Country
16. Ayala, GX, Baquero, B, Laraia, BA, Ji, M, Linnan, L. Efficacy of a store-based environmental change intervention compared with a delayed treatment control condition on store customers' intake of fruits and vegetables. Public Health Nutrition. 2013. 16:1953-1960. doi:10.1017/S1368980013000955.	Outcome



Citation	Reason for exclusion
17. Baker, SL, McCabe, SD, Swithers, SE, Payne, CR, Kranz, S. Do healthy, child-friendly fruit and vegetable snacks appeal to consumers? A field study exploring adults' perceptions and purchase intentions. <i>Food Quality and Preference</i> . 2015. 39:202-208. doi:10.1016/j.foodqual.2014.07.013.	Outcome
18. Balzan, S, Fasolato, L, Cardazzo, B, Berti, G, Novelli, E. Cold Chain and Consumers' Practices: Exploratory Results of Focus Group Interviews. <i>Ital J Food Saf</i> . 2014. 3:4516. doi:10.4081/ijfs.2014.4516.	Country
19. Barska, Anetta. Millennial consumers in the convenience food market. <i>Konsumenci generacji Y na rynku żywności wygodnej..</i> 2018. 22:251-264. doi:10.2478/manment-2018-0018.	Country
20. Baumhofer, NK, Panapasa, SV, Francis Cook, E, Roberto, CA, Williams, DR. Sociodemographic factors influencing island foods consumption in the Pacific Islander Health Study. <i>Ethnicity and Health</i> . 2020. 25:305-321. doi:10.1080/13557858.2017.1418300.	Outcome
21. Berge, JM, Tate, A, Trofholz, A, Loth, K, Miner, M, Crow, S, Neumark-Sztainer, D. Examining variability in parent feeding practices within a low-income, racially/ethnically diverse, and immigrant population using ecological momentary assessment. <i>Appetite</i> . 2018. 127:110-118. doi:10.1016/j.appet.2018.04.006.	Outcome
22. Binkley, JK, Liu, Y. Food at Home and away from Home: Commodity Composition, Nutrition Differences, and Differences in Consumers. <i>Agricultural and Resource Economics Review</i> . 2019. 48:221-252. doi:10.1017/age.2019.1.	Intervention/Exposure
23. Bird Jernigan, Valarie Blue, Salvatore, AliciaL, Williams, Mary, Wetherill, Marianna, Taniguchi, Tori, Jacob, Tvli, Cannady, Tamela, Grammar, Mandy, Standridge, Joy, Fox, Jill, Tingle Owens, JoAnna, Spiegel, Jennifer, Love, Charlotte, Teague, Travis, Noonan, Carolyn. A Healthy Retail Intervention in Native American Convenience Stores: The THRIVE Community-Based Participatory Research Study. <i>American Journal of Public Health</i> . 2019. 109:132-139. doi:10.2105/AJPH.2018.304749.	Outcome
24. Bishop, L, Goeddeke-Merickel, CM. Kidney-Friendly Frozen Meal Tips and Suggestions "In A Pinch". <i>Journal of Renal Nutrition</i> . 2012. 22:e43-e45. doi:10.1053/j.jrn.2012.06.002.	Outcome; Study design
25. Bodor, JN, Hutchinson, PL, Rose, D. Car ownership and the association between fruit and vegetable availability and diet. <i>Preventive Medicine</i> . 2013. 57:903-905. doi:10.1016/j.ypmed.2013.10.003.	Outcome
26. Bosworth, RC, Bailey, D, Curtis, KR. Consumer Willingness to Pay for Local Designations: Brand Effects and Heterogeneity at the Retail Level. <i>Journal of Food Products Marketing</i> . 2015. 21:274-292. doi:10.1080/10454446.2013.843488.	Outcome
27. Bower, Patrick. Forecasting New Products in Consumer Goods. <i>Journal of Business Forecasting</i> . 2012. 31:4-30.	Outcome
28. Brauchla, M, Fulgoni, VL. Cost-effective Options for Increasing Consumption of Under-consumed Food Groups & Nutrients in the United States. <i>Public Health Nutrition</i> . 2021. doi:10.1017/S1368980021000537.	Outcome
29. Briefel, RR, Chojnacki, GJ, Gabor, V, Forrestal, SG, Kleinman, R, Cabili, C, Gleason, PM. A Cluster Randomized Controlled Trial of a Home-Delivered Food Box on Food Security in Chickasaw Nation. <i>Journal of the Academy of Nutrition and Dietetics</i> . 2021. 121:S46-S58. doi:10.1016/j.jand.2020.07.021.	Outcome
30. Briefel, RR, Collins, AM, Wolf, A, Gordon, AR, Cabili, CL, Klerman, JA. Nutrition impacts in a randomized trial of summer food benefits to prevent childhood hunger in U.S. schoolchildren. <i>Journal of Hunger and Environmental Nutrition</i> . 2018. 13:304-321. doi:10.1080/19320248.2017.1393366.	Outcome
31. Briefel, RR, Wilson, A, Gleason, PM. Consumption of Low-Nutrient, Energy-Dense Foods and Beverages at School, Home, and Other Locations among School Lunch Participants and Nonparticipants. <i>Journal of the American Dietetic Association</i> . 2009. 109:S79-S90. doi:10.1016/j.jada.2008.10.064.	Data date range
32. Burani, J. Home cooking. Eat healthy, save money!. <i>Diabetes self-management</i> . 2010. 27:	Publication status
33. Camire, ME, Savoie, K, Perry, J, Calder, B. Preliminary assessment of maine consumers' educational preferences for fermenting foods at home. <i>Food Protection Trends</i> . 2019. 39:116-126.	Outcome

Citation	Reason for exclusion
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