USDA
UNITED STATES DEPARTMENT OF AGRICULTURE

Portion Size and Energy Intake: A Systematic Review

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Suggested citation: Andres A, Fisher JO, Anderson CAM, Gardner CD, Giovannucci E, Hoelscher DM, Jernigan VBB, Odoms-Young A, Palacios C, Raynor HA, Stanford FC, Fultz AK, Obbagy J, Butera G, Higgins M, Terry N. *Portion Size and Energy Intake: A Systematic Review.* November 2024. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://doi.org/10.52570/NESR.DGAC2025.SR28.

Related citation: 2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

Table of contents

Plain language summary

What is the question?
The question is: What is the relationship between portion size and energy intake? The populations of interest for this question include young children, children, adolescents, adults, older adults, and individuals during pregnancy and postpartum.

Why was this question asked?
This systematic review was conducted by the 2025 Dietary Guidelines Advisory Committee as part of the process to develop the *Dietary Guidelines for Americans, 2025-2030*.

How was this question answered?
The Committee conducted a systematic review to answer this question with support from the USDA Nutrition Evidence Systematic Review team.

What is the answer to the question?

- Serving larger portions of energy dense foods increases energy intake in children. This conclusion statement is based on evidence graded as strong.
- Serving larger portions of vegetables and fruits increases intake of those foods without increasing energy intake in children. This conclusion statement is based on evidence graded as moderate.
- A conclusion statement cannot be drawn about the relationship between portion size and energy intake in young children and adolescents because there is no evidence available.
- A conclusion statement cannot be drawn about the relationship between pre-portioned foods by young children, children, and adolescents and energy intake because there is not enough evidence available.
- Serving larger portions of foods increases food and energy intake in adults and older adults. This conclusion statement is based on evidence graded as strong.
- Portion size and energy density are independent and additive in their effects on energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate.
- Serving foods as smaller pre-portioned amounts decreases energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate.
- A conclusion statement cannot be drawn about the relationship between portion size and energy intake during pregnancy because there is no evidence available.
- A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during pregnancy because there is no evidence available.
- A conclusion statement cannot be drawn about the relationship between portion size and energy intake during postpartum because there is no evidence available.
- A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during postpartum because there is no evidence available.

How up-to-date is this systematic review?
Conclusion statements from this review are based on articles published between January 2000 and January 2024.

Abstract

Background

This systematic review was conducted by the 2025 Dietary Guidelines Advisory Committee as part of the process to develop the *Dietary Guidelines for Americans, 2025-2030*. The U.S. Departments of Health and Human Services (HHS) and Agriculture (USDA) appointed the 2025 Dietary Guidelines Advisory Committee (Committee) in January 2023 to review evidence on high priority scientific questions related to diet and health. Their review forms the basis of their independent, science-based advice and recommendations to HHS and USDA, which is considered as the Departments develop the next edition of the *Dietary Guidelines*. As part of that process, the Committee conducted a systematic review with support from USDA's Nutrition Evidence Systematic Review (NESR) team to answer the following question: What is the relationship between portion size and energy intake?

Methods

The Committee conducted a systematic review using the methodology of the USDA NESR team. The Committee first developed a protocol. The intervention/exposure was food and/or beverage portion size and pre-portioned foods that considers energy density, nutrient density and/or the quality or type of food served or consumed in young children, children, adolescents, adults, older adults, and individuals during pregnancy and postpartum. The comparator was a different portion size served or consumed. The outcome was energy intake. Additional inclusion criteria were established for the following study characteristics: a) use randomized or non-randomized controlled trial, prospective or retrospective cohort, or nested case-control study designs, b) be published in English in peer-reviewed journals, c) be from countries classified as high or very high on the Human Development Index, and d) enroll participants with a range of health statuses. The review excluded studies with infants (birth up to 12 months), studies that exclusively enrolled participants diagnosed with a disease, and studies that examined portion size using liquid meal replacements.

NESR librarians conducted a literature search in PubMed, Embase, CINAHL, and Cochrane to identify articles published between January 2000 and January 2024. Two NESR analysts independently screened all electronic results and the reference lists of included articles based on the pre-determined criteria.

NESR analysts extracted data, from each included article, with a second analyst verifying accuracy of the extraction. Two NESR analysts independently conducted a formal risk of bias assessment, by study design, for each included article, then reconciled any differences in the assessment. The Committee qualitatively synthesized the evidence, according to the synthesis plan, with attention given to the overarching themes or key concepts from the findings, similarities and differences between studies, and factors that may have affected the results. The Committee developed conclusion statements and graded the strength of evidence based on its consistency, precision, risk of bias, directness and generalizability.

Results

Young children, children, and adolescents

Conclusion statement and grade: Serving larger portions of energy dense foods increases energy intake in children. This conclusion statement is based on evidence graded as strong. (Grade: Strong)

Summary of the evidence:

- Twenty-seven articles comprising 28 interventions met the inclusion criteria for this review. Twenty-five were crossover randomized controlled trials, 2 were parallel randomized controlled trials, and 1 was a non-randomized controlled trial.
- The direction of results and size of effects were similar across studies.
- The size of study groups was large across studies. Most studies examined enough cases of energy intake. Variation around the effect estimates were narrow across studies.
- Most studies were designed and conducted well.
- The populations, interventions/exposures, comparators, and outcomes that were examined directly represent those of interest in this review.
- The evidence applies to the U.S. population.

Conclusion statement and grade: Serving larger portions of vegetables and fruits increases intake of those foods without increasing energy intake in children. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Summary of the evidence:

- Six articles met the inclusion criteria for this review. Six were crossover randomized controlled trials.
- The direction of results and size of effects were similar across studies.
- The size of study groups was small in some studies. Some studies examined few cases of vegetable and fruit portion sizes and energy intake.
- Most studies were designed and conducted well.
- The populations, interventions/exposures, comparators, and outcomes that were examined directly represent those of interest in this review.

- The evidence applies to the U.S. population, but may not apply to all race and ethnicities and socioeconomic positions.

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between portion size and energy intake in young children and adolescents because there is no evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between pre-portioned foods by young children, children, and adolescents and energy intake because there is not enough evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Adults and Older Adults

Conclusion statement and grade: Serving larger portions of foods increases food and energy intake in adults and older adults. This conclusion statement is based on evidence graded as strong. (Grade: Strong)

Summary of the evidence:
- Forty-four articles comprising 51 interventions met the inclusion criteria for this review. Thirty-nine were crossover randomized controlled trials, 9 were parallel randomized controlled trials, and 3 were non-randomized controlled trials.
- The direction of results and size of effects were similar across studies.
- The size of study groups was large across studies. Most studies examined enough cases of energy intake. Variation around the effect estimates were narrow across studies.
- Most studies were designed and conducted well.
- The populations, interventions/exposures, comparators, and outcomes that were examined directly represent those of interest in this review.
- The evidence applies to the U.S. population.

Conclusion statement and grade: Portion size and energy density are independent and additive in their effects on energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Summary of the evidence:
- Five articles comprising 6 interventions met the inclusion criteria for this review. Six were crossover randomized controlled trials.
- The direction of results and size of effects were similar across studies.
- The size of study groups was small in some studies. Some studies examined few cases of portion size, energy density, and energy intake.
- Most studies were designed and conducted well.
- The populations, interventions/exposures, and comparators that were examined directly represent those of interest in this review.
- The evidence applies to the U.S. population, but may not apply to all race and ethnicities and socioeconomic positions.

Conclusion statement and grade: Serving foods as smaller pre-portioned amounts decreases energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Summary of the evidence:
- Eight articles met the inclusion criteria for this review. Six were parallel randomized controlled trials and 2 were crossover randomized controlled trials.
- The direction of results was similar across studies, but effect size differed.
- The size of study groups was small in some studies. Some studies examined few cases of pre-portioned amounts of foods and energy intake.
- Most studies were designed and conducted well.
- The populations, interventions/exposures, and comparators that were examined directly represent those of interest in this review.
- The evidence applies to the U.S. population, but may not apply to all race and ethnicities and socioeconomic positions.

Pregnancy

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between portion size and energy intake during pregnancy because there is no evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during pregnancy because there is no evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Postpartum

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between portion size and energy intake during postpartum because there is no evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Conclusion statement and grade: A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during postpartum because there is no evidence available. (Grade: Grade Not Assignable)

Summary of the evidence:
- There was not enough evidence available to answer this question.

Introduction

To prepare for the development of the *Dietary Guidelines for Americans, 2025-2030*, the U.S. Departments of Health and Human Services (HHS) (**Appendix 1**) and Agriculture (USDA) identified a proposed list of scientific questions based on relevance, importance, potential federal impact, and avoiding duplication, which were posted for public comment.[*] The Departments appointed the 2025 Dietary Guidelines Advisory Committee (Committee) in January 2023 to review evidence on the scientific questions. The Committee's review of the evidence forms the basis of the Scientific Report of the 2025 Dietary Guidelines Advisory Committee,[†] which includes independent, science-based advice and recommendations to HHS and USDA and, is considered during the development of the next edition of the *Dietary Guidelines*.

The proposed scientific questions were refined and prioritized by the Committee for consideration in their review of the evidence. As part of that process, the following systematic review question was prioritized: What is the relationship between portion size and energy intake? The Committee conducted a systematic review to address this question, with support from USDA's Nutrition Evidence Systematic Review (NESR) team.

Methods

The Committee used NESR's methodology to conduct this systematic review. NESR's methodology is described in detail in its methodology manual,[‡] as well as in the Committee's Scientific Report.[*] This section presents an overview of the specific methods used to answer the systematic review question: What is the relationship between portion size and energy intake?

Develop a protocol

A systematic review protocol is the plan for how NESR's methodology will be used to conduct a specific systematic review and is established by the Committee, *a priori*, before any evidence is reviewed. The protocol is designed to capture the most appropriate and relevant body of evidence to answer the systematic review question. Development of the protocol involves discussion of the strengths and limitations of various methodological approaches relevant to the question, which then inform subsequent steps of the systematic review process. The protocol describes all of the methods that will be used throughout the systematic review process. Additionally, the protocol includes the following components, which are tailored to each systematic review question: the analytic framework, the inclusion and exclusion criteria, and the synthesis plan.

The protocol was posted online (https://nesr.usda.gov/protocols) for the public to view and comment on. Revisions to the systematic review protocol were made during the review process. These amendments are documented in **Table 1**.

[*] Dietary Guidelines for Americans: Learn About the Process. 2022. Available at: https://www.dietaryguidelines.gov/work-under-way/learn-about-process

[†] 2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

[‡] USDA Nutrition Evidence Systematic Review Branch. USDA Nutrition Evidence Systematic Review: Methodology Manual. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview

Table 1. Protocol revisions

Date	Protocol revision	Description
January 2024	Inclusion and exclusion criteria for publication date were updated to document that the review will include studies published through January 2024.	This revision was made to document the final publication date range covered by the literature search.

Develop an analytic framework

An analytic framework visually represents the overall scope of the systematic review question and depicts the contributing elements that were examined and evaluated. It presents the core elements of each systematic review question, including the **P**opulation (i.e., those who experience the intervention/exposure and/or outcome), **I**ntervention and/or exposure (i.e., the independent variable of interest), **C**omparator (i.e., the alternative being compared to the intervention or exposure), and **O**utcome(s). Definitions for key terms are also included because they provide the basis for how concepts are operationalized throughout the review. The Committee identified key confounders based on their knowledge of nutrition and health research and experience as subject matter experts. Key confounders are participant characteristics, such as demographics, health status, and diet and lifestyle behaviors, and/or other factors related to both the intervention/exposure and the outcome of interest that may impact the relationships of interest. Key confounders were considered during review and evaluation of the evidence, particularly during the risk of bias assessment of non-randomized and observational studies.

Figure 1 is the analytic framework for the systematic review. The intervention or exposure of interest is a food-based strategy targeting food and/or beverage portion size and pre-portioned foods that considers energy density, nutrient density and/or the quality or type of food served or consumed in young children, children, adolescents, adults, older adults, and individuals during pregnancy and postpartum. The comparator is a different portion size served or consumed. The outcome is energy intake. The key confounders are sex, age, physical activity, race and/or ethnicity, socioeconomic position, anthropometry, and energy intake at baseline in all populations; smoking (adults, older adults, pregnancy, postpartum); parity (pregnancy, postpartum), diabetes mellitus in the current pregnancy (pregnancy), hypertensive disorders in the current pregnancy (pregnancy), and human milk feeding (postpartum). Portion size is defined as the amount of food or beverage served at 1 time in 1 eating occasion. Energy density is defined as the amount of calories (energy) in a given weight of food or beverage.

Figure 1. Analytic framework for the systematic review question: What is the relationship between portion size and energy intake?

Population	***Intervention/ exposure***	***Comparator***	***Outcome***	***Key confounders***
Young children, children, and adolescents (1 up to 19 years) Adults and older adults (19 years and older) Individuals during pregnancy and postpartum	Portion size that considers energy density, nutrient density and/or the quality or type of the food/beverage served or consumed Pre-portioned foods	Different portion size served or consumed	Energy intake	• Sex • Age • Race/ethnicity • Socioeconomic position • Anthropometry • Physical activity • Energy intake at baseline • Smoking (adults, older adults, pregnancy, postpartum) • Parity (pregnancy, postpartum) • Diabetes mellitus in the current pregnancy (pregnancy) • Hypertensive disorders in the current pregnancy (pregnancy) • Human milk feeding (postpartum)

Synthesis organization:

I. ***Intervention/Exposure***: Portion size (accounting for energy density; nutrient density; and/or the quality or type of the food/beverage served or consumed); Pre-portioned foods

   a. ***Population***: Young children; Children; Adolescents; Adults; Older adults; Individuals during pregnancy and postpartum

      i. ***Outcome***: Energy intake

Key definitions:

Portion size: The amount of food or beverage served at 1 time in 1 eating occasion

Energy density: The amount of calories (energy) in a given weight of food or beverage

Develop inclusion and exclusion criteria

The inclusion and exclusion criteria provide an objective, consistent, and transparent framework for determining which articles to include in the systematic review (**Table 2**). These criteria ensure that the most relevant and appropriate body of evidence is identified for the systematic review question, and that the evidence reviewed is:[*]

- Applicable to the U.S. population of interest
- Relevant to Federal public health nutrition policies and programs
- Rigorous from a scientific perspective

Table 2. Inclusion and exclusion criteria

Category	Inclusion Criteria	Exclusion Criteria
Study design	• Randomized controlled trials • Non-randomized controlled trials[†] • Prospective cohort studies • Retrospective cohort studies • Nested case-control studies	• Uncontrolled trials[‡] • Case-control studies • Cross-sectional studies • Ecological studies • Narrative reviews • Systematic reviews • Meta-analyses • Modeling and simulation studies
Publication date	• January 2000 – January 2024	• Before January 2000, after January 2024
Population: Study participants	• Human	• Non-human
Population: Life stage	• At intervention or exposure and outcome: o Young children (12 up to 24 months) o Children and adolescents (2 up to 19 years) o Adults and older adults (19 years and older) o Individuals during pregnancy o Individuals during postpartum	• At intervention or exposure and outcome: o Infants (birth up to 12 months)

[*] USDA Nutrition Evidence Systematic Review Branch. USDA Nutrition Evidence Systematic Review: Methodology Manual. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview

[†] Including quasi-experimental and controlled before-and-after studies

[‡] Including uncontrolled before-and-after studies

Category	Inclusion Criteria	Exclusion Criteria
Population: Health status	• Studies that exclusively enroll participants not diagnosed with a disease* • Studies that enroll some participants: o diagnosed with a disease; o diagnosed with a disorder that affects feeding/eating or growth (e.g., autism spectrum disorder, attention-deficit/hyperactivity disorder, eating disorder); o with severe undernutrition, failure to thrive/underweight, stunting, or wasting; o who became pregnant using Assisted Reproductive Technologies; o with multiple gestation pregnancies; o receiving pharmacotherapy to treat obesity; o pre- or post-bariatric surgery; o and/or hospitalized for an illness, injury, or surgery	• Studies that exclusively enroll participants: o diagnosed with a disease;† o diagnosed with a disorder that affects feeding/eating or growth (e.g., autism spectrum disorder, attention-deficit/hyperactivity disorder, eating disorder); o with severe undernutrition, failure to thrive/underweight, stunting, or wasting; o who became pregnant using Assisted Reproductive Technologies; o with multiple gestation pregnancies; o receiving pharmacotherapy to treat obesity; o pre- or post-bariatric surgery; o and/or hospitalized for an illness, injury, or surgery‡
Intervention/ exposure	• Portion size that considers energy density, nutrient density, and/or the quality or type of food served or consumed • Pre-portioned foods • Multi-component intervention in which the isolated effect of the intervention of interest on the outcome(s) of interest is provided or can be determined despite multiple components	• Studies that examine portion size using liquid meal replacements • Multi-component intervention in which the isolated effect of the intervention of interest on the outcome(s) of interest is not provided or cannot be determined due to multiple components
Comparator	• Different portion size served or consumed	• N/A
Outcome(s)	• Energy intake	• N/A
Publication status	• Peer-reviewed articles published in research journals	• Non-peer-reviewed articles, unpublished data or manuscripts, pre-prints, reports, editorials, retracted articles, and conference abstracts or proceedings
Language	• Published in English	• Not published in English
Country§	• Studies conducted in countries classified as high or very high on the Human Development Index the year(s) the intervention/exposure data were collected	• Studies conducted in countries classified as medium or low on the Human Development Index the year(s) the intervention/exposure data were collected

* Studies that enroll participants who are at risk for chronic disease were included

† Studies that exclusively enroll participants with obesity were included

‡ Studies that exclusively enroll participants post-cesarean section were included

§ The classification of countries on the Human Development Index (HDI) is based on the UN Development Program Human Development Report Office (http://hdr.undp.org/en/data) for the year the study intervention occurred or data were collected. If the study does not report the year(s) in which the intervention/exposure data were collected, the HDI classification for the year of publication is applied. Studies conducted prior to 1990 are classified based on 1990 HDI classifications. If the year is more recent than the available

Search for and screen studies

NESR librarians, in collaboration with NESR analysts and the Committee, used the analytic framework and inclusion and exclusion criteria to develop a comprehensive literature search strategy. The literature search strategy included selecting and searching the appropriate bibliographic databases, translating search using syntax appropriate for the databases being searched, and employing search refinements, such as search filters. The full literature search is documented in **Appendix 2**.

The results of all electronic database searches, after removal of duplicates, were screened independently by 2 NESR analysts using a step-wise process by reviewing titles, abstracts, and full-texts to determine which articles meet the inclusion criteria. Manual searching was conducted to find peer-reviewed published articles not identified through the electronic database search. These articles were also screened independently by 2 NESR analysts at the abstract and full-text levels.

Extract data and assess the risk of bias

NESR analysts extracted all essential data from each included article to describe key characteristics of the available evidence, such as the author, publication year, cohort/trial name, study design, population life stage at intervention/exposure and outcome, intervention/exposure and outcome assessment methods, and outcomes. One NESR analyst extracted the data and a second NESR analyst reviewed the extracted data for accuracy. Each article included in the systematic review underwent a formal risk of bias assessment, with 2 NESR analysts independently completing the risk of bias assessment using the tool that is appropriate for the study design.[*†‡]

Synthesize the evidence

The Committee described, compared, and combined the evidence from all included studies to answer the systematic review question.[§] Synthesis of the body of evidence involved identifying overarching themes or key concepts from the findings, identifying and explaining similarities and differences between studies, and determining whether certain factors impact the relationships being examined, which includes potential causes of heterogeneity across all included evidence.

Extracted data and risk of bias assessments for all included studies were tabulated to visually display results and facilitate synthesis. During synthesis, the Committee considered the effect direction, magnitude, and statistical significance of the results reported across the articles included in the body of evidence. The evidence was synthesized qualitatively without meta-analysis of effect estimates, statistical pooling or conversion of data, or quantitative tests of heterogeneity.

The synthesis plan for this review was designed with the end-use in mind, to inform the Committee's advice to HHS and USDA regarding dietary guidance across life stages. The first level of synthesis organization was by

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HDI values, then the most recent HDI classifications are used. If a country is not listed in the HDI, then the current country classification from the World Bank is used (The World Bank Country and Lending Groups, available from: https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-country-and-lending-groups)

[*] Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; 366: l4898. doi: 10.1136/bmj.l4898

[†] Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomized studies of interventions. *BMJ* 2016; 355; i4919. doi: 10.1136/bmj.i4919

[‡] Higgins JPT, Morgan RL, Rooney AA, et al. A tool to assess risk of bias in non-randomized follow-up studies of exposure effects (ROBINS-E). *Environment International* 2024 (published online Mar 24). doi: 10.1016/j.envint.2024.108602.

[§] USDA Nutrition Evidence Systematic Review Branch. USDA Nutrition Evidence Systematic Review: Methodology Manual. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview

portion size and pre-portioned foods. Then, within each of the population life stage groups, the evidence was organized by similar types of food based on the available evidence.

Develop conclusion statements and grade the evidence

After the Committee synthesized the body of evidence, they drafted conclusion statements. A conclusion statement is one or more summary statements carefully constructed to answer the systematic review question. Each conclusion statement reflects the evidence reviewed, as outlined in the analytic framework (e.g., PICO elements) and synthesis plan, and does not take evidence from other sources into consideration. Conclusion statements do not draw implications and should not be interpreted as dietary guidance. The Committee reviewed, discussed, and revised the conclusion statements until they reached agreement on wording that accurately reflected the body of evidence.

The Committee then graded the strength of the evidence underlying each conclusion statement. They did this using NESR's predefined criteria, based on 5 grading elements: consistency, precision, risk of bias, directness and generalizability of the evidence. Study design and publication bias were also considered.[*]

- Consistency: Consistency considers the degree of similarity in the direction and magnitude of effect across the body of evidence. This element also considers whether differences across the results can be explained by variations in study designs and methods.
- Precision: Precision considers the degree of certainty around an effect estimate for a given outcome. This element considers measures of variability, such as the width and range of confidence intervals, the number of studies, and sample sizes, within and across studies.
- Risk of bias: Risk of bias considers the likelihood that systematic errors resulting from the design and conduct of the studies could have impacted the accuracy of the reported results across the body of evidence.
- Directness: Directness considers the extent to which studies are designed to directly examine the relationship among the interventions/exposures, comparators, and outcome(s) of primary interest in the systematic review question.
- Generalizability: Generalizability considers whether the study participants, interventions and/or exposures, comparators, and outcomes examined in the body of evidence are applicable to the U.S. population of interest for the review.

The Committee assigned a grade to each conclusion statement (i.e., strong, moderate, limited, or grade not assignable). The grade communicates the strength of the evidence supporting a specific conclusion statement to decision makers and stakeholders. A conclusion statement can receive a grade of Strong, Moderate, or Limited, and if insufficient or no evidence is available to answer a systematic review question, then no grade is assigned (i.e., Grade Not Assignable) (**Table 3**). The overall grade is not based on a predefined formula for scoring or tallying ratings of each element. Rather, each overall grade reflects the expert group's thorough consideration of all of the grading elements, as they each relate to the specific nuances of the body of evidence under review.

[*] Spill MK, English LK, Raghavan R, et al. Perspective: USDA Nutrition Evidence Systematic Review Methodology: Grading the Strength of Evidence in Nutrition- and Public Health-Related Systematic Reviews. *Adv Nutr*. 2022 Aug 1;13(4):982-991. doi: 10.1093/advances/nmab147

Table 3. Definitions of NESR grades

Grade	Definition
Strong	The conclusion statement is based on a strong body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is strong, such that if new evidence emerges, modifications to the conclusion are unlikely to be required.
Moderate	The conclusion statement is based on a moderate body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is moderate, such that if new evidence emerges, modifications to the conclusion may be required.
Limited	The conclusion statement is based on a limited body of evidence as assessed by consistency, precision, risk of bias, directness, and generalizability. The level of certainty in the conclusion is limited, such that if new evidence emerges, modifications to the conclusion are likely to be required.
Grade Not Assignable	A conclusion statement cannot be drawn due to either a lack of evidence, or evidence that has severe limitations related to consistency, precision, risk of bias, directness, and generalizability.

Recommend future research

The Committee identified and documented research gaps and methodological limitations throughout the systematic review process. These gaps and limitations are used to develop research recommendations that describe the research, data, and methodological advances that are needed to strengthen the body of evidence on a particular topic. Rationales for the necessity of additional or stronger research are also provided with the research recommendations.

Peer review

This systematic review underwent external peer review in a process coordinated by staff from the National Institutes of Health (NIH). NIH staff identified potential peer reviewers through outreach to a variety of professional organizations to select academic reviewers from U.S. colleges and universities across the country with a doctorate degree, including MDs, and expertise specific to the questions being reviewed. All peer reviewers were external to the *Dietary Guidelines* process, and therefore, current Committee members or Federal staff who supported the Committee or the development of the *Dietary Guidelines* were not eligible to serve as peer reviewers.

The peer review process was anonymous and confidential in that the peer reviewers were not identified to the Committee members or NESR staff, and in turn, the reviewers were asked not to share or discuss the review with anyone. Peer reviewers were made aware that per USDA, Food and Nutrition Service (FNS) agency policy, all peer reviewer comments would be summarized and made public, but comments would not be attributed to a specific reviewer.

Peer review occurred after draft conclusion statements were discussed by the full Committee at its third, fourth, fifth, and sixth public meetings. NIH staff assigned and distributed the reviews to at least 2 peer reviewers based on area of expertise. Following peer review, the Committee reviewed and discussed comments and made revisions to the systematic review, as needed, based on the discussion.

Health equity considerations

The Committee was charged by HHS and USDA to review all scientific questions with a health equity lens to ensure that the next edition of the *Dietary Guidelines* is relevant to people with diverse racial, ethnic, socioeconomic, and cultural backgrounds. The Committee made a number of health equity considerations throughout the NESR systematic review process. The Committee's Scientific Report[*] includes a more detailed discussion of their approach to applying a health equity lens to their review of evidence, but examples include consideration of key confounders relevant to health equity and assessment of generalizability of the evidence.

Results

Literature search and screening results

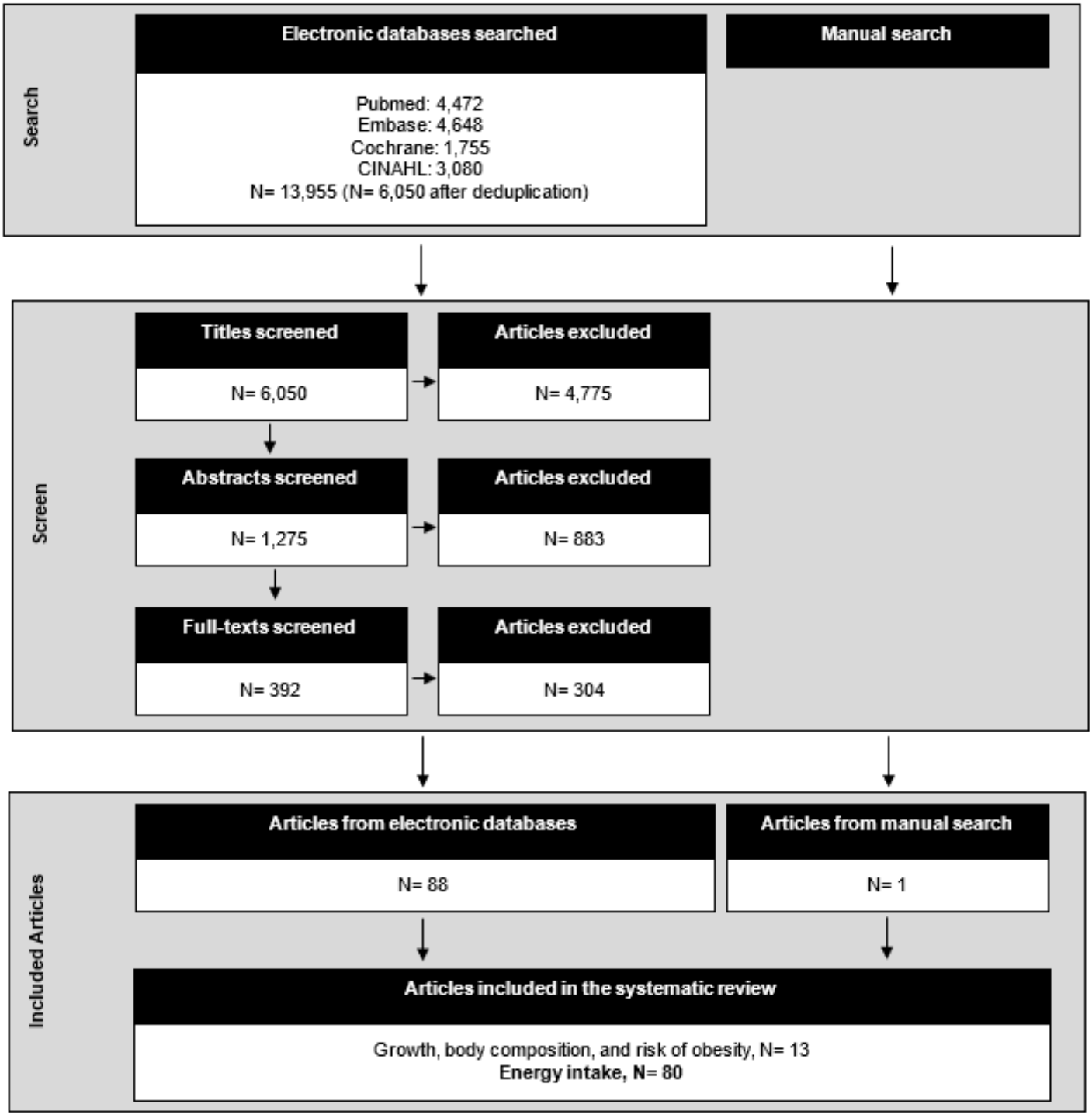
Articles included in this systematic review were identified from literature searches conducted to identify all potentially relevant articles for this systematic review and a systematic review assessing the relationship between portion size and pre-portioned foods and growth, body composition, and risk of obesity.[†] The intervention/exposures of interest for this review, portion size and pre-portioned foods, were considered separately. The literature search (**Appendix 2**) yielded 6,050 search results after the removal of duplicates (see **Figure 2**). Dual-screening resulted in the exclusion of 4,775 titles, 883 abstracts, and 304 full-texts articles. Reasons for full-text exclusion are in **Appendix 3**. One additional article was identified from the manual search. The body of evidence included 80 articles:

- Portion size in young children, children, and adolescents: 27 articles
- Pre-portioned foods in young children, children, and adolescents: 1 article
- Portion size in adults and older adults: 44 articles
- Pre-portioned foods in adults and older adults: 8 articles
- Portion size in individuals during pregnancy: 0 articles
- Pre-portioned foods in individuals during pregnancy: 0 articles
- Portion size in individuals during postpartum: 0 articles
- Pre-portioned foods in individuals during postpartum: 0 articles

[*] 2025 Dietary Guidelines Advisory Committee. 2024. Scientific Report of the 2025 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Health and Human Services and Secretary of Agriculture. U.S. Department of Health and Human Services. https://doi.org/10.52570/DGAC2025

[†] Raynor HA, Gardner CD, Anderson CAM, Andres A, Fisher JO, Giovannucci E, Hoelscher DM, Jernigan VBB, Odoms-Young A, Palacios C, Stanford FC, Fultz, AK, Obbagy J, Butera G, Higgins M, Terry N. *Portion Size and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. November 2024. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://doi.org/10.52570/NESR.DGAC2025.SR17

Figure 2. Literature search and screen flowchart



Portion size in young children, children, and adolescents

Description of the evidence

Twenty-seven articles met inclusion criteria to examine the relationship between portion size and energy intake in young children, children, and adolescents. One article conducted two experiments allowing for a total of 28 interventions to be examined in this body of evidence.[1] Of the 28 interventions, 25 were crossover randomized controlled trials,[1-25] 2 were parallel arm randomized controlled trials,[1,26] and 1 was a non-randomized controlled trial.[27] Evidence for portion size and energy intake in young children, children, and adolescents is summarized in **Table 15**.

Population

Twenty-three articles were conducted in the U.S.,[3-7,9-25] 2 in the U.K.,[8,26] 1 in Belgium,[1] and 1 in Singapore.[27] The total analytic sample sizes ranged from N=17 to N=125. Children enrolled in the trials were between the ages of 2 and 9 years with the majority between 4 to 5 years of age. Studies included approximately 46-61% female participants, however, there were 3 studies that included predominately male participants.[4,7,23] Children ranged between the 50-70th percentile for body mass index for age. Parents reported high levels of education and annual household incomes. The majority of studies enrolled predominantly non-Hispanic White participants, though 6 studies did include a majority of participants who identified as Black/African American[12,13,15,20,21] and/or Hispanic or Latino,[14] and 4 studies reported approximately 30%[4,17,19] or predominately Asian.[27]

Intervention/exposure and comparator

Most interventions (N=23) tested the effects of varying portion sizes of one meal or snack, with the number of test conditions ranging from 3 to 12.[1-3,6,8-20,22-25,27] Articles varied in terms of duration, and in how many and which foods were varied in portion size. Most articles, 17 of 23, examined portion size effects at a single meal; 8 of 23 articles manipulated the portion size of the main entrée with fixed amounts of other components at the meal, 5 of 23 articles manipulated portion sizes of all components of the meal, 10 of 23 manipulated portion sizes of snacks, vegetable side dishes, first courses, or the beverage only. Five of 28 studies evaluated effects of portion size beyond a single meal, with durations ranging from 1 day to 8 weeks. One of the five articles manipulated 2 lunches per week for 8 weeks.[4] Another tested the effects of portion size for 5 days by increasing the portion size of vegetables and fruits offered at meals and snacks with either no change in other foods or simultaneously decreasing the portion size of all other foods for 5 days.[5] Another study increased all foods at meals and snacks by 50% for 5 days.[7] One study tested a snack reduction for 3 weeks[26] while another study increased the portion sizes of entrees at lunch, dinner, and breakfast as well as an afternoon snack over 1 day.[21]

Outcome

The main outcome of interest was energy intake. Energy intake was assessed most often by weighing food intake before and after test meals. Two articles assessed energy intake differently, which included a plate waste method measured after the meal (method not described in detail)[4] and 4-day weighed food diaries assessed weekly.[26] Most articles reported energy intake of the manipulated foods and total energy intake of the manipulated foods combined with additional meal components (side dishes, beverages).[2,3,6,8,10,12,14-16,19,20,23,24] Fewer articles reported energy intake of a snack,[1,11,18,26] or total meal energy intake only.[13,22,25,27] Of the articles that evaluated portion size effects beyond a single meal, one study reported entrée energy intake, energy intake from dessert, and total lunch energy intake.[4] Another reported energy intake across 5 days including energy intake from food only, milk only, and food and milk.[5] One study reported daily energy intake including all food/meal components.[7] One study reported weekly snack energy intake[26] and another reported energy intakes at meals, snacks, and total daily energy intake.[21]

Synthesis of the evidence

Evidence was synthesized by the types of foods of which portion size was manipulated: energy dense food, vegetables and fruits, and all foods. Effects on energy intake were examined by considering energy intake from the portion size manipulated food, effects on other foods, and effects on total energy intake.

Energy dense food

There were 10 articles that manipulated the portion size of energy dense foods (e.g., macaroni and cheese, sandwiches, graham crackers)[1,4,8,11,16,21-25] and of these, 8 showed increases in energy intake of the energy dense food that was manipulated.[1,8,11,16,21-24] Of the remaining 2 articles, one reported null results for increased energy intake of the energy dense food (i.e., lunch entrée)[4] and in the other, increases in energy intake of the energy dense macaroni and cheese was observed for 5-year-old children but not for 3-year-old children.[25] Among the 10 articles, increasing the portion size of energy dense food had limited effects on intake of other foods served with them. Six articles found null effects of increasing portion size of an energy dense entrée on energy intake of other foods served at the meal.[4,8,11,21,22,24] One article found a null effect for milk while energy intake of the vegetable and side roll decreased.[16] Another article found that increasing the portion size of an energy dense entrée lead to increased energy intakes of other foods served with the entrée among 5–6-year-old and 8–9-year-old children but not among children 2-3 years of age.[23] Most of these single meal studies demonstrated increases in total energy intake of the meal,[8,16,22-24] with one study demonstrating increases in total daily energy intake.[21] One article manipulated the portion size of a beverage served at the meal and found no effects on meal energy intake.[11] Another study found that increases to portion size of an energy dense entrée increased meal energy intake for 5-year-old children but did not affect meal energy intake among 3-year-old children.[25]

Vegetables and fruits

There were 6 articles that manipulated portion sizes of vegetables and fruits, and all found significant increases in both food and energy intake of the manipulated vegetable and fruit.[5,6,15,17,19,20] However, in the case of one article, the increase in energy intake was only found for the fruit (applesauce) side, not the vegetables (broccoli or carrots).[20] Three articles found an effect of increasing vegetable and/or fruit portion sizes on energy intake of other foods served at the meal.[15,17,20] One found a decrease in entrée energy intake with no effect on the milk served at the meal.[20] Another study reported a decrease in pasta entrée energy intake when double portions of vegetables and fruits were served.[15] When smaller compared to larger servings of a vegetable soup and when serving the vegetable soup as a first course compared to not, there was a decrease in entrée energy intake as well as increase in vegetable consumption at the meal; however, there was also a subsequent increase in energy intake during the afternoon snack.[17] In most articles, increasing vegetable and fruit portion sizes had non-significant effects on meal energy intake, indicating that increasing vegetable and fruit portion sizes at meals produced increases in intakes of those foods without appreciable effects on total energy intake at the meal. One article found that serving a vegetable soup as first course resulted in reduced energy intake at the meal compared to a no soup control, however, when energy intakes of the soup plus meal were combined, the results were no longer significant.[17] Another article which doubled portion size and increased energy density of vegetables at the meal found an increase in meal energy intake, and while it was found to be statistically significant, the increase amounted to 13 kilocalories or a 5% increase.[6] Only 1 article reported results for daily total energy intake, which decreased over 5 days in addition to lower energy intake from food per day and food and milk per day when the portion size of vegetables and fruits were increased while simultaneously decreasing the portion size of all other food served.[5] In this same study when the portion size of vegetables and fruits was increased with no adjustments made to the rest of the meal, energy intake increased for food only, food and milk, and energy intake across 5 days.[5]

All foods

Seven articles manipulated the portion size of all foods served at the meal or throughout the day. Of the articles reporting effects on children's consumption of energy dense foods, all found increases in energy intake and gram weight intake of the energy dense foods.[2,3,7,10,12,13,27] Effects of increasing portion sizes of all foods at a meal or throughout the day on vegetable and fruit intakes were variable. One article found no change in intakes of vegetables and fruits when all foods at the meal were increased in portion size.[2] However, it is important to note that while vegetable energy intake was unchanged across portion size conditions, there was a trend for increased fruit intake.[2] Another article reported no change in energy intakes of the vegetables and fruits associated with the meal.[12] Two articles reported increased energy intakes for fruits at the meal but not for vegetables.[7,10] One article found increased energy intakes for both vegetables and fruits[3] while the remaining articles[13,27] did not report effects associated with vegetables and fruits. All 7 articles reported increased meal energy intakes when the portion size of all foods at the meal were increased. One article reported on daily energy intake which also increased across portion size manipulations.[7]

The remaining articles in this body of evidence manipulated portion sizes of both energy dense foods and vegetables and fruits,[1,18,26] with 1 article manipulating the portion size of milk.[9] One study found increased energy intakes of both the energy dense snack (pudding) and fruit snack (applesauce) which subsequently increased overall snack energy intake.[18] Another study showed that increasing the portion size of an energy dense snack (cookies) resulted in increased energy intake but not when a vegetable (carrots) was served as a snack.[1] Total snack energy intakes were not reported. One study tested snack reduction for a week and found no change in snack energy intake compared to baseline[26]. In the article that tested varying portion sizes of milk, milk energy intake increased with increased portion size, however, there was no effect on other foods or meal energy intake.[9]

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed 3 conclusion statements to answer the question, "What is the relationship between portion size and energy intake?" based on their review of the body evidence on portion sizes served to young children, children, and adolescents (**Table 4**, **Table 5**, **Table 6**).

Table 4. Conclusion statement and grade for portion size and energy intake in young children, children, and adolescents

Conclusion Statement	**Serving larger portions of energy dense foods increases energy intake in children. This conclusion statement is based on evidence graded as strong.**
Grade	Strong
Body of Evidence	Twenty-seven articles comprising 28 interventions; 25 RCT-crossover, 2 RCT-parallel, 1 NRCT
Consistency	Few concerns with consistency. Strengths demonstrated by consistent direction and magnitude of effects with similar study designs and methods used.
Precision	Few concerns with precision. Strengths demonstrated by studies with sufficient power.
Risk of bias	Some concerns with risk of bias due to a lack of information about randomization methods and the potential for selective reporting of results.
Directness	Few concerns with directness. The studies were directly designed to examine the effects of portion size and energy intake.
Generalizability	Some concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position.

Table 5. Conclusion statement and grade for portion size and energy intake in young children, children, and adolescents

Conclusion Statement	Serving larger portions of vegetables and fruits increases intake of those foods without increasing energy intake in children. This conclusion statement is based on evidence graded as moderate.
Grade	Moderate
Body of Evidence	Six articles; all RCT-crossover • An additional 3 articles examined both high energy dense food and vegetables and fruits on energy intake, although vegetables and fruits were not the primary purpose; 2 RCT-crossover, 1 RCT-parallel
Consistency	Few concerns with consistency. Strengths demonstrated by consistent direction and magnitude of effects with similar study designs and methods used.
Precision	Some concerns due to fewer number of studies directly testing portion size of vegetables and fruits, however, those that did were sufficiently powered.
Risk of bias	Some concerns with risk of bias due to a lack of information about randomization methods and the potential for selective reporting of results.
Directness	Few concerns with directness. The studies were directly designed to examine the effects of vegetable and fruit portion sizes and energy intake.
Generalizability	Some concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position.

Table 6. Conclusion statement and grade for portion size and energy intake in young children, children, and adolescents

Conclusion Statement	A conclusion statement cannot be drawn about the relationship between portion size and energy intake in young children and adolescents because there is no evidence available.
Grade	Grade not assignable
Body of Evidence	0 articles
Rationale	There is not enough evidence available to answer this question.

Assessment of the evidence

The body of evidence underlying these conclusion statements includes 25 crossover randomized controlled trials, 2 parallel arm randomized controlled trials, and 1 non-randomized controlled trial. All articles were conducted in children, and no articles were identified that examined portion size and energy intake in young children or adolescents. The strength of the evidence was graded based on an assessment of 5 grading elements, as described below. Publication bias was also considered, and there were some concerns with publication bias for this body of evidence. While the literature search was comprehensive, a search of the gray literature was not done, which may increase the possibility of publication bias. In addition, while few studies with null findings were identified in the literature, several of the included articles did report both statistically significant and non-significant results.

Consistency

The findings reported by the articles in this body of evidence were consistent in the direction and magnitude of effect. Results consistently showed that serving larger portion sizes led to increased intakes, such that when energy dense foods were consumed, total energy intake increased. Conversely, when larger portions of vegetables and fruits were served to children, intakes increased, but because of the lower energy density of those foods, the increased intake did not lead to increased total energy intakes.

Precision

This body of evidence demonstrated precision due to an adequate number of studies conducted in children, and while there were fewer studies that examined the effects of portion sizes for vegetables and fruits, those that did were sufficiently powered.

Risk of bias

These studies had some concerns with risks of bias including lack of detail on randomization and concealment methods, limited detail on missing data and those lost to follow-up, and no preregistered protocol or data analysis plans. Despite these risks of bias, however, there was little indication that randomization was not effective or that selective reporting occurred. There were a few studies with higher risks of bias due to concerns related to the description of outcome measurements, potential deviations from intended intervention, not accounting for compliance or consumption of other foods, not accounting for all key confounders, and no power calculations (**Table 16** and **Table 17**).

Directness

The studies in this body of evidence were directly designed to test the relationship between portion size and energy intake in children.

Generalizability

The body of evidence is generalizable to children in the U.S. regarding both participant characteristics and the interventions and outcomes studied. Articles that provided details on participants' race and ethnicity and socioeconomic position tended to enroll a majority of White, non-Hispanic children from higher socioeconomic positions. However, there were some studies conducted in populations reflecting greater diversity with respect to these characteristics, and the results of those studies were consistent.

Pre-portioned foods in young children, children, and adolescents

Description of the evidence

One article met inclusion criteria to examine the relationship between pre-portioned foods and energy intake in young children, children, and adolescents.[28] The article was a parallel randomized controlled trial. Evidence for pre-portioned foods and energy intake in young children, children, and adolescents is summarized in **Table 21**.

Population

This study was conducted in Belgium with a sample size of N=77 children with a mean age of ~9 years including both males and females (55% female). Children were approximately in the 40th percentile for BMI-for-age. Socioeconomic position was not reported and 86% of the children were of Belgian nationality.[28]

Intervention/exposure and Comparator

This study evaluated the effects of cookie size (and number) on energy intake, holding the total amount (weight) offered constant. Small cookies (N=40; 36 half-sized, 3.5g/each, 126g total) were served compared to larger cookies (N=37; 18 normal size, 7g/each, 126g total).[28] Children always received the same sized cookies per session based on their randomized placement.

Outcome

The study measured energy intake as its primary outcome. Energy intake was measured via visual estimation of the cookies before and after the test.[28]

Synthesis of the evidence

The results of this study showed that children served the large cookies consumed 68 kilocalories more compared to the children served smaller cookies.[28]

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, "What is the relationship between portion size and energy intake?" based on their review of the body evidence on serving pre-portioned foods to young children, children, and adolescents (**Table 7**). The body of evidence includes 1 parallel randomized controlled trial with a high risk of bias for measurement of the outcome related to visual estimation as opposed to weighing (**Table 22**). Publication bias was unable to be evaluated, and it is unknown if the influence of publication bias contributed to the lack of articles available for inclusion in this body of evidence. The evidence was insufficient to develop a conclusion statement.

Table 7. Conclusion statement and grade for pre-portioned foods and energy intake in young children, children, and adolescents

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between pre-portioned foods by young children, children, and adolescents and energy intake because there is not enough evidence available.**
Grade	Grade not assignable
Body of Evidence	One article; RCT-Parallel
Rationale	There is not enough evidence available to answer this question.

Portion size in adults and older adults

Description of the evidence

Forty-four articles met inclusion criteria to examine the relationship between portion size and energy intake in adults and older adults. Several articles included multiple experiments, so there were 51 interventions examined in the 44 articles.[29-35] Of the 51 experiments, 39 were crossover randomized controlled trials,[21,29,31,33,35-65] 9 were parallel arm randomized controlled trials,[30,32,66-69] and 3 were non-randomized controlled trials.[34,70] Evidence for portion size and energy intake in adults and older adults is summarized in **Table 18**.

Population

Thirty articles were conducted in the U.S.,[21,31,33,34,36,37,39,41-50,52-55,57-59,62,63,70] 14 in the U.K.,[29,30,32,35,40,61,64-66] 3 in the Netherlands,[60,67,69] and 1 each in New Zealand,[38] Japan,[56] Australia,[68] and Ireland.[51] The total analytic

sample sizes ranged from N=13 to N=154 with a few larger studies conducted in worksite/college cafeterias. The mean age range of study participants was from 20 to 71 years, with most participants between 20 to 40 years of age. Most articles enrolled both women and men, with 2 studies in men only[32,56] and 18 studies in women only.[21,31,32,35,40,43,45,46,48,50,54,55,63,65,68,69] Participants had a mean body mass index (BMI) between 22 to 34 kg/m^2 with most articles reporting BMI between 23-26 kg/m^2. Fifteen articles provided information on socioeconomic position with most only describing education and household income. Within those articles, most participants reported a college degree or higher and annual household incomes greater than $50,000 per year. The majority of articles did not report information on race or ethnicity and in those that did, 13 reported to be predominately White[31,35,37,42,45-48,53,59,62] and 1 article each with predominately African American (48%) or Hispanic (52%) participants,[21] South Asian (100%),[65] majority Asian (53%),[68] likely majority Japanese,[56] and majority Dutch (95%).[69] Overall, subject criteria of studies included participants who were in generally good health, liked the study foods, had no food allergies or intolerances, were not dieting or reported disordered eating or restrained eating, ate regular meals, were non-smokers, were not pregnant or breastfeeding, were not taking medications that affected appetite, and were not athletes in training.

Intervention/exposure and comparator

Most articles tested the effects of portion size on energy intake by examining intake at a single meal or snack. Thirteen articles tested the effects of varying the portion size of a single food on energy intake, examining the following types of foods: sandwiches,[36] macaroni and cheese,[37,39,41,42] pasta dishes,[29,38,68] chili,[40] popcorn,[30] cookies,[67] and ice cream.[66] Eight articles tested the effects of varying the portion sizes of all foods served at the meal.[31,43-47,69] Some of these articles focused solely on testing the effects of portion size, while some examined whether other factors moderate the portion size effect, such as engagement in activities while eating (reading a book, watching TV),[42,67] self-serving food,[41] labeling foods,[68] or eating in a laboratory or a more naturalistic setting.[30] Fourteen studies tested how varying the portion size of a test food effects other foods at the meal.[29,32,39,53,56,57,59,62,70 34,61]

Fewer articles measured effects beyond a single meal. There were 5 articles that measured the effects of varying portion size on energy intake over the course of 1 day.[21,35,63,64] Five articles were longer in duration and varied portion sizes of all foods over multiple days. These longer duration articles included an 8 week study in which the portions of foods at lunch were changed,[48] as well as studies that changed the portion sizes of all meals and snacks served over 2,[49,50] 4,[51] and 11 days.[52] There was 1 behavioral weight loss intervention that tested a portion control utensil set versus a portion control crockery set with participants using both sets of portion control tools for 4 weeks each.[65]

Finally, 6 interventions tested the combined effects of varying portion size and energy density of a single food or beverage.[33,54,55,58,63]

Outcome

The main outcome of interest was energy intake. Most articles assessed energy intake by weighing food before and after meals. For those that did not, there were two articles in a restaurant/cafeteria setting which weighed plate waste after the meal and subtracted the amount from the average serving weight. Calories were derived from recipes provided by the restaurant manager or chef. One article provided participants with boxed lunches for 4 weeks and used 2, 24-hour dietary recalls during each 4-week period in addition to participant self-report on consumption of boxed lunches. One article collected diet diaries to account for the remainder of the day's intake in addition to measuring weighed food intake before and after the test meal. For interventions testing single foods, the outcome was energy intake of the test food.[29,30,36-42,66-68] Interventions that varied the portion sizes of all foods at the meal reported total energy intake of the meal, with most also reporting energy intake of individual meal components.[31,43-47,69] Interventions that measured the effects of portion size manipulations on other foods at the meal provided energy intakes for the test food, other foods served at the meal, and total meal energy intake.[29,32-34,39,53-63,70] For longer term interventions, energy intakes were provided

for the test food, total meal, and total daily energy intake[48-52] with some providing effects on individual food components.[21,35,63,64] Finally, the behavioral weight loss intervention measured daily energy intake via 3-day food diaries.[65] See **Table 18** for detailed energy intake assessment methods per article.

Synthesis of the evidence

There were 13 articles that tested the effects of varying the portion size of a single food.[29,30,34,36-42,66-68] The results from all studies indicate that as the portion size of the test food is increased, energy intake of the test food increases. In addition, among studies that tested a single food served as part of a meal, total energy intake at the meal also increased. There was 1 article where differences were found between men and women regarding ice cream intake served after a standard meal. The male participants increased energy intake of the ice cream, while there was no statistically significant increase in energy intake from the women, however, the direction of effect indicated increased energy intake.[66]

Among articles that varied the portion size of all foods at a meal,[31,43-47,69] all showed that increasing portion sizes increased total energy intake at the meal, and 7 of the 8 articles reported outcomes for the individual foods served, and found portion size effects for the individual foods. Five of the articles tested the effects of portion size under different conditions and found that the effect persisted regardless of whether food was served or self-served, and with increased variety, but 2 articles reported no effect of varying portion size for certain foods served under certain conditions. One article found no effect of portion size on energy for the chicken and pasta meal components when participants were provided with a doggy bag, though there was a portion size effect for broccoli, garlic bread, and grapes.[45] Notably, there was portion size effects for the chicken and pasta in the condition where a doggy bag was not offered.[45] And in the other article, there was portion size effects for chicken, pasta, broccoli, salad, and garlic bread, but no effect on the grapes and chocolate chip cookies served at the meal.[46] This article also found that among participants who had received training and education on the use of portion size as a strategy to moderate intake, participants were more likely to consume larger portions of lower energy dense foods.[46]

There was also a group of 11 articles comprising 14 interventions[29,32,34,53,56,57,59-62,70] that tested the effects of increasing the portion size of one food served at the meal, reporting the effects on that test food, on other foods served at the meal, and on total energy intake at the meal. An additional 5 interventions within 4 studies tested effects over the course of a whole day.[21,35,63,64] In nearly all studies, increasing the portion size of the test food increased energy intake from the test food. However, in one study, intake of the test food was compulsory,[61] and in another study, there was no effect of portion size on intake of the test food.[60] Effects on other foods served with the test food were more variable. The majority of studies showed that increasing the portion size, and intake, of a test food, did not have an effect on consumption of other foods served at the meal.[32,35,53,56,61-64] In a few studies, increasing the portion size of a test food decreased intake of 1 or more other foods served at the meal.[21,32,35,57,59,64] Only one article showed that increasing the portion size of an entrée increased the intake of other foods served (a tomato with pesto and a roll).[70] Of the 13 studies that reported total energy intake at the meal,[29,32,34,35,53,56,57,59-63,70] 10 showed that increasing the portion size of 1 food at the meal led to an increase in total energy intake at that meal.[29,34,35,56,57,59,62,63,70] The remaining studies either did not report effects[32,53] or showed no effect.[60,61] All 5 studies that examined a full day of intake reported increased total daily energy intake.[21,29,35,63] This suggests that the increased intake from the test food is not compensated for, either partially or fully, by reduced intake of other foods at the meal.

There were 5 articles[48-52] that changed the portion size of all foods over multiple days. All showed increases in daily energy, energy intake at individual meals, and, when reported, of individual meal components. One article found differential effects of portion size depending on type of food group.[52] There was a portion size effect for entrées, starches, desserts, yogurts, fruit with a meal, and snack foods, but no effect on fruit served as a snack or vegetables.

Portion size and energy density

Five articles were designed to test the independent and combined effects of portion size and energy density and can be found within **Table 18**.[33,54,55,58,63] All 5 articles found the effects of portion size and energy density on energy intake to be both independent and additive, particularly when higher energy dense foods were served. One article with 2 experiments tested portion size and energy density on the vegetable side dish (broccoli) either adding the additional portion sizes and energy densities to the meal or simultaneously decreasing the portion size of the other meal components.[33] These experiments reported increased energy intakes of the vegetable (manipulated test food) with 1 experiment reporting statistically significant increases in total meal energy intake with the other experiment showing a direction of effect for increased total meal energy intake but overall, no statistically significant effect.[33] Two articles offered salads as a compulsory first course in conditions that were systematically varied by portion size and energy density; a no salad control condition was also included. In the first article, compared with a no salad control, consuming low energy dense salads reduced meal energy intake and consuming high energy dense salads increased meal energy intake.[54] This article also found decreased entrée intake with the low energy dense salads compared to the high energy dense salads.[54] In the other article, a pasta entrée was increased in portion size and energy density with either a salad first course or no salad first course. This article found increased energy intakes of the pasta entrée and meal energy intake with increased pasta portion size and energy density, while consuming a salad decreased energy intake of the pasta but did not affect total energy intake at meal.[55] Another article tested portion size and energy density of different beverages.[58] This article reported increased intakes of the beverages with no effect on other foods served. For total meal energy intake, energy intake increased with the high energy dense/caloric beverages but had no effect for total meal energy intake when the low energy dense/non-caloric beverages were consumed.[58] Finally, one article increased the portion size and energy density of a baked pasta dish which resulted in increased energy intakes of the baked pasta and total meal energy intake but had no effect on the other food served.[63] Taken together, these articles consistently show that serving high energy dense versions of food increases energy intake, serving larger portions of a food increases energy intake, and together they lead to even greater increases in energy intake.

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed 2 conclusion statements to answer the question, “What is the relationship between portion size and energy intake?” based on their review of the body evidence on portion sizes served to adults and older adults (**Table 8** and **Table 9**).

Table 8. Conclusion statement and grade for portion size and energy intake in adults and older adults

Conclusion Statement	**Serving larger portions of foods increases food and energy intake in adults and older adults. This conclusion statement is based on evidence graded as strong.**
Grade	Strong
Body of Evidence	Forty-four articles comprising 51 interventions: 39 RCT-Crossover; 9 RCT-Parallel; 3 NRCT
Consistency	Few concerns with consistency. Strengths demonstrated by consistent direction and magnitude of effects with similar study designs and methods used.
Precision	Few concerns with precision. Strengths demonstrated by studies with sufficient power.
Risk of Bias	Some concerns with risk of bias due to a lack of information about randomization methods and the potential for selective reporting of results.
Directness	Few concerns with directness. The studies were directly designed to examine the effects of portion size and energy intake.

Conclusion Statement	**Serving larger portions of foods increases food and energy intake in adults and older adults. This conclusion statement is based on evidence graded as strong.**
Generalizability	Some concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position.

Table 9. Conclusion statement and grade for portion size and energy intake in adults and older adults

Conclusion Statement	**Portion size and energy density are independent and additive in their effects on energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate.**
Grade	Moderate
Body of Evidence	Five articles comprising 6 interventions directly tested portion size and energy density: 6 RCT-Crossover • An additional 6 articles demonstrated effects of portion size on low energy dense foods although it was not the primary purpose of the articles: 5 RCT-Crossover; 1 RCT-Parallel
Consistency	Few concerns with consistency. Strengths demonstrated by consistent direction and magnitude of effects with similar study designs and methods used.
Precision	Few concerns with precision. Strengths demonstrated by studies with sufficient power.
Risk of Bias	Some concerns with risk of bias due to a lack of information about randomization methods and the potential for selective reporting of results.
Directness	Few concerns with directness. The studies in this subset were directly designed to examine the effects of portion size and energy density on energy intake.
Generalizability	Several concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position.

Assessment of the evidence

The body of evidence included 44 articles comprising 51 interventions. Of these, 39 were crossover randomized controlled trials, 9 were parallel arm randomized controlled trials, and 3 were non-randomized controlled trials. Most articles reported effects of the manipulated foods as well as other foods served, total meal, and though fewer, some did report on daily energy intakes. While the literature search was comprehensive, a search of the gray literature was not done, which may increase the possibility of publication bias. However, there was a small number of articles with null findings, which indicates that publication bias, though possibly present, was likely not a major concern within this body of evidence.

Consistency

The body of evidence included strong study designs with consistent findings in direction and effect. There were few articles with overall null results. Given most reported effects on the manipulated food, other foods, and/or total energy intake, results were comparable in direction and effect.

Precision

There were few concerns with precision. There were adequate number of articles with sample sizes ranging from N=13 to N=154 with a few larger (up to N=603) articles conducted in worksites/college cafeterias. While there were fewer articles examining portion size and energy density, most reported power calculations and were adequately powered.

Risk of bias

There were some concerns for risks of bias for most articles surrounding lack of information provided about randomization and concealment methods, lack of details on attrition/those excluded from analysis and having no pre-registered protocol or data analysis plans increasing the potential for selective reporting of results. Despite these risks of bias, there was little indication that randomization was not effective or that selective reporting occurred. A few articles had higher risks of bias which included concerns for self-reporting, not accounting for the rest of the diet, no power calculation, not accounting for all key confounders, and concerns with outcome assessment methods (**Table 19** and **Table 20**).

Directness

Nearly all articles were directly designed to test the effects of portion size on energy intake. Some tested other factors that impact the relationship (food characteristics including energy density, protein, or variety), setting or environment (naturalistic vs. laboratory, TV viewing, reading a book, conducting a body scan, blind folding, bowl size, contextual information, self-serving, or provided with a doggy bag) and socioeconomic position. There were fewer articles that directly tested the relationship between portion size and energy density, however, in those that did most indicated that serving larger portion sizes increases energy intake, serving high energy dense food increases energy intake, and together, they substantially increase energy intake.

Generalizability

There were some concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position. Most articles were conducted in predominately White, non-Hispanic populations of middle to high socioeconomic position. However, regardless of where the study was conducted, and who the participants were, results were consistent with participant characteristics reflective of the U.S. population.

Pre-portioned foods in adults and older adults

Description of the evidence

Eight articles met inclusion criteria to examine the relationship between the consumption of pre-portioned foods by adults and older adults and energy intake.[71-78] Of the 8 articles, 6 were parallel arm randomized controlled trials[71-73,75,77,78] and 2 were crossover randomized controlled trials.[74,76] This body of evidence is summarized in **Table 23**.

Population

Most articles were conducted in the U.S.,[71-77] while 1 was conducted in The Netherlands.[78] Sample sizes ranged from N=20 to N=229. One article enrolled only women[75] while 7 enrolled both men and women, though most participants overall were women. Participants ranged in age from 20-50 years, with most participants having a mean age less than 25 years. Participants were generally free from disease, not dieting to gain or lose weight, not exhibiting disordered eating symptoms or behaviors, and not taking medications known to impact appetite. Body mass index ranged from approximately 22 to 34 kg/m^2. In the 5 articles that described participant race and/or ethnicity, participants were predominately in White, non-Hispanic populations.[71-73,75,77] In the 4 articles that provided information about socioeconomic position, participants reported having earned a college degree, higher incomes (>$40,000), and were married.[71-73,75]

Intervention/exposure and Comparator

The articles in this body of evidence conducted interventions to determine the effects of serving pre-portioned foods, though the articles varied in terms of the methods used to pre-portion foods, whether they tested meals or snacks, and the duration of the intervention. One study compared the effects of pre-portioned box lunches

that differed in portion size (calorie amounts) to a habitual lunch over a 6-month period.[71] Another study compared the effects of serving the same amount of pretzels in single serve packages or standard multi-serving packages over 4 days.[72] One study compared the effects of providing breakfast foods as single-serve items to the same breakfast foods provided in standard, non-portioned amounts over 8 weeks.[73] Another study tested the effects of serving the same amount of snacks in smaller compared to larger packages over 3 days.[74] As part of a 12 month behavioral weight loss intervention, one study compared the effects of pre-portioned foods (given as pre-paid vouchers for single-serving main dishes) to a portion selection group (a group instructed to choose food portions based on energy density), or a standard dietary advice group.[75] Another study tested the effects of providing breakfast, lunch, and dinner foods served in standard unit sizes compared to serving the same foods cut into smaller pieces, or units.[76] This article also tested the effects of energy density, serving each unit size condition in lower and higher energy density versions. One study compared the effects of providing snacks that varied both in package size and number of packages over 3 days.[77] Finally, one study compared the effects of serving the same amount of chocolate as either large bars or smaller bars at a single snack session.[78] This article also tested the effects of wrappers, serving the bars wrapped and unwrapped.

Outcome

All articles measured energy intake as an outcome of interest (**Table 23**). Six of 8 articles assessed energy intake via weighed food intake,[72-74,76-78] and 2 measured energy intake by conducting 3, 24-hour dietary recalls.[71,75] In addition, 3 of the articles were weight loss interventions, in which energy intake was also measured.[71,73,75]

Synthesis of the evidence

Most articles reported consistent findings, showing that energy intake was higher when participants were served larger compared to smaller pre-portioned foods. Four articles reported statistically significant differences between groups. One study found energy intake of the lunch meal to be significantly higher in the 1600 calorie boxed lunch group compared to all other groups. Lunch energy intake was significantly higher for the 800-calorie boxed lunch group when compared to the 400-calorie boxed lunch group. While the 1600 calorie boxed lunch group energy intake of the meal was higher compared to the 800- and 400-calorie groups, total daily energy intake was not different compared to the control group consuming a habitual lunch. Total daily energy intake was not different between the 800- and 400-calorie groups either.[71] However, total daily energy intake was significantly higher in the control group compared to the 400-calorie lunch box group.[71] Another study reported total daily energy intake was significantly higher in participants served the standard, non-pre-portioned breakfast compared to the single-serve pre-portioned breakfast.[73] This effect did differ by type of food with energy intakes from cereal and applesauce higher in the non-pre-portioned breakfast compared to the pre-portioned breakfast. There were no significant differences in energy intake from peaches and cheese between groups.[73] In another study, there was increased energy intakes when the larger compared to smaller packaged snacks were served[74] and in another, increased energy intakes with the larger chocolate bars compared to smaller units of chocolate bars.[78]

Three articles did not find statistically significant increases in energy intakes, but the direction of effect was similar. One study found no statistically significant differences in snack energy intake in participants who were served a standard versus single-serving snack package, though energy intake was higher when the standard package size was served.[72] In addition, participants with overweight or obesity in this study consumed significantly more calories from the standard packages compared to those with normal weight, but no difference was found for single serving packages.[72] Another study reported a main effect of package size, as energy intake was significantly higher in the large compared to the small package groups.[77] However, there were no differences in energy intake from snack foods between the large and small unit groups, and the interaction between unit size and package size was not significant. One study found no significant differences in energy intake between the pre-portioned foods group, portion selection group, and standard dietary advice

group.[75] However, within group analyses showed that all groups decreased energy intake significantly from baseline, suggesting that pre-portioned foods did effectively decrease energy intakes, but was no better than the other strategies tested in the intervention.[75]

Finally, one study tested the effects of serving an omelet, wraps, and pizzas in standard sizes compared to cutting them into smaller pieces, found no differences in energy intake.[76] This study also tested the effects of energy density, and reported that increasing energy density significantly increased energy intake.[76]

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, "What is the relationship between portion size and energy intake?" based on their review of the body evidence on pre-portioned food served to adults and older adults (**Table 10**).

Table 10. Conclusion statement and grade for pre-portioned food and energy intake in adults and older adults

Conclusion Statement	**Serving foods as smaller pre-portioned amounts decreases energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate.**
Grade	Moderate
Body of Evidence	Eight articles: 6 RCT-Parallel; 2 RCT-Crossover
Consistency	Some concerns with consistency. The direction of results consistently showed that energy intake was lower when food was served in smaller, pre-portioned amounts, though effect size varied.
Precision	Some concerns with precision due to the small size of study groups and variance in effect estimates.
Risk of bias	Some concerns with risks of bias due to a lack of information about randomization methods and the potential for selective reporting of results.
Directness	Few concerns with directness. The studies were directly designed to examine the effects of pre-portioned foods on energy intake.
Generalizability	Several concerns with generalizability due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position.

Assessment of the evidence

The body of evidence underlying these conclusion statements comes from 8 randomized controlled trials, including 6 parallel arm randomized controlled trials and 2 crossover randomized controlled trials. The strength of the evidence was graded based on an assessment of 5 grading elements, as described below. Publication bias was also considered, and there are some concerns with publication bias for this body of evidence. While the literature search was comprehensive, a search of the gray literature was not done, which may increase the possibility of publication bias. However, several of the included articles did report null findings.

Consistency

The body of evidence was generally consistent with respect to the direction of effect of the findings, though there was some variability in terms of the magnitude of effect reported. The direction of results consistently showed that energy intake was lower when food was served in smaller, pre-portioned amounts. However, given that studies tested different types of foods over different durations, the magnitude of the change of energy intake varied across studies.

Precision

The body of evidence demonstrated precision given the adequate number of sufficiently powered studies. However, there were some concerns with precision due to the generally small size of study groups and variance in effect estimates.

Risk of bias

Across the body of evidence, there were some concerns with risks of bias. This was primarily due to a lack of information about randomization methods and the potential for selective reporting of results, due to a lack of pre-registered protocols or data analysis plans. However, despite these concerns, there was little indication that randomization was not effective or that selective reporting of results occurred (**Table 24**).

Directness

There were few concerns with directness in this body of evidence. Articles were directly designed to examine the effects of pre-portioned foods on energy intake in adults and older adults.

Generalizability

There were several concerns with generalizability in this body of evidence. These concerns are primarily due to a lack of diversity for study participants with regards to race and ethnicity and socioeconomic position. Several articles did not describe participant characteristics for these variables, and among those that did, participants were majority non-Hispanic White, and of higher socioeconomic position due to education and income.

Portion size in individuals during pregnancy

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, “What is the relationship between portion size and energy intake?” based on their review of the body evidence on portion sizes served to individuals during pregnancy (**Table 11**). There were no articles in the body of evidence, so a conclusion statement could be not drawn. Due to the lack of evidence identified, it is difficult to evaluate publication bias. While the literature search was comprehensive, a search of the gray literature was not conducted, and therefore there are some concerns that publication bias contributed to the lack of articles available for inclusion in this body of evidence.

Table 11. Conclusion statement and grade for portion size and energy intake in individuals during pregnancy

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between portion size and energy intake during pregnancy because there is no evidence available.**
Grade	Grade not assignable
Body of Evidence	0 articles
Rationale	There is not enough evidence available to answer this question.

Pre-portioned foods in individuals during pregnancy

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, “What is the relationship between portion size and energy intake?” based on their review of the body evidence on pre-portioned foods served to individuals during pregnancy (**Table 12**). There were no articles in the body of evidence, so a conclusion statement could be not drawn. Due to the lack of evidence identified, it is difficult to evaluate publication bias. While the literature search was comprehensive, a search of the gray literature was not conducted, and therefore there are some concerns that publication bias contributed to the lack of articles available for inclusion in this body of evidence.

Table 12. Conclusion statement and grade for pre-portioned foods and energy intake in individuals during pregnancy

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during pregnancy because there is no evidence available.**
Grade	Grade not assignable
Body of Evidence	0 articles
Rationale	There is not enough evidence available to answer this question.

Portion size in individuals during postpartum

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, “What is the relationship between portion size and energy intake?” based on their review of the body evidence on portion sizes served to individuals during postpartum (**Table 13**). There were no articles in the body of evidence, so a conclusion statement could be not drawn. Due to the lack of evidence identified, it is difficult to evaluate publication bias. While the literature search was comprehensive, a search of the gray literature was not conducted, and therefore there are some concerns that publication bias contributed to the lack of articles available for inclusion in this body of evidence.

Table 13. Conclusion statement and grade for portion size and energy intake in individuals during postpartum

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between portion size and energy intake during postpartum because there is no evidence available.**
Grade	Grade not assignable
Body of Evidence	0 articles
Rationale	There is not enough evidence available to answer this question.

Pre-portioned foods in individuals during postpartum

Conclusion statement and grade

The 2025 Dietary Guidelines Advisory Committee developed a conclusion statement to answer the question, “What is the relationship between portion size and energy intake?” based on their review of the body evidence on pre-portioned foods served to individuals during postpartum (**Table 14**). There were no articles in the body of evidence, so a conclusion statement could be not drawn. Due to the lack of evidence identified, it is difficult to evaluate publication bias. While the literature search was comprehensive, a search of the gray literature was not conducted, and therefore there are some concerns that publication bias contributed to the lack of articles available for inclusion in this body of evidence.

Table 14. Conclusion statement and grade for pre-portioned foods and energy intake in individuals during postpartum

Conclusion Statement	**A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during postpartum because there is no evidence available.**
Grade	Grade not assignable
Body of Evidence	0 articles
Rationale	There is not enough evidence available to answer this question.

Summary of conclusion statements and grades

The 2025 Dietary Guidelines Advisory Committee answered the systematic review question, "What is the relationship between portion size and energy intake?", with the following conclusion statements.[*] The grades reflect the strength of the evidence underlying the conclusion statements.

Young children, children, and adolescents

Serving larger portions of energy dense foods increases energy intake in children. This conclusion statement is based on evidence graded as strong. (Grade: Strong)

Serving larger portions of vegetables and fruits increases intake of those foods without increasing energy intake in children. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

A conclusion statement cannot be drawn about the relationship between portion size and energy intake in young children and adolescents because there is no evidence available. (Grade: Grade Not Assignable)

A conclusion statement cannot be drawn about the relationship between pre-portioned foods by young children, children, and adolescents and energy intake because there is not enough evidence available. (Grade: Grade Not Assignable)

Adults and older adults

Serving larger portions of foods increases food and energy intake in adults and older adults. This conclusion statement is based on evidence graded as strong. (Grade: Strong)

Portion size and energy density are independent and additive in their effects on energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Serving foods as smaller pre-portioned amounts decreases energy intake in adults and older adults. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Individuals during pregnancy and postpartum

A conclusion statement cannot be drawn about the relationship between portion size and energy intake during pregnancy because there is no evidence available. (Grade: Grade Not Assignable)

A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during pregnancy because there is no evidence available. (Grade: Grade Not Assignable)

A conclusion statement cannot be drawn about the relationship between portion size and energy intake during postpartum because there is no evidence available. (Grade: Grade Not Assignable)

A conclusion statement cannot be drawn about the relationship between pre-portioned foods and energy intake during postpartum because there is no evidence available. (Grade: Grade Not Assignable)

Research recommendations

- Design and conduct portion size interventions of longer duration and in free-living settings, including the strategic use of portion size to better control total energy intake and improve diet quality. Examine how changing the portion size of some foods impacts intake of other foods served at a meal.
- Apply best practices for nutrition research by measuring and reporting adherence data and conducting adequately powered trials.
- Ensure adequate representation of populations in which evidence is lacking including young children, adolescents, individuals during pregnancy and postpartum, older adults, and among diverse populations (e.g., minoritized racial and/or ethnic groups, individuals of various socioeconomic

[*] A conclusion statement is carefully constructed, based on the evidence reviewed, to answer the systematic review question. A conclusion statement does not draw implications and should not be interpreted as dietary guidance.

positions, individuals of various geographical locations, individuals with various countries of birth and/or length of time in the U.S.)

- Include a variety of pre-portioned meal options such as commercially prepared products, researcher prepared meals, and meals prepared at home.
- Conduct research to determine the effects of portion control in the context of medically tailored meals (food is medicine).
- Conduct family-based studies that examine the intervention/exposures at the family level and assesses outcomes among all family members.

Table 15. Evidence examining the relationship between portion size and energy intake in young children, children, and adolescents[a]

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Fisher, 2007c[23] **RCT-crossover , U.S.** Baseline N=75, Analytic N, Reference: N=65, Large: N=65, Self-select: N=69 (Attrition: ~13%) **Study objective:** To study the effects of age on children's responsiveness to large and self-selected portions **Participant characteristics at baseline:** Children, 3 age groups: 2-3yrs, 5-6yrs, 8-9yrs • Age: 2.6 (0.5) y; 5.6 (0.5) y; 8.7 (0.4) y • Female: 41% • Race and/or ethnicity: Non-Hispanic White: 100% • Socioeconomic position: Parent education >high school: 93%; Employment: 51% • Anthropometry: BMI percentile 2-3y: 76 (33) % 5-6y: 61 (31) % 8-9y: 75 (25) % • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Those not identifying as non-Hispanic White, presence of any chronic condition or medication affecting food intake, food allergies, BMI-for-age <5th percentile, dislike of 2 or more study foods.	**Intervention:** 2-3 year olds Condition 1: 100% (200g, 284kcal) Condition 2: 200% (400g, 568kcal) Condition 3: Self-selected individual serving dish, 200% (400g, 568kcal) 5-6 year olds Condition 1: 100% (250g, 355kcal) Condition 2: 200% (500g, 710kal) Condition 3: Self-selected individual serving dish, 200% (500g, 710kcal) 8-9 year olds Condition 1: 100% (450g, 639kcal) Condition 2: 200% (900g, 1278kcal) Condition 3: Self-selected individual serving dish, 200% (900g, 1278kcal) **Duration**: 1 meal (dinner) once a week for 3 weeks **Compliance:** 8 excluded from reference condition, 2 from large condition, and 4 in the self-select condition for entree intake 0 grams. Two were excluded for change scores >3 SD above the mean. **Outcomes and assessment methods**: Weighed food intake; Before and after test meal	**Energy intake, all children combined:** Energy intake from the entree: Condition 2 (200%) vs Condition 1 (100%): +29%, P<0.001 Total energy intake from the meal: Condition 2 (200%) vs Condition 1 (100%): +13%, P<0.001 **Energy intake 2-3y children:** Entree: 100%= 133 (82) kcal; 200%= 145 (113) kcal; 200% self-serve= 127 (92) kcal Other foods: 100%= 143 (80)kcal; 200%= 149 (59) kcal; 200% self-serve= 153 (68) kcal Total energy: 100%= 276 (135) kcal; 200% =294 (123) kcal; 200% self-serve= 280 (134) kcal **Energy intake in 5-6y children:** Entree: 100%= 223 (83) kcal; 200%= 290 (145) kcal; 200% self-serve= 241 (156) kcal Other foods: 100%= 257 (84) kcal; 200%= 271 (96) kcal; 200% self-serve= 260 (80) kcal Total energy: 100%= 276 (85) kcal; 200% =294 (81) kcal; 200% self-serve= 261 (94) kcal **Energy intake in 8-9y children:** Entree: 100%= 361 (173) kcal; 200%= 407 (258) kcal; 200% self-serve= 380 (270) kcal Other foods: 100%= 276 (85)kcal; 200%= 294 (81) kcal; 200% self-serve= 261 (94) kcal Total energy: 100%= 637 (190) kcal; 200% =700 (282) kcal; 200% self-serve= 641 (286) kcal	**Model adjustments:** NA **Limitations:** • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding:** North American International Life Sciences Association Committee on Lifestyle and Weight Management

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Huss, 2013[4] **RCT-Crossover, U.S.** Baseline N=23, Analytic N=23 (Attrition: 0%) **Study objective:** To determine the individual and combined impact of the timing of serving dessert and portion size of main course on energy intake at lunch in a childcare setting **Participant characteristics at baseline**: Children, 2-5, who attended full day childcare • Age: 2-5 y • Female: 26% • Race and/or ethnicity: Caucasian: 56.5%; Asian: 30.4%; Other: 13.1% • Socioeconomic position: NR • Anthropometry: NR • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food restrictions, food allergies, or digestive diseases, such as Crohn's Disease or Cystic Fibrosis	**Intervention:** Condition 1: Reference portion (100%), dessert with lunch (~325 kcal, 2y; 400 kcal, 3-5y) Condition 2: Reference portion (100%), dessert after lunch (~325 kcal, 2y; 400 kcal, 3-5y) Condition 3: Large portion (150%), dessert with lunch (~490 kcal, 2y; 600 kcal, 3-5y) Condition 4: Large portion (150%), dessert after lunch (~490 kcal, 2y; 600 kcal, 3-5y) **Duration**: 1 meal (lunch), 2 times/week for 8 weeks **Compliance**: NA **Outcomes and assessment methods**: After meal; "Plate waste method," not described	**Energy intake from the main course, kcal (fish, pasta):** Condition 1 (100%, dessert with lunch): 47 (32), 94 (65) Condition 2 (100%, dessert after lunch): 62 (50), 91 (57) Condition 3 (150%, dessert with lunch): 53 (36), 83 (68) Condition 4 (150%), dessert after lunch): 57 (34), 100 (57) Portion size effect, P=NS **Energy intake from dessert, kcal (fish, pasta):** Condition 1 (100%, dessert with lunch): 84 (38), 82 (37) Condition 2 (100%, dessert after lunch): 97 (25), 87 (31) Condition 3 (150%, dessert with lunch): 85 (36), 85 (35) Condition 4 (150%), dessert after lunch): 88 (31), 87 (26) Portion size effect, P=NS **Total energy intake at lunch, kcal (fish, pasta):** Condition 1 (100%, dessert with lunch): 131 (50), 176 (76) Condition 2 (100%, dessert after lunch): 159 (58), 172 (65) Condition 3 (150%, dessert with lunch): 138 (44), 166 (78) Condition 4 (150%), dessert after lunch): 145 (40), 187 (67) Portion size effect, P=NS	**Model adjustments:** NA **Limitations:** • Randomization and concealment methods NR; Did not describe the outcome measurement, and concerns with mismeasurement; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2000[25] **RCT-crossover, U.S.** Baseline N=32, Analytic N=32 (Attrition: 0%) **Study objective**: To examine the effects of portion size on children's food intake and to test the prediction that the effects of portion size on children's food intake will be greater for 5 year old than 3 year old children **Participant characteristics at baseline:** Preschool children, age 3-6y • Age: 3.6y, 5y • Female: 56% • Race and/or ethnicity: White: 78%; African American: 6%; Asian: 6%; Other: 9% • Socioeconomic position: NR • Anthropometry: Weight-for-height percentiles: 67.1 (3.4) % for 3y and 60.8 (3.8) % for 5y • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: N **Excluded from study or analysis**: NR	**Intervention:** 3y Condition 1: 100% entrée (150 g) Condition 2: 175% entrée (263 g) Condition 3: 250% entrée (376 g) 5y Condition 1: 100% entrée (225 g) Condition 2: 150% entrée (338 g) Condition 3: 200% entrée (450 g) **Duration**: 1 meal (lunch) once a week for 3 weeks **Compliance:** NR **Outcomes and assessment methods:** Before and after test meal; Weighed food intake	**Entree intake for 3y (g):** Condition 1 (100%): 44.8 (12.3) g Condition 2 (175%): 54.6 (15.8) g Condition 3 (250%): 39.6 (9.2) g P=NS **Total meal intake for 3y (kcal):** Condition 1 (100%): 140 (18.5) kcal Condition 2 (175%): 155 (22.3) kcal Condition 3 (250%): 146 (18.2) kcal P=NS **Entree intake for 5y (g):** Condition 1 (100%): 76.7 (14.8) g Condition 2 (150%): 100.7 (18.7) g Condition 3 (200%): 122.7 (21.6) g P<0.002 **Total meal intake for 5y (kcal):** Condition 1 (100%): 186 (18.4) kcal Condition 2 (150%): 227 (28.8) kcal Condition 3 (200%): 258 (35.4) kcal P<0.002	**Model adjustments**: NA **Limitations:** • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding:** NIH; The Nestle R&D Center

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Looney, 2011[18] **RCT-Crossover, U.S.** Baseline N=25, Analytic N=17 (Attrition: 32%) **Study objective**: To investigate the impact of portion size on intake of a lower energy-dense and higher energy-dense snack in preschool-aged children **Participant characteristics at baseline**: Preschool children, age 2-5y • Age: 3.8 (0.6) y • Female: 59% • Race and/or ethnicity: White: 82%; Nonwhite: 18%; Hispanic: 6% • Socioeconomic position: Graduate or professional degree: 65%; Caretaker marital status, married: 94% • Anthropometry: BMI-z score: 0.01 (1.06) BMI percentile: 50.2(32.4)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Did not receive parental consent, unable to use a spoon, were lactose intolerant, allergic to or disliked study foods, were absent at least 1 data collection day, consumed <5 kcal during a session	**Intervention**: Condition 1: Small portion (0.43 kcal/g), applesauce (150 g, 64.5 kcal) Condition 2: Large portion, applesauce (300 g, 129 kcal) Condition 3: Small portion, pudding (1.19 kcal/g) (150 g, 178.5 kcal) Condition 4: Large portion, pudding (300 g, 357 kcal) **Duration**: 1 snack every other week for 4 sessions **Compliance**: 4 excluded for consuming <5kcal in at least 1 session **Outcomes and assessment methods**: Before and after test snack; Weighed food intake	**Energy intake of the snack**: (pudding and applesauce combined) Small portion (150g): 99.0(52.5) kcal Large portion (300g): 84.2(30.8) kcal Main effect of PS: P<0.05 ED: P=NS PS*ED: P=NS	**Model adjustments**: NA • Other: Fixed factors: PS, ED, and order **Limitations**: • Methods for randomization and concealment NR; High rate of attrition, without accounting for missing data; No power calculation; No preregistered data analysis plan **Funding**: None

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Carstairs, 2018[8] **RCT-Crossover, U.K.** Baseline N=51, Analytic N=40 (Attrition: 22%) **Study objective**: To test the effect on intake of reducing the portion size of a high energy dense unit lunch item while varying the variety of the accompanying low energy dense vegetables **Participant characteristics at baseline**: 3-5 y old nursery preschoolers • Age: 3.9 (0.57) • Female: 53% • Race and/or ethnicity: NR • Socioeconomic position: Parent education, undergraduate degree: 61% of mothers; HHI >40,000 pounds: 72% • Anthropometry: BMI: 16.5 kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Children who were allergic to foods served; those who did not attend lunchtime sessions at the nursery on test days; non-eaters (those who consumed <10% of the smallest high energy dense portion on at least 4 occasions)	**Intervention**: Condition 1: Familiarization Block 1: Total meal ED: 1.3 kcal/g Condition 2 :100% PS for HED sandwich, 117g, 3.2 kcal/g; 120g LED cucumber Condition 3: 100% PS for HED sandwich, 117g, 3.2 kcal/g; 120g LED cherry tomatoes Condition 4: 100% PS for HED sandwich, 117g, 3.2 kcal/g; 120g LED carrot Condition 5: 100% PS for HED sandwich, 117g, 3.2 kcal/g; 120g LED cucumber, cherry tomatoes, carrot Block 2: Total meal ED: 1.1 kcal/g Condition 6: 60% PS for HED sandwich, 70g, 3.2 kcal/g; 120g LED cucumber Condition 7: 60% PS for HED sandwich, 70g, 3.2 kcal/g; 120g LED cherry tomatoes Condition 8: 60% PS for HED sandwich, 70g, 3.2 kcal/g; 120g LED carrot Condition 9: 60% PS for HED sandwich, 70g, 3.2 kcal/g; 120g LED cucumber, cherry tomatoes, carrot **Duration**: 1 meal (lunch) for 8 sessions **Compliance**: Two withdrew during the course of study, 6 were non-eaters (<10% of the smallest HED portion on at least 4 occasions), 3 did not complete all 8 conditions **Outcomes and assessment methods**: Before and after meal; Weighed food intake	**Total Meal Intake (kcal)** 60%: 278.0 (10.7) kcal 100%: 322.0 (16.5) kcal PS effect x total meal intake: P=0.001 PS effect x sandwich: P<0.001 PS effect x vegetable condition: P=0.877 Interaction PS*vegetable: P=0.590 **Vegetable Intake** 60%: 35.1 (5.3) g 100%: 31.5 (4.1) g P=0.169 **Sandwich Intake**: 60%: 48.4 (2.9) g 100%: 61.3 (4.4) g P<0.001	**Model adjustments**: NA **Limitations**: • Randomization and concealment methods NR; Did not account for missing data from those lost to follow-up; No preregistered data analysis plan **Funding**: BBSRC, Diet and Nutrition Research Industry Club

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Norton, 2015[11] **RCT-Crossover, U.S.** Baseline N=30, Analytic N=26 (Attrition: 13%) **Study objective**: To examine how beverage type vs. water and beverage portion size influenced beverage intake and food and overall snack energy intake **Participant characteristics at baseline**: Preschool children 3y or older, attending childcare • Age: 3.9 (0.6) y • Female: 49% • Race and/or ethnicity: White: 73%; Hispanic or Latino: 11.5% • Socioeconomic position: Parent education, graduate or professional level: 65%; Married: 92% • Anthropometry: BMI percentile: 62.2 (20.5)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Under 3 y of age by the start of the study, not enrolled at the on-campus childcare, allergies to or dislike of the foods used in the study, not able to use a spoon, no parental consent	**Intervention**: Condition 1: Small juice (100%, 6oz), applesauce, graham crackers (369 kcal) Condition 2: Large juice (200%, 12oz), applesauce, graham crackers (459 kcal) Condition 3: Small water (100%, 6oz), applesauce, graham crackers (279 kcal) Condition 4: Large water (200%, 12oz), applesauce, graham crackers (279 kcal) **Duration**: 1 meal (snack) for 4 sessions **Compliance**: One excluded for consuming all foods provided, 3 excluded for being absent during test sessions **Outcomes and assessment methods**: Before and after the test meal; Weighed food intake	**Beverage intake (g and/or kcal)**: Main effect of beverage portion size, large vs small: 173.9 (101.7) g vs. 121.3 (59.9) g, P<0.01 Main effect of beverage type, juice vs water: 184.9 (82.8) g vs. 110.5 (71.9) g, P<0.001 **Food intake (g and/or kcal)**: Condition 1 (small juice): NR Condition 2 (large juice): 88.5 (64.1) kcal Condition 3 (small water): NR Condition 4 (large water): 117.7 (69.1) kcal Main effect of beverage portion size, type interaction: P<0.05 Main effect of beverage portion size: P=NS Main effect of beverage type: P=NS **Total energy intake at snack (kcal)**: Main effect of beverage type, juice vs. water: 175.4 (50) kcal vs 104.8 (62.8) kcal, P=NS Main effect of beverage portion size: P=NS	**Model adjustments**: NA **Limitations**: • No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Reale, 2018[26] **RCT-Parallel, U.K.** Baseline N=47, Analytic N=46 (Attrition: 2%) **Study objective**: To explore the feasibility and acceptability of two strategies of snack portion control: snack reduction and snack replacement; the secondary aim was to examine the efficacy of the two methods of portion size reduction to improve the diets of preschool children **Participant characteristics at baseline**: Mothers (at least 18 y) of children aged 22-56 months who reported being primarily responsible for feeding their child • Age: 36.6 (9.5) months • Female: 48% • Race and/or ethnicity: Chinese: 4% Asian Indian: 2%; White British, mixed, or other: 94% • Socioeconomic position: Parent education, >A-level or equivalents: 74%; HHI, £30-40,000: 24%; £40,000+: 22%; Married/cohabiting: 100%; Employment status: 63% employed fulltime/part time or on maternity leave • Anthropometry: BMI percentile: 60.9 (26.7) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Child not consuming at least 1 high energy dense commercially available snack per day, could not commit to the 3-week study, child not likely or not familiar with study snack items, child had a food allergy or were taking medications known to impact appetite, child attended nursery for more than 3 full consecutive days	**Intervention**: Group 1: Snack Reduction Week 1: Baseline Week 2: Acclimation, replace HED snacks with study snacks Week 3: Snack reduction, replaced HED snacks with study snacks and reduced portion size by 50% Group 2: Snack Replacement Week 1: Baseline Week 2: Acclimation, replaced HED snacks with study snacks Week 3: Snack replacement, replaced HED snacks with 40g of fruits and vegetables and starch-based foods **Duration**: 3 weeks, all snacks (kept normal snacking routines) **Compliance**: 98% participation at week 3; total compliance was associated with study week but not condition. Compliance to the snacking schedule was higher in week 3 compared to week 2. **Outcomes and assessment methods**: Weekly; 4-day weighed food diary	**Snack Reduction, Mean (SD)** Week 1, 100%: 1052.1 (235.8) kcal Week 2, 100%: 1077.8 (229.1) kcal Week 3, 50%: 1063.5 (284.1) kcal p=NS	**Model adjustments**: NA • Other: Study week was within subject's variable and intervention group was between group **Limitations**: • Concerns with concealment; deviations from intended intervention with free-living environment (not accounting for compliance and consumption of other non-snack foods); Concerns with outcome measurement method due to use of food diary for outcome **Funding**: BBSRC, Diet and Nutrition Research Industry Club

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Orlet Fisher, 2003[24] **RCT-crossover, U.S.** Baseline N=35, Analytic N=30 (Attrition: 14%) **Study objective**: To determine the effects of repeated exposure to a large portion of an entrée on preschool aged children's awareness of portion size, self-selected portion size, and food intake and to evaluate associations of children's responsiveness to portion size with weight status and overeating **Participant characteristics at baseline**: Preschool • Age: 4.0 (0.5) y; (Range: 2.9-5.1y) • Female: 51% • Race and/or ethnicity: White, non-Hispanic: 80%; African American: 3%; Asian: 11%; Hispanic: 6% • Socioeconomic position: 4y University degree: 81% of mothers, 90% of fathers; HHI >$50k: 68%; Current employment: 84% of mothers, 90% of fathers • Anthropometry: NR • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Parents did not give permission	**Intervention**: Condition 1: 100% entrée (125 g, 463 kcal for <4y, 175 g, 648 kcal for >4y) Condition 2: 200% entrée (250 g, 925 kcal for <4y, 350 g, 1295 kcal for >4y) Condition 3: Self-selected Entrees (macaroni and cheese) were served with a fixed amount of carrot sticks, apple, sugar cookies, and milk **Duration**: 1 meal (lunch) once a week for 12 weeks (each condition served 4 times) **Compliance**: Five excluded for consuming <10g of entrée **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Entree intake (kcal)**: Condition 1 (100%) vs Condition 2 (200%): 25 (7) % increase in kcal, P<0.001 **Intake of other foods served at the meal**: Condition 1 (100%): 167 (15) kcal Condition 2 (200%): 163 (14) kcal P=0.91 **Total energy intake at lunch**: Condition 1 (100%): 544 (26) kcal Condition 2 (200%): 622 (37) kcal P<0.01	**Model adjustments**: NA **Limitations**: • No preregistered data analysis plan **Funding**: USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Kling, 2016a[9] **RCT-Crossover, U.S.** Baseline N=143, Analytic N=125 (Attrition: 13%) **Study objective**: To test the effects of varying the energy density and portion size of milk consumed with a lunch meal on energy intake in preschool children **Participant characteristics at baseline**: Preschool children • Age: 4.2 (0.1) y • Female: 46% • Race and/or ethnicity: White: 75%; Black or African American: 3%; Asian: 15%; Mixed or another race: 7%; Hispanic or Latino: 8% • Socioeconomic position: College degree or higher: 92% of mothers, 86% of fathers; HHI >$50,000: 72% • Anthropometry: BMI percentile: 53.6 (2.4)% BMI z-score: 0.12 (0.13) boys; 0.04 (0.11) girls • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis:** Allergy or intolerance to study foods or milk being served.	**Intervention**: Condition 1: 100% portion size (6 fl. oz), lower energy density (1% milk) Condition 2: 150% portion size (9 fl. oz), lower energy density (1% milk) Condition 3: 100% portion size (6 fl. oz), higher energy density (whole milk) Condition 4: 150% portion size (9 fl. oz), higher energy density (whole milk) Milk and all lunch foods (macaroni and cheese, chicken nuggets, broccoli, bananas) were consumed ad libitum **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: Eight children were excluded for being absent for 2 or more meals, 10 children were excluded for not consuming a minimum amount of milk **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Milk intake (kcal), total meal intake (kcal)**: Condition 1 (100% PS, lower ED): 63(2), 322(8) Condition 2 (150% PS, lower ED): 79(3), 337(10) Condition 3 (100% PS, higher ED): 90(3), 328(9) Condition 4 (150% PS, higher ED): 113(4), 337(10) Energy density: P<0.003, NS Portion size: P<0.04, NS Sex: In boys, meal energy intake did not differ by milk ED. In girls, higher milk ED led to significant increases in meal energy intake (24 (10) kcal, P=0.03)	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR **Funding**: NIH, USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Diktas, 2021[6] **RCT-Crossover, U.S.** Baseline N=NR, Analytic N=67 (Attrition: NR) **Study objective**: To test the independent and combined effects on preschool children's vegetable intake of serving a larger portion of vegetables and enhancing their flavor **Participant characteristics at baseline**: Preschool children • Age: 4.2 (0.6) y (Range: 3-5y) • Female: 61% • Race and/or ethnicity: White: 77.3%; Black or African American: 4.6%; Asian: 7.6%; Mixed or another race: 10.6%; Hispanic or Latino: 10.6% • Socioeconomic position: University degree: 85% of mothers and 78% of fathers; >$50k: 75% • Anthropometry: BMI z-score: 0.1 (1) BMI-for-age percentile: 54 (27)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NR	**Intervention**: Condition 1: 100% portion size, plain vegetables (lower ED, 0.42/1.26 kcal/g) Condition 2: 100% portion size, enhanced vegetables (higher ED, 0.58/1.42 kcal/g) Condition 3: 200% portion size, plain vegetables (lower ED, 0.42/1.26 kcal/g) Condition 4: 200% portion size, enhanced vegetables (higher ED, 0.58/1.42 kcal/g) Lunch meal included corn and broccoli (PS and ED manipulated) with fish sticks, rice, applesauce, ketchup, milk (portions held constant). **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: NR **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Condition 1 (100% PS, low ED)**: Broccoli: 8 (1) kcal Corn: 18 (2) kcal Total meal: 262 (10) kcal **Condition 2 (100% PS, high ED)**: Broccoli: 10 (1) kcal Corn: 19 (2) kcal Total meal: 277 (8) **Condition 3 (200% PS, low ED)**: Broccoli: 13 (2) kcal Corn: 35 (3) kcal Total meal: 282 (10) kcal **Condition 4 (200% PS, high ED)**: Broccoli: 16 (2) kcal Corn: 30 (3) kcal Total meal: 284 (11) kcal Broccoli: PS effect: P<0.0001, ED effect: P=0.0002 Corn: PS effect: P<0.0001, ED effect: P=0.25 Broccoli: PS effect: P=0.018, ED effect: P=0.10	**Model adjustments**: NA **Limitations**: • Did not describe baseline sample size or attrition **Funding**: NIH

Savage, 2012[16]
RCT-crossover , U.S.
Baseline N=21, Analytic N=17 (Attrition: 19%)

Study objective: To assess the effect of serving a range of entrée portions on children's ad libitum intake and energy density consumed at the meal

Participant characteristics at baseline:
3-5 y old children at a full-day childcare center
- Age: 4.3 (0.5) y
- Female: 59%
- Race and/or ethnicity: NR
- Socioeconomic position: Parents tended to be highly educated; HHI >$50,000: 60%; Parent marital status, married: 70%
- Anthropometry: BMI percentile: 74.6 (18.9); >85th percentile: 35%
- Physical activity: NR
- Smoking: NR
- TEI: NR
- Habitual diet at baseline: NR

Excluded from study or analysis: Presence of food intolerance to study food, chronic illnesses affecting food intake, consuming <22g of the entree (<10%), dislike of the main entree, uncooperative behavior during lunch, non-English speaking, extended absences

Intervention:
Condition 1: 100g (100%)
Condition 2: 160g (160%)
Condition 3: 220g (220%)
Condition 4: 280g (280%)
Condition 5: 340g (340%)
Condition 6: 400g (400%)

Duration: 1 meal (lunch) 6 weeks

Compliance: Four excluded for not meeting predefined attendance criteria

Outcomes and assessment methods:
Before and after test meals; Weighed food intake

Energy intake from the entree:
Condition 1 (100%): 144.7 kcal
Condition 2 (160%): 233.2 kcal
Condition 3 (220%): 261.3 kcal
Condition 4 (280%): 302.3 kcal
Condition 5 (340%): 356.1 kcal
Condition 6 (400%): 389.7 kcal
P<0.0001

Total energy intake at the meal:
Condition 1: 314.9 kcal
Condition 2: 400.9 kcal
Condition 3: 418.4 kcal
Condition 4: 434.7 kcal
Condition 5: 498.7 kcal
Condition 6: 505.8 kcal
P<0.001

Energy intake from other foods:
Energy intake from unsweetened applesauce:
Condition 1: 56.6 kcal
Condition 2: 50.4 kcal
Condition 3: 49.0 kcal
Condition 4: 41.6 kcal
Condition 5: 31.3 kcal
Condition 6: 33.2 kcal
P<0.0001

Energy intake from green beans:
Condition 1: 7.6 kcal
Condition 2: 7.8 kcal
Condition 3: 6.1 kcal
Condition 4: 7.3 kcal
Condition 5: 5.6 kcal
Condition 6: 2.7 kcal
P=0.05

Energy intake from the whole-wheat roll:
Condition 1: 54.6 kcal
Condition 2: 52.2 kcal
Condition 3: 38.7 kcal
Condition 4: 24.1 kcal
Condition 5: 41.9 kcal
Condition 6: 26.1 kcal
P<0.001

Model adjustments: NA
• Other: Random factors: child classroom, lunch table, day of the week lunch was eaten, session order

Limitations:
• Methods for randomization and concealment NR; High attrition rate, not accounted for in analyses; No power calculation; No preregistered data analysis plan

Funding:
NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
		Energy intake from milk: Condition 1: 51.4 kcal Condition 2: 57.4 kcal Condition 3: 63.3 kcal Condition 4: 59.5 kcal Condition 5: 63.8 kcal Condition 6: 53.9 kcal P=NS	

Kling, 2016b[10]
RCT-Crossover, U.S.
Baseline N=131, Analytic N=120 (Attrition: 8%)

Study objective: To test the effects on intake of varying the portion size and ED of lunches served to children in their usual eating environment

Participant characteristics at baseline:
Children, age 3-6y
- Age: 4.4 (0.1) y
- Female: 49%
- Race and/or ethnicity: White: 69%; Black or African American: 3%; Asian: 21%; Mixed or another race: 7%; Hispanic or Latino: 4%
- Socioeconomic position: Parent education, bachelor's degree or higher: 92% of Mothers; 90% of Fathers; HHI >$50,000: 69%
- Anthropometry: BMI percentile: 56.8 (2.6)%
- Physical activity: NR
- Smoking: NR
- TEI: NR
- Habitual diet at baseline: NR

Excluded from study or analysis: Allergy or intolerance to foods and milk being served; those absent for >3 of the 6 study days

Intervention:
Condition 1: 100% portion size, low energy density (100%)

Condition 2: 150% portion size, low energy density (100%)

Condition 3: 200% portion size, low energy density (100%)

Condition 4: 100% portion size, high energy density (142%)

Condition 5: 150% portion size, high energy density (142%)

Condition 6: 200% portion size, high energy density (142%)

Duration: 1 meal (lunch) for 6 sessions

Compliance: Eleven participants were absent >3 of the 6 experimental meals

Outcomes and assessment methods:
Before and after test meal; Weighed food intake

Total Meal energy intake (kcal):
100% PS, 100% ED: 222 (9)
150% PS, 100% ED: 279 (11)
200% PS, 100% ED: 279 (12)
100% PS, 142% ED: 321 (12)
150% PS, 142% ED: 366 (14)
200% PS, 142% ED: 390 (15)
Main effect of PS: P<0.0001 (100% vs 150%, 200%; P=NS for 150% vs 200%)
Main effect of ED: P<0.0001
PS, ED interaction: P<0.05

Energy intake of chicken (kcal):
100% PS, 100% ED: 48 (4)
150% PS, 100% ED: 47 (4)
200% PS, 100% ED: 44 (4)
100% PS, 142% ED: 95 (5)
150% PS, 142% ED: 95 (7)
200% PS, 142% ED: 106 (8)
PS: P=NS; ED: P<0.02

Energy intake from macaroni and cheese (kcal):
100% PS, 100% ED: 86 (6)
150% PS, 100% ED: 117 (8)
200% PS, 100% ED: 116 (9)
100% PS, 142% ED: 102 (8)
150% PS, 142% ED: 119 (10)
200% PS, 142% ED: 127 (12)
PS: P<0.03; ED: P<0.02

Energy intake from vegetable, (kcal):
100% PS, 100% ED: 12 (1)
150% PS, 100% ED: 12 (2)
200% PS, 100% ED: 11 (2)
100% PS, 142% ED: 15 (2)
150% PS, 142% ED: 15 (2)
200% PS, 142% ED: 16 (2)
PS: P=NS; ED: P<0.02

Energy intake from applesauce (kcal):
100% PS, 100% ED: 36 (2)
150% PS, 100% ED: 49 (3)
200% PS, 100% ED: 60 (3)
100% PS, 142% ED: 50 (2)
150% PS, 142% ED: 70 (4)

Model adjustments: NA
• Other: Fixed factors in model: PS, ED, study week, and classroom, significant interactions

Limitations:
• None identified

Funding:
NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
		200% PS, 142% ED: 79 (5) PS: P<0.03; ED: P<0.02 **Energy intake from ketchup (kcal)**: 100% PS, 100% ED: 6 (1) 150% PS, 100% ED: 8 (1) 200% PS, 100% ED: 8 (1) 100% PS, 142% ED: 9 (1) 150% PS, 142% ED: 12 (1) 200% PS, 142% ED: 14 (1) PS: P<0.05; ED: P<0.02 **Energy intake from milk (kcal)**: 100% PS, 100% ED: 35 (3) 150% PS, 100% ED: 46 (4) 200% PS, 100% ED: 41 (4) 100% PS, 142% ED: 50 (4) 150% PS, 142% ED: 56 (5) 200% PS, 142% ED: 51 (5) PS: P<0.03; ED: P<0.02	

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Spill, 2010[19] **RCT-crossover, U.S.** Baseline N=51, Analytic N=51 (Attrition: 0%) **Study objective**: To test whether increasing the portion size of vegetables served at the start of a meal leads to increased vegetable consumption and decreased meal energy intake in children **Participant characteristics at baseline**: Children, aged 3-6y enrolled in daycare • Age: 4.4 (0.1) y • Female: 57% • Race and/or ethnicity: White: 61%; Black or African American: 7%; Asian: 30%; American Indian or Alaska Native: 2% • Socioeconomic position: College degree: 90% (mothers); 85% (fathers); >$50,000: 79% • Anthropometry: BMI-for-age percentile: 63.5 (3.7); Overweight or obese: 24% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NR	**Intervention**: Condition 1: No carrots or ranch dip Condition 2: Carrots (100%, 30 g, 12 kcal), ranch dip (30 g, 20 kcal) Condition 3: Carrots (200%, 60 g, 24 kcal), ranch dip (30 g, 20 kcal) Condition 4: Carrots (300%, 90 g, 36 kcal), ranch dip (30 g, 20 kcal) **Duration**: 1 meal (first course, lunch, afternoon snack) once a week for 4 weeks **Compliance**: N/A **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Energy intake from carrots**: Condition 1: 0 kcal (no carrots provided) Condition 2 (100%): 8.7 (0.4) kcal Condition 3 (200%): 12.8 (0.9) kcal Condition 4 (300%): 13.5 (1.1) kcal Condition 2 vs 3, P<0.003 Condition 2 vs 4, P<0.003 Condition 3 vs 4, P=NS **Energy intake from lunch**, P=NS across conditions **Energy intake from broccoli**, P=NS across conditions **Total energy intake from carrots and lunch**, P=NS across conditions	**Model adjustments**: NA • Other: Portion size and session number **Limitations**: • Methods for randomization and concealment NR; Inclusion/exclusion criteria NR; No preregistered data analysis plan **Funding**: NIH; Robert Wood Johnson Foundation

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Smethers, 2019[7] **RCT-Crossover, U.S.** Baseline N=50, Analytic N=46 (Attrition: 8%) **Study objective**: To test whether the portion size effect is sustained in preschool children across 5 days **Participant characteristics at baseline**: Children, 3-5 y, attending childcare • Age: 4.4 (0.6) y • Female: 35% • Race and/or ethnicity: White: 74%; Asian: 9%; Mixed or other race: 6%; Hispanic or Latino: 13% • Socioeconomic position: Parent education, college or higher: 96% of mothers, 84% of fathers; HHI >$50k: 76% • Anthropometry: BMI-for-age percentile: 52.8 (24.5)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies, food restrictions, or health issues that precluded their participation or if they were not available for the duration of the study	**Intervention**: Condition 1: 100% portions Condition 2: 150% portions **Duration**: 5 days for 2 sessions **Compliance**: Four excluded for not meeting predefined attendance criteria **Outcomes and assessment methods**: Before and after the test meals; Weighed food intake	**Daily energy intake, Condition 1 (100%), Condition 2 (150%), P-value** All food: 758 (36), 900 (36), P<0.0001 Food at main meals: 459 (23), 515 (23), P<0.0001 Main dish: 289 (16), 329 (16), P<0.0001 Vegetable: 55 (5), 59 (5), P=0.12 Fruit: 95 (7), 106 (7), P=0.02 Condiments: 22 (2), 26 (2), P=0.002 Food at snacks: 306 (18), 388 (18), P<0.0001 Grain-based snacks: 230 (15), 291 (15), P<0.0001 Dairy snacks: 63 (5), 81 (5), P<0.0001 Fruit and vegetable snacks: 16 (2), 20 (2), P=0.006 All milk: 153 (13), 178 (13), P=0.0004 Milk at main meals: 117 (11), 128 (11), P=0.06 Milk at snacks: 36 (2), 49 (2), P<0.0001 All food and milk: 914 (44), 1081 (44), P<0.0001 Food and milk at main meals: 577 (29), 644 (29), P<0.0001 Food and milk at snacks: 341 (19), 437 (19), P<0.0001	**Model adjustments**: NA **Limitations**: • None identified **Funding**: NIH, USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Roe, 2022[5] **RCT-Crossover, U.S.** Baseline N=57, Analytic N=53 (Attrition: 7%) **Study objective**: To test the effects on children's intake of two strategies for increasing the proportion of vegetables and fruits: either adding or substituting extra portions as side dishes at meals and snacks over five days **Participant characteristics at baseline**: Aged 3-5 y in classrooms of childcare center • Age: 4.4 (1.1) y • Female: 47% • Race and/or ethnicity: White: 58%; Black: 4%; Asian: 13%; Mixed or another race: 13%; Hispanic or Latino: 6% • Socioeconomic position: Parent education, at least undergraduate degree: 85% of Mothers; 75% of Fathers; >$50,000 HHI: 70% • Anthropometry: BMI z-score: 0.12 (1.12) BMI percentile: 56.1 (4.1)% Overweight or obesity: 16% • Physical activity: Mean daily step counts Control: 5180 (164) Addition: 4868 (160) Substitution: 5092 (165) p=0.07 (Step count not related to effect on daily energy intake of the proportion of fruits and vegetables served) • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Not available for duration of study, followed a diet that excluded study foods served, food allergy to foods served	**Intervention**: Addition: Increased portion sizes of vegetables and fruits by 50%, with no change in other foods served Substitution: Increased the portion size of vegetables and fruits by 50%, and decreased the portion sizes of all other foods served by an equivalent weight Control: Typical portions in all food groups to meet CACFP requirements **Duration**: 5 days for 3 sessions **Compliance**: Four participants withdrew because of scheduling conflicts or moving to another childcare center **Outcomes and assessment methods**: Before and after each meal or session; Weighed food intake	**Fruit and vegetable intake, kcal not reported**: Intake was significantly higher in the substitution condition vs addition and control, and in the addition condition vs. control (P<0.0001) **Energy Intake, kcal**: Food Only Control: 925 (33) Addition: 981 (33) Substitution: 864 (33) p<0.0001 Milk Only Control: 130 (10) Addition: 132 (10) Substitution: 129 (10) p=0.97 Food and Milk Control: 1054 (35) Addition: 1111 (35) Substitution: 990 (35) p<0.0001 **Energy intake across 5 days**: Substitution<Control<Addition, p<0.0001	**Model adjustments**: NA • Other: Fixed factors in models were experimental condition, study week, study day, menu, childcare center, classroom, false discovery rate **Limitations**: • None identified **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Spill, 2011[17] **RCT-crossover, U.S.** Baseline N=73, Analytic N=72 (Attrition: 1%) **Study objective**: To test whether varying the portion of low-energy-dense vegetable soup served at the start of a meal affects meal energy and vegetable intakes in children **Participant characteristics at baseline**: Children, aged 3-6y enrolled in daycare • Age: 4.7 (0.1) y; (Range: 3.3-5.7 y) • Female: 57% • Race and/or ethnicity: White: 67%; Black or African American: 6%; Asian: 27% • Socioeconomic position: Parent education, college degree: 95% (mothers); 88% (fathers); HHI >$50,000: 70% • Anthropometry: BMI-for-age percentile: 59.8 (3.4)%; Range (1.4-99.0)%; Overweight/obese: 27% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NA	**Intervention**: Condition 1: No soup Condition 2: 100% (150 g, 56 kcal) Condition 3: 150% (225 g, 83 kcal) Condition 4: 200% (300 g, 111 kcal) Children were served fixed breakfast, lunch main course, and afternoon snack. **Duration**: 1 meal (first course, lunch, afternoon snack) once a week for 4 weeks **Compliance**: One was excluded for undue influence on the results because of high variability across meals **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Energy intake from the soup**: Condition 1 (no soup): 0 kcal Condition 2 (100%): 39.8 (2.2) kcal Condition 3 (150%): 44.8 (3.3) kcal Condition 4 (200%): 48.8 (3.8) kcal Condition 2 vs. 3, 4; p<0.0001 Condition 3 vs. 4; NS **Energy intake from lunch**: Condition 1: 385 (24.2) kcal Condition 2: 292.4 (21.8) kcal Condition 3: 325.9 (22.5) kcal Condition 4: 334.0 (21.7) kcal Condition 1 vs. 2, 3, 4; p<0.0001 **Energy intake from soup + lunch**: Condition 1: 491.0 (25.1) kcal Condition 2: 436.5 (23.2) kcal Condition 3: 467.2 (23.0) kcal Condition 4: 478.8 (24.3) kcal Condition 1 vs. 2; p<0.05 Condition 2 vs. 4; p<0.05 **Energy intake from afternoon snack**: Condition 1: 34.9 (5.8) kcal Condition 2: 33.8 (5.2) kcal Condition 3: 39.4 (5.7) kcal Condition 4: 51.3 (6.6) kcal Condition 1, 2, 3 vs. 4; P<0.05	**Model adjustments**: NA • Other: Portion size, classroom, test session **Limitations**: • Methods for randomization and concealment NR; Inclusion/exclusion criteria unclear; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
McCrickerd, 2017[27] **NRCT, Singapore** Baseline N=37, Analytic N=22 (Attrition: 41%) **Study objective**: To investigate whether the portions teachers serve to children i.) differ from those children would serve themselves and ii.) impact food intake **Participant characteristics at baseline**: Preschool-aged, 3.0-6.8 years old • Age: 4.9 (1.3) y • Female: 46% • Race and/or ethnicity: Likely majority • Socioeconomic position: NR • Anthropometry: BMI percentile: 44.2 (27.5)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Missing data due to children being absent for 1 or more study sessions	**Intervention**: Condition 1: 100%, teacher served Condition 2: 150%, teacher served Energy density of meals inadvertently varied in some conditions; results reported separately for equal and varied ED **Duration**: 1 meal (lunch) for 6 sessions **Compliance**: Fifteen were absent >1 testing day **Outcomes and assessment methods**: Before and after meals; Weighed food intake	**Equal Energy Density Meals** Energy intake (kcal): Energy intake was significantly greater when children were served 150% vs 100%, P<0.01 **Varied Energy Density Meals** The amount of food consumed was significantly greater when children were served 150% vs 100%, P<0.01 Energy intake did not differ significantly when children were served 150%, ED 1.65 kcal/g vs. 100% 1.30 kcal/g, P=NS	**Model adjustments**: • TEI: NR • Key confounders: Sex, Age, Energy intake **Limitations**: • Did not account for all key confounders; Concerns related to deviations from the intended intervention because energy density inadvertently varied between conditions; No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Mathias, 2012[15] **RCT-Crossover, U.S.** Baseline N=38, Analytic N=30 (Attrition: 21%) **Study objective**: To evaluate the effects of vegetable portion size, fruit portion size, and their interaction on children's food and energy intakes at dinner meals **Participant characteristics at baseline**: Children, 4-6y • Age: 5.4 (0.2) y • Female: 60% • Race and/or ethnicity: Non-Hispanic White: 30%; Non-Hispanic Black/African American: 47%; Hispanic White: 23% • Socioeconomic position: NR; Parent employment, part-time or full-time: 50% • Anthropometry: BMI-for-age-percentile: 72.3 (5.4)%; >85th percentile: 50% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Disliked study foods; those who ate negligible amounts of FVs; had severe food allergies, chronic illnesses, conditions affecting food intake, or were receiving a special diet	**Intervention**: Condition 1: 100% fruit and vegetable (75g, 45 kcal each) Condition 2: 200% vegetable (150g, 90 kcal) Condition 3: 200% fruit (150g, 90 kcal) Condition 4: 200% fruit and vegetable (150g, 90 kcal each) Amounts of milk and main entree were fixed. **Duration**: 1 meal (dinner) once a week for 5 sessions **Compliance**: Three excluded for disliking main entree, 1 for disliking both FVs, 4 excluded for eating a negligible amount of fruit/vegetables at more than half of the visits. **Outcomes and assessment methods:** Before and after test meal; Weighed food intake	**Total energy intake at the meal**: Condition 1: 368 (33) kcal Condition 2: 366 (33) kcal Condition 3: 383 (34) kcal Condition 4: 342 (34) kcal P=NS **Energy intake from the fruit and vegetables**: Condition 1 vs. Condition: 35.5 (3)kcal vs. 60.6 (5.4) kcal, P<0.0001 Condition 1 vs. Condition 3: 19.2 (3.6) kcal vs. 26.4 (5.4) kcal, P<0.01 Condition 1 vs. Condition: 58 (5) kcal vs. 88 (9) kcal, P<0.0001 **Energy intake from the entree**: Condition 1 vs. Condition 4: 172 (27) kcal vs. 217 (26) kcal, P<0.05	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; Attrition high (but adequately powered); Did not account for the effects of those excluded due to not consuming enough study foods; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Mooreville, 2015[12] **RCT-Crossover, U.S.** Baseline N=NR, Analytic N=100 (Attrition: NR) **Study objective**: To determine the association of children's susceptibility to large food portion sizes with appetite regulation and obesity **Participant characteristics at baseline**: Children, 5-6 y, "normal" weight or with obesity • Age: 5.4 (0.5) y • Female: 55% • Race and/or ethnicity: Black, non-Hispanic: 100% • Socioeconomic position: Parent education, beyond high school: 58%; NR; Participating in federal assistance programs: 85% • Anthropometry: BMI-for-age percentile: 98.12 (1.6)% for those with obesity; 58.99 (23.4)% for those with "normal" weight • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Underweight or overweight, race other than non-Hispanic Black, dislike of study foods, medical conditions (e.g., Sickle cell anemia, diabetes), medication use (e.g., corticosteroids), developmental delays, or severe food allergies (e.g., gluten) known to affect food intake or growth	**Intervention**: Condition 1: 100% portion sizes, 677 kcal Condition 2: 150% portion sizes, 1015 kcal Condition 3: 200% portion sizes, 1353 kcal Condition 4: 250% portion sizes, 1691 kcal **Duration**: 1 meal (dinner) for 4 sessions **Compliance**: Two children missed the 100% portion size condition, 2 children missed the 150% portion size condition, 1 child missed the 200% portion size condition **Outcomes and assessment methods**: Before and after the test meal; Weighed food intake	**Energy intake from macaroni and cheese**: Condition 1: 262.5(147.7) kcal Condition 2: 299.61(190.0) kcal Condition 3: 282.9(212.9) kcal Condition 4: 317.0(234.2) kcal P<0.05 **Energy intake from corn**: Condition 1: 30.4 (25.4) kcal Condition 2: 23.0 (31.3) kcal Condition 3: 35.9 (38.5) kcal Condition 4: 29.9 (36.0) kcal P=NS **Energy intake from applesauce**: Condition 1: 26.1 (19.5) kcal Condition 2: 26.7 (26.7) kcal Condition 3: 30.1 (31.9) kcal Condition 4: 25.2 (31.4) kcal P=NS **Energy intake from cookies**: Condition 1: 88.2 (40.8) kcal Condition 2: 109.1(63.1) kcal Condition 3: 126.0(78.3) kcal Condition 4: 140.4(102.6) kcal P<0.0001 Energy intake from milk, did not differ significantly across conditions, P=NS **Total energy intake at dinner**: Condition 1: 479.9 (167.8) kcal Condition 2: 531.2 (204.9) kcal Condition 3: 540.9 (216.5) kcal Condition 4: 585.1 (247.8) kcal P<0.001	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; Did not describe attrition; No power calculation; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Kral, 2010[20] **RCT-crossover , U.S.** Baseline N=43, Analytic N=43 (Attrition: 0%) **Study objective**: To examine the effects of increasing the portion size of F&V side dishes on children's intake **Participant characteristics at baseline**: Children, between 5-6y with BMI-for-age >5th percentile • Age: 5.9 (0.6) y • Female: 49% • Race and/or ethnicity: White: 11.6%; Black or African American: 76.7%; More than one race: 11.6% • Socioeconomic position: NR • Anthropometry: BMI: 17.0 (2.5) kg/m^2 BMI z-score: 0.73 (1.1) BMI-for-age percentile: 5th to 84th, 62.8%; 85th to 94th, 20.9%; >95th, 16.3% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Did not like study foods, had a serious medical condition known to affect food intake and body weight, developmental, medical, or psychiatric conditions that might impact study compliance, food allergies, taking medications know to affect food or body weight	**Intervention**: Condition 1: 100% each of broccoli, (75g, 22kcal), carrots (75g, 22kcal), and applesauce (122g, 49kcal) (626 kcal) Condition 2: 200% each of broccoli (150g, 44kcal), carrots (150g, 44kcal), and applesauce (244g, 133kcal) (719 kcal) **Duration**: 1 meal (dinner) once a week for 2 weeks **Compliance**: NA **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Energy intake from vegetable and fruit sides**: Broccoli: Condition 1 (100%) vs. Condition 2 (200%), P=NS Carrots: Condition 1 vs. Condition 2 , P=NS Applesauce: Condition 2 vs. Condition 1, +15 (4) kcal, P=0.001 **Energy intake from entree**: Condition 2 vs. Condition 1: -36 (17) kcal, P=0.04 **Energy intake from milk**: Condition 1 vs. Condition 2: P=NS **Total meal energy intake**: Condition 1, 100%: 446 (19) kcal Condition 2, 200%: 426 (19) kcal P=NS	**Model adjustments**: • Other: Fixed factor effects were portion size condition and time (week). If significant, interaction between portion size condition and time **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: The Obesity Society

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Fisher, 2007b[22] **RCT-Crossover, U.S.** Baseline N=53, Analytic N=53 (Attrition: 0%) **Study objective**: To test the effects of entrée portion size and ED on satiation in preschool children **Participant characteristics at baseline**: Preschool children • Age: 5-6y • Female: 53% • Race and/or ethnicity: Non-Hispanic White: 30%; Non-Hispanic Black: 38%; Other: 4%; Hispanic: 28% • Socioeconomic position: Parent education >high school: 79%; Married: 80% • Anthropometry: BMI percentile: 61.4 (28.4)% BMI z-score: 0.45 (1.08) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Chronic medical conditions or medication use affecting food intake, food allergies, BMI <5th percentile, dislike of study food	**Intervention**: Condition 1: 100% portion size (250g, 329 kcal), lower energy density (1.32 kcal/g) Condition 2: 200% portion size (500g, 658 kcal), lower energy density (1.32 kcal/g) Condition 3: 100% portion size (250g, 460 kcal), higher energy density (1.84 kcal/g) Condition 4: 200% portion size (500g, 920 kcal), higher energy density (1.84 kcal/g) Children were served a macaroni and cheese entree that varied in PS and ED at a dinner meal; others foods were served in fixed portions **Duration**: 1 meal (dinner) for 4 sessions **Compliance**: 100% (NR) **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Entrée intake, total meal intake (kcal)**: Condition 1: 217, 444 Condition 2: 281, 511 Condition 3: 282, 498 Condition 4: 382, 598 Portion size on entree intake and total meal energy: P<0.0001 Energy density on entree intake and total meal energy: P<0.0001 Porton size effects on energy intake did not interact with ED, P=0.32 PS and ED effects did not interact with child age, sex, ethnicity, BMI, or entree preference.	**Model adjustments**: NA • Other: Entree food preference; consumption of >95% of the reference portion **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Fisher, 2013[14] **RCT-crossover, U.S.** Baseline N=77, Analytic N=60 (Attrition: 22%) **Study objective**: To test effects of the amount of entree available and serving spoon size on children's self-served entree portions and intakes at dinner meals **Participant characteristics at baseline**: Children, 4-6y, English speaking • Age: 59.5 (7.2) months; Range: 48.4-72.0 • Female: 55% • Race and/or ethnicity: White: 20%; Black: 30%; Asian: 7%; Hispanic: 43% • Socioeconomic position: Parent education, high school or less: 20%; Parent employment: 50%; Participating in federally funded food assistance programs: 25%; Married: 77% • Anthropometry: BMI-for-age percentile: 59.9 (29.4)%, (Range: 48.4-72.0%) BMI-for-age z-score: 0.39 (1.11), (-2.03-3.28) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: On a highly restrictive diet, severe food allergies, chronic illnesses or medication use affecting food intake, anticipated discomfort being away from parent during experiment, perceived and stated dislike of study foods, serving 0g of entree at >2 of 4 conditions	**Intervention**: Condition 1: 100% (275g, 426kcal) Condition 2: 200% (550g, 852kcal) In 2 other conditions, children served the food using a teaspoon vs. tablespoon. Children were served an entree with fixed portions of unsweetened applesauce, baby carrots, corn, chocolate chip cookie, and 2% milk **Duration**: 1 meal (dinner) once a week for 4 sessions **Compliance**: Six excluded because seen in 1 or fewer trials due to dropout, child refusal, or dislike of the entree; 11 excluded for not serving any of the entree in >2 of 4 conditions **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Condition 1 vs Condition 2**: Energy intake from the entree, other foods, and total meal energy intake, P=NS	**Model adjustments**: NA • Other: Time, portion size, serving spoon size, and entree available by spoon size interaction were all included in the model **Limitations**: • Methods for randomization and concealment NR; Did not account for the effects of those excluded due to not consuming enough study foods; No power calculation; No preregistered data analysis plan **Funding**: USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Fisher (children), 2007a[21] **RCT-Crossover, U.S.** Baseline N=59, Analytic N=58 (Attrition: 2%) **Study objective**: To examine the effects of large portions on daily energy intake in 5y old Hispanic and African American children from low-income families **Participant characteristics at baseline**: Mother-child pairs, with 5y children attending Head Start • Age: 5y • Female: 60% • Race and/or ethnicity: White: 0%; African American: 48%; Asian: 0%; Hispanic: 52% • Socioeconomic position: Maternal education, HS or less: 53%; Maternal current employment: 55%; Low household food security: ~33% • Anthropometry: BMI percentile: 60 (29)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Presence of severe food allergies or chronic illnesses affecting food intake, dislike of the study foods, and self-reported previous diagnosis of maternal depression or eating disorders	**Intervention**: Condition 1: Reference portion (100%) Condition 2: Large portion (200%) All foods were provided to participants. The following foods varied in portion size: *Lunch*: Macaroni and cheese *Afternoon snack*: Apple juice, graham crackers *Dinner*: Chicken *Breakfast*: Cereal All other foods served were held constant across conditions. **Duration**: 1 day (breakfast, lunch, dinner, snacks) **Compliance**: 1 excluded due to a loose tooth **Outcomes and assessment methods**: Before and after test meals; Weighed food intake	**Morning snack**: No PS manipulation, P=NS between conditions **Energy intake at lunch (macaroni and cheese, kcal; all other foods, kcal)**: Condition 1: 226 (125) kcal; 170 (95) kcal Condition 2: 239 (118) kcal; 167 (86) kcal Manipulated food: P=NS All other foods: P=NS **Energy intake afternoon snack (apple juice, kcal; graham cracker, kcal)**: Condition 1: 81 (37) kcal; 94 (66) kcal Condition 2: 81 (59) kcal; 115 (92) kcal Manipulated foods: P=NS for apple juice and graham crackers **Energy intake at dinner (chicken, kcal; all other foods, kcal)**: Condition 1: 267 (96) kcal; 136 (71) kcal Condition 2: 357 (143) kcal; 125 (62) kcal Manipulated food: P<0.001 All other foods: P=NS **Evening snack**: No PS manipulation, P=NS between conditions **Energy intake at breakfast (cereal, kcal; all other foods, kcal)**: Condition 1: 108 (59) kcal; 140 (50) kcal Condition 2: 163 (101) kcal; 130 (47) kcal Manipulated food: P<0.001 All other foods: P=NS **Total energy intake**: Condition 1: 1500 (359) kcal Condition 2: 1639 (378) kcal P<0.001	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Keller, 2023[2] **RCT-Crossover, U.S.** Baseline N=95, Analytic N=88 (Attrition: 7%) **Study objective**: To determine the effects of portion size in children with lower executive functions **Participant characteristics at baseline**: Children, 7-8y without obesity • Age: 7.8 (0.6) y • Female: 48% • Race and/or ethnicity: White: 97%; Non-White: 3% • Socioeconomic position: Parent education, college or greater: 82%; Family income, $51k or greater: 88% • Anthropometry: BMI percentile: 47.2 (24.6) % • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Obesity, not in good health status, not reading at grade level, developmental disorders	**Intervention**: Condition 1: 100% portions (769 g, 1048 kcal) Condition 2: 133% portions (1011 g, 1377 kcal) Condition 3: 167% portions (1256 g, 1707 kcal) Condition 4: 200% portions (1492 g, 2030 kcal) **Duration**: 1 meal (either lunch or dinner) for 4 sessions **Compliance**: Five excluded for not attending all portion size visits **Outcomes and assessment methods**: Before and after test meals; Weighed food intake	**Energy intake at meals**: **Macaroni and cheese** Condition 1: 202.1(165.7) kcal Condition 2: 218.9(179.1) kcal Condition 3: 230.1(207.7) kcal Condition 4: 223.7(196.6) kcal **Chicken nuggets** Condition 1: 173.6(108.2) kcal Condition 2: 189.2(134.8) kcal Condition 3: 228.6(187.9) kcal Condition 4: 243.4(167.1) kcal **Broccoli** Condition 1: 30.5 (46.7) kcal Condition 2: 27.1 (46.1) kcal Condition 3: 28.1 (48.8) kcal Condition 4: 30.6 (56.0) kcal **Grapes** Condition 1: 64.2 (52.2) kcal Condition 2: 69.5 (58.2) kcal Condition 3: 68.5 (64.2) kcal Condition 4: 75.2 (68.0) kcal **Total energy intake:** Condition 1: 482.9 (206.9) kcal Condition 2: 516.7 (222.5) kcal Condition 3: 569.1 (284.8) kcal Condition 4: 588.8 (252.1) kcal Main effect for total energy intake at lunch: P<0.001 Main effect for grapes, broccoli: P=NS Main effect for macaroni cheese, chicken nuggets: P=0.0009	**Model adjustments**: NA • Other: Familial risk status, resting energy expenditure, study visit number, pre-meal fullness, average liking rating of foods at meal **Limitations**: • Methods for randomization and concealment NR; Differences in attrition (stated sample size does not align with Figure); **Funding**: NIH, USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Diktas, 2022[3] **RCT-Crossover, U.S.** Baseline N=54, Analytic N=51 (Attrition: 6%) **Study objective**: To investigate the effect of food liking on portion selection in middle childhood and examined how children's selections were related to measured intake at meals in which portions of all foods were varied across 4 test days **Participant characteristics at baseline**: Children, 7-10y • Age: 8.9 (12.) y • Female: 49% • Race and/or ethnicity: White: 94%; Black: 4%; Asian: 2% • Socioeconomic position: Parent education, university degree: 88% of mothers, 77% of fathers; HHI > $50k: >80% • Anthropometry: BMI-for-age percentile: 54.1 (28.7)% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies, taking medications that might influence appetite	**Intervention**: Condition 1: 100% portions (630 g) Condition 2: 133% portions (840 g) Condition 3: 167% portions (1050 g) Condition 4: 200% portions (1260 g) **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: One excluded for highly variable data **Outcomes and assessment methods**: Before and after the test meal; Weighed food intake	**Energy intake from cherry tomatoes, kcal** (100%, 133%, 167%, 200%): 3 (1), 2 (1), 3(1), 3 (1) **Energy intake from broccoli, kcal** (100%, 133%, 167%, 200%): 20 (2), 21 (3), 26 (3), 24 (4) **Energy intake from grapes, kcal** (100%, 133%, 167%, 200%): 53 (3), 60 (4), 71 (6), 71 (6) **Energy intake from macaroni and cheese, kcal** (100%, 133%, 167%, 200%): 224 (22), 268 (27), 261 (30), 245 (31) **Energy intake from angel food cake, kcal (100%, 133%, 167%, 200%)**: 68 (6), 82 (7), 89 (9), 89 (11) **Energy intake from garlic bread, kcal (100%, 133%, 167%, 200%)**: 168 (9), 208 (12), 245 (16), 256 (19) , P=NR Main effect of portion size across all foods compared to baseline: P<0.0001 **Total energy intake at lunch**: Condition 1 (100%): 536 (28) kcal Condition 2 (133%): 641 (35) kcal Condition 3 (167%): 695 (37) kcal Condition 4 (200%): 689 (41) kcal P=0.003	**Model adjustments**: NA **Limitations**: • Randomization and concealment methods NR; Did not clearly report statistical significance between conditions for energy intake **Funding**: NIH, Penn State

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Kral, 2014[13] **RCT-Crossover, U.S.** Baseline N=59, Analytic N=50 (Attrition: 15%) **Study objective**: To determine if children's weight status and relative reinforcing value of food interact with portion size to affect intake **Participant characteristics at baseline**: Children, 8-10y who were normal weight or obese • Age: 9.6 (0.8) y • Female: 52% • Race and/or ethnicity: White: 22%; Black or African American: 68%; More than one race: 10%; Hispanic: 8%; Not Hispanic: 82%; Unknown: 10% • Socioeconomic position: NR • Anthropometry: BMI: 20.8 (1.8) kg/m^2 BMI z-score: 0.9 (0.5) BMI-for-age percentile: 71.8% (13.1) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Did not like study foods, had medical conditions or were taking medications known to affect food intake or body weight, were diagnosed with a learning disability or sight/hearing impairment, had food allergies/intolerances, or were on a special diet.	**Intervention**: Condition 1: 100% portion size, 1,563 kcal Condition 2: 150% portion size, 2,345 kcal Condition 3: 200% portion size, 3,126 kcal **Duration**: 1 meal (dinner) for 3 sessions **Compliance**: Eight were used as pilot subjects to determine food and beverage portion size; 1 was excluded due to medical diagnosis and starting medication while participating in study. **Outcomes and assessment methods**: Before and after the test meal; Weighed food intake	**Total energy intake at dinner**: Condition 1: 921 (40) kcal Condition 2: 1046 (41) kcal Condition 3: 1041 (40) kcal P=0.003	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Aerts (Study 1), 2017[1] **RCT-Parallel, Belgium** Baseline N=96, Analytic N=96 (Attrition: 0%) **Study objective**: To determine the effect of increasing portion size on intake in children, and to determine whether the effect varies depending on type of food **Participant characteristics at baseline**: Children, ages 6-7y • Age: 6.43 (0.68) y • Female: 48% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 16 (1.84) kg/m^2; Overweight: 14.5% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: No parental consent; allergies; did not like popcorn	**Intervention**: Group 1: 100%, 30 g, 124 kcal, sugared popcorn Group 2: 100%, 30 g, 118 kcal, salted popcorn Group 3: 200%, 60 g, 247 kcal, sugared popcorn Group 4: 200%, 60 g, 235 kcal, salted popcorn **Duration**: 1 meal (snack) for 4 sessions **Compliance**: NR **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Energy intake (kcal)**: Group 1: 112 (31) kcal Group 2: 94 (40) kcal Group 3: 233 (50) kcal Group 4: 167 (47) kcal Portion size: P<0.01 (Group 1, 2 vs Group 3, 4 (100% vs 200%): 26.45 (9.01) g vs 51.21 (13.79) g, P<0.01) Popcorn type: P<0.01 Portion size vs popcorn type: P=0.02	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; Weighing prior to eating may have influenced intake; Almost all children consumed popcorn; No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Aerts (Study 2), 2017[1] **RCT-Crossover, Belgium** Baseline N=61, Analytic N=55 (Attrition: 10%) **Study objective**: To determine the effect of increasing portion size on intake in children, and to determine whether the effect varies depending on type of food **Participant characteristics at baseline**: Children, ages 3-6y • Age: 4.67 (0.86) y • Female: 47% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: NR • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: No parental consent, did not like or were allergic to study foods, illness, unusable data	**Intervention**: Condition 1: 100% carrots, 80 g carrots, 28 kcal Condition 2: 160% carrots, 130 g carrots, 46 kcal Condition 3: 100% cookies, 30 g cookies, 120 kcal Condition 4: 160% cookies, 48 g, 192 kcal **Duration**: 1 meal (snack) for 4 sessions **Compliance**: Four excluded for allergy or disliking of study foods, 2 excluded for illness **Outcomes and assessment methods**: Before and after test meal; Weighed food intake	**Energy intake (kcal)**: Condition 1: 15 (10) kcal Condition 2: 17 (14) kcal Condition 3: 102 (34) kcal Condition 4: 131 (63) kcal Portion size: P<0.01 for cookies; P=NS for carrots Food type: P<0.01 Portion size vs food type: P<0.01	**Model adjustments**: NA **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NR

[a] Abbreviations: RCT: Randomized Controlled Trial; y: years; BMI: Body Mass Index; kg/m^2: Kilograms per meters squared; SD: Standard Deviation; NR: Not Reported; TEI: Total Energy Intake; g: gram; Kcal: kilocalorie; kcal/g: kilocalories per gram; fl. oz: Fluid ounce; NA: Not applicable; NIH: National Institutes of Health; NS: Not significant; R&D: Research and development; PS: Portion size; ED: Energy density; HED: High energy dense; LED: Low energy dense; HHI: Household income; U.S: United States; U.K.: United Kingdom; BBSRC: Biotechnology and biological sciences research council; £: U.K. pound; USDA: United States Department of Agriculture; 50k: $50,000; CACFP: Child and Adult Care Food Program; NRCT: non-randomized controlled trial; FVs: Fruits and vegetables

Table 16. Risk of bias for randomized controlled trials examining portion size and energy intake in young children, children, and adolescents*

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Fisher, 2007c[23]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Huss, 2013[4]	HIGH	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS	HIGH
Rolls, 2000[25]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Looney, 2011[18]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Carstairs, 2018[8]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Norton, 2015[11]	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Reale, 2018[26]	SOME CONCERNS	NOT APPLICABLE	HIGH	LOW	HIGH	LOW	HIGH
Orlet Fisher, 2003[24]	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Kling, 2016a[9]	SOME CONCERNS	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS
Diktas, 2021[6]	LOW	LOW	LOW	SOME CONCERNS	LOW	LOW	SOME CONCERNS
Savage, 2012[16]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Kling, 2016b[10]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Spill, 2010[19]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS

* Possible ratings of low, some concerns, or high determined using the "Cochrane Risk-of-bias 2.0" (RoB 2.0) (August 2019 version)" (Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366**: l4898. doi:10.1136/bmj.l4898.)

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Smethers, 2019[7]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Roe, 2022[5]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Spill, 2011[17]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Mathias, 2012[15]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Mooreville, 2015[12]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Kral, 2010[20]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Fisher, 2007b[22]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Fisher, 2013[14]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Fisher, 2007a[21]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Keller, 2023[2]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Diktas, 2022[3]	SOME CONCERNS	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS
Kral, 2014[13]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Aerts, 2017 (study 1)[1]	SOME CONCERNS	NOT APPLICABLE	HIGH	LOW	HIGH	LOW	HIGH
Aerts, 2017 (study 2)[1]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS

Table 17. Risk of bias for non-randomized controlled trials examining portion size energy intake in young children, children, and adolescents*

Article	Confounding	Selection of participants	Classifications of interventions	Deviations from intended interventions	Missing data	Outcome measurement	Selection of the reported result	Overall risk of bias
McCrickerd, 2017[27]	SERIOUS	LOW	LOW	SERIOUS	LOW	LOW	LOW	SERIOUS

* Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool" (Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomized studies of interventions. *BMJ* 2016; 355; i4919. doi: 10.1136/bmj.i4919.)

Table 18. Evidence examining the relationship between portion size and energy intake in adults and older adults[a]

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Haynes (Study 1), 2020a[29] **RCT-Crossover, U.K.** Baseline N=49, Analytic N=45 (Attrition: 8%) **Study objective:** To test whether portion size effects on intake would be impacted if the resulting portion size was no longer visually perceived as 'normal' **Participant characteristics at baseline**: Adults, BMI between 22.5-32.5 kg/m^2 • Age: 30.4 (12.7) y (18–76y) • Female: 51% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 26.9 (3.7) kg/m^2 (18.9-35.3) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies or intolerances, specific dietary requirements, history of eating disorders, did not like or not willing to consume test foods	**Intervention**: Condition 1: Large normal (120%, 336 g, 307 kcal) Condition 2: Small normal (90%, 252 g, 230 kcal) Condition 3: Smaller than normal (60%, 168 g, 154 kcal) *A bowl of extra pasta (200%) was provided to allow for refills if desired* **Duration**: 1 meal (lunch) per 3 conditions **Compliance**: One excluded due to scheduling conflict, 2 excluded due to an error in portion served, 1 excluded due to high BMI **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal) from the initial entree**: Condition 1 vs Condition 3: 136 (5) kcal, P<0.001 Condition 2 vs Condition 3: 72 (2) kcal, P<0.001 Condition 1 vs Condition 2: 64 (4) kcal, P<0.001 **Energy intake (kcal) from the additional entree**: Condition 1 vs Condition 3: 59 (12) kcal, P<0.001 Condition 2 vs Condition 3: 38 (12) kcal, P=0.002 Condition 1 vs Condition 2: 21 (12) kcal, P=0.08 **Energy intake (kcal) from total meal**: Condition 1 vs Condition 3: 77 (12) kcal, P<0.001 Condition 2 vs Condition 3: 34 (11) kcal, P=0.01 Condition 1 vs Condition 2: 43 (12) kcal, P=0.001	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR; No preregistered data analysis plan (for study 1) **Funding**: Medical Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Haynes (Study 2), 2020a[29] **RCT-Crossover, U.K.** Baseline N=41, Analytic N=37 (Attrition: 10%) **Study objective**: To test whether portion size effects on intake would be impacted if the resulting portion size was no longer visually perceived as 'normal' **Participant characteristics at baseline**: Adults, BMI between 22.5-32.5 kg/m^2 • Age: 32.2 (12.2) y (20-59y) • Female: 51% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 26.9 (3.7) kg/m^2 (20.1-35.5) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies or intolerances, specific dietary requirements, history of eating disorders, did not like or not willing to consume test foods	**Intervention**: Condition 1: Large normal (130%, 423 g, 506 kcal) Condition 2: Small normal (100%, 325 g, 389 kcal) Condition 3: Smaller than normal (70% 228 g, 272 kcal) *A dessert buffet was provided, and participants were allowed to self-serve dessert if desired* **Duration**: 1 meal (lunch) per 3 conditions **Compliance**: 1 excluded due to scheduling conflict, 2 excluded due to an error in portion served **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal) from the initial entree**: Condition 1 vs Condition 3: 188 (13) kcal, P<0.001 Condition 2 vs Condition 3: 101 (7) kcal, P<0.001 Condition 1 vs Condition 2: 87 (8) kcal, P<0.001 **Energy intake (kcal) from the dessert buffet**: Condition 1 vs Condition 3: 56 (20) kcal, P=0.01 Condition 2 vs Condition 3: 36 (18) kcal, P=0.06 Condition 1 vs Condition 2: 20 (17) kcal, P=0.26 **Energy intake (kcal) from the total meal**: Condition 1 vs Condition 3: 132 (22) kcal, P<0.001 Condition 2 vs Condition 3: 66 (19) kcal, P=0.001 Condition 1 vs Condition 2: 67 (21) kcal, P=0.003	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR **Funding**: Medical Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Gough (Study 1), 2021[30] **RCT-Parallel, U.K.** Baseline N=68, Analytic N=60 (Attrition: 12%) **Study objective**: To compare the influence of portion size on snack food intake when food intake was examined in a standard laboratory setting vs. at home **Participant characteristics at baseline**: Adults, 18 y and older, afternoon snack consumers • Age: ~32 (11) y • Female: 73% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: ~24 (4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, don't like study foods, no history of food allergies or intolerances	**Intervention:** Group 1: 100% (100 g, 526 kcal); laboratory vs. home setting Group 2: 200% (200 g, 1052 kcal); laboratory vs. home setting *Portion size was a between subjects comparison; the study also included a within subjects comparison of consuming a snack in a laboratory vs. naturalistic setting* **Duration**: 1 meal (snack) **Compliance**: Four excluded for missing a session, 4 excluded for dieting at the end of the study **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal)**: Participants served the larger PS (200%) consumed significantly more kcal than those served the smaller PS (100%), P=0.001 (Data not reported; figure only)	**Model adjustments**: • TEI: NR **Limitations**: • No preregistered data analysis plan **Funding**: Medical Research Council; Wellcome Trust; British Psychological Society

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Gough (Study 2), 2021[30] **RCT-Parallel, U.K.** Baseline N=65, Analytic N=59 (Attrition: 9%) **Study objective**: To examine the effects of portion size of snack food intake in a standard laboratory setting vs. semi-naturalistic laboratory setting designed to resemble a lounge (home) setting; similar to study 1, but with sex of participants equally distributed **Participant characteristics at baseline**: Adults, 18 y and older, afternoon snack consumers • Age: ~28 (8) y • Female: 66% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: ~24 (6) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, did not like study foods, no history of food allergies or intolerances; participants from study 1; anyone based in the same building as the labs	**Intervention**: Group 1: 100% (100 g, 526 kcal); laboratory vs. semi-naturalistic setting Group 2: 200% (200 g, 1052 kcal); laboratory vs. semi-naturalistic setting *Portion size was a between subjects comparison; the study also included a within subjects comparison of consuming a snack in a laboratory vs. naturalistic setting* **Duration**: 1 meal (snack) **Compliance**: One excluded for missing a session, 5 excluded for dieting at the end of the study **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal)**: Participants served the larger PS (200%) consumed significantly more kcal than those served the smaller PS (100%), P=0.05 (Data not reported; figure only)	**Model adjustments**: • TEI: NR **Limitations**: • No preregistered data analysis plan **Funding**: Medical Research Council; Wellcome Trust; British Psychological Society

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Cunningham (Experiment 1), 2023b[31] **RCT-Crossover, U.S.** Baseline N=43, Analytic N=42 (Attrition: 2%) **Study objective**: To determine the effect of serving meals with high variety or large portions on food intake compared to meals with low variety or small portions, at meals with a simultaneous structure **Participant characteristics at baseline**: Women, 20-65 y • Age: 39 (13) y • Female: 100% • Race and/or ethnicity: White: 71%; Asian: 19%; Multiple races: 7%; Hispanic: 7% • Socioeconomic position: University degree: 90%; HHI >$50k: 79% • Anthropometry: BMI: 24.9 (4.3) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Males, do not regularly eat 3 meals a day, unwilling to eat the study food, unwilling to refrain from drinking alcohol the day before study meals, currently dieting, smokers, athletes in training, taking medications or reported a health condition known to affect appetite, pregnant or breastfeeding, allergies or intolerances to the food served, religious or other restrictions to the food served, ever been diagnosed with an eating disorder or depression, or specialized in the fields of Psychology or Nutritional Sciences, participants with a low liking for any of the study foods or who had high variability in their liking of study foods, BMI <18.5 or >35.0 kg/m^2	**Intervention**: Condition 1: Small portion (450 g), Low variety (1 entrée) Condition 2: Small portion (450 g), High variety (3 entrées served simultaneously) Condition 3: Large portion (600 g), Low variety (1 entrée) Condition 4: Large portion (600 g), High variety (3 entrée served simultaneously) *Entrees were shrimp teriyaki, chicken alfredo, and southwestern rice. All had an energy density of 1.3 kcal/g.* *In the low variety conditions, subjects were served their preferred entree* **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: One excluded after withdrawing for personal reasons **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entree intake at lunch**: Condition 1: 358 (26) kcal Condition 2: NR Condition 3: NR Condition 4: 452 (26) kcal Portion size effect, Large vs small portion: 76 (11) kcal, P<0.0001 Variety effect, High vs low variety: 19 (11) kcal, P=0.03 Portion size and variety interaction: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR **Funding**: Jenny Craig, Inc

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Cunningham (Experiment 2), 2023b[31] **RCT-Crossover, U.S.** Baseline N=52, Analytic N=49 (Attrition: 6%) **Study objective**: To determine the effect of serving meals with high variety or large portions on food intake compared to meals with low variety or small portions, at meals with a sequential structure **Participant characteristics at baseline**: Women, 20-65 y • Age: 36 (15) y • Female: 100% • Race and/or ethnicity: White: 71%; Asian: 24%; Multiple races: 4%; Hispanic: 2% • Socioeconomic position: University degree: 96%; HHI >$50k: 80% • Anthropometry: BMI: 24.3 (3.8) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Males, do not regularly eat 3 meals a day, unwilling to eat the study food, unwilling to refrain from drinking alcohol the day before study meals, currently dieting, smokers, athletes in training, taking medications or reported a health condition known to affect appetite, pregnant or breastfeeding, allergies or intolerances to the food served, religious or other restrictions to the food served, ever been diagnosed with an eating disorder or depression, or specialized in the fields of Psychology or Nutritional Sciences, participants with a low liking for any of the study foods or who had high variability in their liking of study foods, BMI <18.5 or >35.0 kg/m^2, those who took part in experiment 1	**Intervention**: Condition 1: Small portion (450 g), Low variety (1 entrée) Condition 2: Small portion (450 g), High variety (3 entrée served sequentially) Condition 3: Large portion (600 g), Low variety (1 entrée) Condition 4: Large portion (600 g), High variety (3 entrée served sequentially) *Entrees were shrimp teriyaki, chicken alfredo, and southwestern rice. All had an energy density of 1.3 kcal/g.* *In the low variety conditions, subjects were served their preferred entree* **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: Two were excluded after withdrawing for personal reasons, and 1 withdrew due to pregnancy **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entree intake at lunch**: Condition 1: 385 (22) kcal Condition 2: NR Condition 3: NR Condition 4: 490 (22) kcal Portion size effect, Large vs small portion: 66 (11) kcal, P<0.0001 Variety effect, High vs low variety: 39 (11) kcal, P<0.001 Portion size and variety interaction: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR **Funding**: Jenny Craig, Inc

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Robinson (Experiment 1), 2018[32] **RCT-Parallel, U.K.** Baseline N=84, Analytic N=75 (Attrition: 11%) **Study objective**: To test whether reducing a food portion size "renormalizes" perceptions of what constitutes a normal amount of that food to eat and results in people selecting and consuming smaller portions of that food in the future **Participant characteristics at baseline**: University staff and students • Age: 31.9 (9.4) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 24.7 (4.8) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies, dieting for weight loss; did not like study food	**Intervention**: **Day 1**: Group 1: 100%, 100g, 220 kcal Group 2: 200%, 200g, 440 kcal **Day 2:** Full family-sized quiche, 400g, 880 kcal *On day 1, subjects were served a meal, and on day 2 they self-served* **Duration**: 1 meal (lunch) on 2 consecutive days **Compliance**: Four excluded for guessing the study purpose, 4 excluded for not attending one session, 1 excluded for not following protocol **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Day 1, Entrée intake (kcal)** Group 1: 218 (21) kcal Group 2: 388 (58) kcal P<0.001 **Day 2, Entree intake (kcal)** Group 1: 318 (159) kcal Group 2: 418 (122) kcal P=0.003 **Intake of other foods:** Group 1 vs Group 2: Salad intake did not significantly differ, P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Randomization concealment NR; Did not account for those lost to follow-up **Funding**: Medical Research Council and Economic Social Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Robinson (Experiment 2), 2018[32] **RCT-Parallel, U.K.** Baseline N=83, Analytic N=78 (Attrition: 6%) **Study objective**: To test whether reducing a food portion size "renormalizes" perceptions of what constitutes a normal amount of that food to eat and results in people selecting and consuming smaller portions of that food in the future **Participant characteristics at baseline**: University staff and students • Age: 24.5 (7.0) y • Female: 0% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 25.2 (4.5) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies, dieting for weight loss	**Intervention**: **Day 1** Group 1: 100%, 100g, 220 kcal Group 2: 200%, 200g, 440 kcal **Day 2** Full family-sized quiche, 400g, 880 kcal *On day 1, subjects were served a meal, and on day 2 they self-served* **Duration**: 1 meal (lunch) on 2 consecutive days **Compliance**: Two excluded for guessing the study purpose, 3 excluded for not following protocol **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entrée intake (kcal)** Group 1: 219 (25) kcal Group 2: 429 (33) kcal P<0.001 **Intake of other foods**: Group 1 vs Group 2: 57.2 (6.3)g vs 51.5 (14.8), P=0.03 Group 1 vs Group 2: Potato chip intake did not significantly differ, P=NS **Day 2**: Group 1: 333 (172) kcal Group 2: 540 (177) kcal P<0.001	**Model adjustments**: • TEI: NR **Limitations**: • Randomization concealment NR; Did not account for those lost to follow-up **Funding**: Medical Research Council and Economic Social Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Robinson (Experiment 3), 2018[32] **RCT-Parallel, U.K.** Baseline N=140, Analytic N=124 (Attrition: 11%) **Study objective**: To test whether reducing a food portion size "renormalizes" perceptions of what constitutes a normal amount of that food to eat and results in people selecting and consuming smaller portions of that food in the future **Participant characteristics at baseline**: University staff and students • Age: 27.7 (9.6) y • Female: 63% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.6 (4.1) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies, dieting for weight loss	**Intervention:** Group 1: 100%, 100g, 279 kcal Group 2: 200%, 200g, 558 kcal **Duration**: 1 meal (lunch) **Compliance**: Three excluded for not completing study questionnaires, 1 excluded for guessing the study purpose, 12 excluded for not following study protocol **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entrée intake (kcal)** Group 1: 272 (36) kcal Group 2: 501 (89) kcal P<0.001 **Intake of other foods**: Group 1 vs Group 2: Salad intake did not significantly differ, P=NS Group 1 vs Group 2: Potato chip intake did not significantly differ, P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Randomization concealment NR; Did not account for those lost to follow-up **Funding**: Medical Research Council and Economic Social Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls (Experiment 1: Addition study), 2010[33] **RCT-Crossover, U.S.** Baseline N=52, Analytic N=49 (Attrition: 6%) **Study objective**: To test the effects of increasing vegetable portion size and energy density, without changing the other meal foods **Participant characteristics at baseline**: Adults, age 20-45y, BMI between 18-40 kg/m^2, regularly ate 3 meals • Age: 26.8 (2.8) y • Female: 49% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 24.1 (0.6) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, medications that affect appetite, smokers, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating	**Intervention:** Condition 1: 180g broccoli, 0.4 kcal/g Condition 2: 180g broccoli, 0.8 kcal/g Condition 3: 270g broccoli, 0.4 kcal/g Condition 4: 270g broccoli, 0.8 kcal/g Condition 5: 360g broccoli, 0.4 kcal/g Condition 6: 360g broccoli, 0.8 kcal/g *ED was increased by adding butter; all meals were served with the same amount of rice and meat (pot roast)* **Duration**: 1 meal (lunch) for 6 weeks **Compliance**: One participant was excluded for non-compliance **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total meal energy intake, kcal** Condition 1: 555 (32) kcal Condition 2: 592 (34) kcal Condition 3: 541 (35) kcal Condition 4: 616 (35) kcal Condition 5: 574 (34) kcal Condition 6: 631 (38) kcal PS effect: NS ED effect: P<0.0001 **Vegetable intake, kcal** Condition 1: 48.4 (3.2) kcal Condition 2: 101.6 (5.6) kcal Condition 3: 59.6 (4) kcal Condition 4: 128 (8) kcal Condition 5: 69.2 (4.8) kcal Condition 6: 151.2 (10.4) kcal PS effect: P<0.0001 ED effect: P<0.007	**Model adjustments**: NA • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls (Experiment 2: Substitution study), 2010[33] **RCT-Crossover, U.S.** Baseline N=48, Analytic N=48 (Attrition: 0%) **Study objective**: To test the effects of increasing vegetable portion size and energy density, while decreasing the portion sizes of other meal components served **Participant characteristics at baseline**: Adults, age 20-45y, BMI between 18-40 kg/m^2, regularly ate 3 meals • Age: 26.7 (1.4) y • Female: 50% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.6 (0.6) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, medications that affect appetite, smokers, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating	**Intervention:** Condition 1: 180g broccoli, 0.4 kcal/g, 326g rice, 281g meat Condition 2: 180g broccoli, 0.8 kcal/g, 326g rice, 281g meat Condition 3: 270g broccoli, 0.4 kcal/g, 272g rice, 234g meat Condition 4: 270g broccoli, 0.8 kcal/g, 272g rice, 234g meat Condition 5: 360g broccoli, 0.4 kcal/g, 217g rice, 187g meat Condition 6: 360g broccoli, 0.8 kcal/g, 217g rice, 187g meat *ED was increased by adding butter; as proportion of vegetable was increased from 25% to 38% or 50% of the plate, the proportions of the grain and meat were decreased from 38% to 31% to 25% of the plate.* **Duration**: 1 meal (lunch) for 6 weeks **Compliance**: 100% compliance **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total meal energy intake, kcal** Condition 1: 514 (27) kcal Condition 2: 552 (26) kcal Condition 3: 469 (24) kcal Condition 4: 517 (26) kcal Condition 5: 466 (22) kcal Condition 6: 537 (24) kcal PS effect: P<0.0001 ED effect: P<0.0001 **Vegetable intake, kcal** Condition 1: 53.2 (2.8) kcal Condition 2: 107.2 (5.6) kcal Condition 3: 67.2 (4.4) kcal Condition 4: 138.4 (8.8) kcal Condition 5: 76 (4.8) kcal Condition 6: 164 (10.4) kcal PS effect: P<0.0001 ED effect: NS	**Model adjustments**: NA • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Berkowitz, 2016[34] **NRCT, U.S.** Baseline N=, Analytic N=521 (Baseline) 603 (Intervention) (Attrition: 0%) **Study objective**: To determine whether customers in two different food-service operator segments (non-commercial worksite cafeteria and commercial upscale restaurant) would select reduced-portion menu items and the impact of selecting reduced-portion menu items on energy and nutrient intakes **Participant characteristics at baseline**: Employees of a worksite cafeteria • Age: NR • Female: NR • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: NR • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NR	**Intervention**: Baseline: Full-size entrees Intervention: Full and reduced-size entrees **Duration**: 12 weeks (lunch): 5-week baseline; 7-week intervention **Compliance**: NR **Outcomes and assessment methods**: Weighed plate waste subtracted from the average serving weight; Calories derived from recipes provided by restaurant manager. After meals	**Energy intake (kcal, mean (SE))**: Baseline: 629 (4.4) kcal Intervention: 555 (5.2) kcal p<0.0001	**Model adjustments**: • TEI: NR • Key confounders: Did not account for key confounders • Other: NA **Limitations**: • Did not account for any key confounders; Did not describe participant selection; Outcome assessment was based on average serving size and recipes, which could be prone to error; Pricing was also manipulated and not accounted for; Unclear how side dishes or other foods ordered were accounted for; No preregistered data analysis plan **Funding**: University of Minnesota; NIFA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Berkowitz, 2016[34] **NRCT, U.S.** Baseline N=, Analytic N=90 (Baseline) 95 (Intervention) (Attrition: 0%) **Study objective**: To determine whether customers in two different food-service operator segments (non-commercial worksite cafeteria and commercial upscale restaurant) would select reduced-portion menu items and the impact of selecting reduced-portion menu items on energy and nutrient intakes **Participant characteristics at baseline**: Diners of a private golf club • Age: NR • Female: NR • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: NR • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NR	**Intervention**: Baseline: Full-size entrees Intervention: Full and reduced-size entrees **Duration**: 7 weeks (dinner): 3-week baseline; 4-week intervention **Compliance**: NR **Outcomes and assessment methods**: Weighed plate waste subtracted from the average serving weight; Calories derived from recipes provided by chef. After meals	**Energy intake (kcal, mean (SE))**: Baseline: 695 (24.4) kcal Intervention: 393 (14.3) kcal p<0.0001	**Model adjustments**: • TEI: NR • Key confounders: Did not account for key confounders **Limitations**: • Did not account for any key confounders; Did not describe participant selection; Outcome assessment was based on average serving size and recipes, which could be prone to error; Pricing was also manipulated and not accounted for; Unclear how side dishes or other foods ordered were accounted for; No preregistered data analysis plan **Funding**: University of Minnesota; NIFA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Langfield (Study 1), 2023[35] **RCT-Crossover, U.K.** Baseline N=61, Analytic N=50 (Attrition: 18%) **Study objective**: To test the effect of reducing food portion sizes on daily energy intake and determine if it differs based on SEP **Participant characteristics at baseline**: Adults, women, age 18 and older, BMI 18.5-32.5 kg/m^2, with either high or low socioeconomic position • Age: 42.3 (19.4) y • Female: 100% • Race and/or ethnicity: White: 84%; Black, African, Caribbean, or Black British: 2%; Asian or Asian British: 12%; Mixed or multiple: 2% • Socioeconomic position: Recruitment was stratified by highest educational qualification, lower (A-levels or less) and higher (higher education/degree level) Years in higher education: 3.00 (2.96); Years in higher education, mean: 3y; HHI: 17k (13k) pounds; Subjective social status, mean: 5.5 (1.4) • Anthropometry: BMI: 25.8 (3) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dietary restrictions including being vegetarian or dieting, food allergies, self-reported dislike of the test foods, history of eating disorders, on medication affecting appetite, pregnant, could not participate in study 2	**Intervention**: Condition 1: 100%, all foods served at lunch (375 g, 544 kcal) and dinner (291 g, 339 kcal), 6328 kcal Condition 2: 150%, all foods served at lunch (563 g, 816 kcal) and dinner (437 g, 509 kcal), 6770 kcal **Duration**: 2 meals (lunch, dinner) for 2 sessions **Compliance**: Five excluded for withdrawing before study started, 6 excluded for not following the protocol or missing a session **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total daily energy intake**: Higher SEP Condition 1: 2517.44 (641.12) kcal Condition 2: 2724.83 (711.90) Lower SEP Condition 1: 2063.59 (397.32) kcal Condition 2: 2326.05 (509.51) kcal Main effect portion size: P<0.001 Main effect SEP: P=0.009 Portion size, SEP interaction: P=NS **Energy intake from portion manipulated foods**: Higher SEP Condition 1: 794.61 (98.81) kcal Condition 2: 1074.74 (225.58) kcal Lower SEP Condition 1: 813.08 (84.30) kcal Condition 2: 1030.80 (187.18) kcal Main effect portion size: P<0.001 Main effect SEP: P=NS Portion size, SEP interaction: P=NS **Energy intake from non-portion manipulated foods**: Higher SEP Condition 1: 1722.8 (595.17) kcal Condition 2: 1650.10 (631.66) kcal Lower SEP Condition 1: 1250.5 (361.19) kcal Condition 2: 1295.24 (403.65) kcal Main effect portion size: P=NS Main effect SEP: P=0.004 Portion size, SEP interaction: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • None identified **Funding**: European Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Langfield (Study 2), 2023[35] **RCT-Crossover, U.K.** Baseline N=50, Analytic N=46 (Attrition: 8%) **Study objective**: To test the effect of reducing food portion sizes on daily energy intake and determine if it differs based on SEP **Participant characteristics at baseline**: Adults, women, age 18 and older, BMI 18.5-39.9 kg/m^2, with either high or low socioeconomic position • Age: 51.6 (15.6) y • Female: 100% • Race and/or ethnicity: White: 94%; Black, African, Caribbean, or Black British: 2%; Asian or Asian British: 2%; Mixed or multiple: 2% • Socioeconomic position: Years in higher education, mean: 3.11 (2.46); HHI: 20k (13k) pounds; Recruitment was stratified by subjective social status, lower (scores of 1-4) and higher 6-10); Subjective social status, mean: 5 • Anthropometry: BMI: 28 (5) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Medium socioeconomic position, dietary restrictions (except for vegetarians) or dieting, food allergies, self-reported dislike of the test foods, history of eating disorders, on medication affecting appetite, pregnant; could not participate in study 1	**Intervention**: Condition 1: 100%, all foods served at breakfast (290 g, 591 kcal), lunch (350 g, 508 kcal), and dinner (291 g, 296 kcal), 5040 kcal Condition 2: 150%, all foods served at breakfast (435 g, 887 kcal), lunch (525 g, 761 kcal), and dinner (437 g, 444 kcal), 5643 kcal **Duration**: 1 day (breakfast, lunch, dinner) for 2 sessions **Compliance**: Two excluded for withdrawing before study started, 2 excluded for not following the protocol or missing a session **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total daily energy intake**: Higher SEP Condition 1: 2009.261 (438.11) kcal Condition 2: 2099.951 (2099.95) kcal Lower SEP Condition 1: 1935.548 (427.29) kcal Condition 2: 2131.757 (506.51) kcal Main effect portion size: P=0.02 Main effect SEP: P=NS Portion size, SEP interaction: P=NS **Energy intake from portion manipulated foods**: Higher SEP Condition 1: 1013.52 (199.64) kcal Condition 2: 1179.53 (262.32) kcal Lower SEP Condition 1: 993.91 (176.28) kcal Condition 2: 1230.96 (271.99) kcal Main effect portion size: P<0.001 Main effect SEP: P=NS Portion size, SEP interaction: P=NS **Energy intake from non-portion manipulated foods**: Higher SEP Condition 1: 995.74 (315.87) kcal Condition 2: 920.42 (246.31) kcal Lower SEP Condition 1: 941.63 (375.63) kcal Condition 2: 900.79 (390.97) kcal Main effect portion size: P=NS Main effect SEP: P=NS Portion size, SEP interaction: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • None identified **Funding**: European Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2004b[36] **RCT-Crossover, U.S.** Baseline N=76, Analytic N=75 (Attrition: 1%) **Study objective**: To investigate the effect on energy intake of increasing the portion size of a food served as a discrete unit. **Participant characteristics at baseline**: Adults, 20-45 y, BMI <40kg/m^2 • Age: 25 (1.1) y • Female: 49% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: Females: 22.9 (0.6) kg/m^2; Males: 24.3 (0.4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting to gain or lose weight, smokers, athlete in training, taking medications that affect appetite, food restrictions or allergies, do not eat meals at regular times, did not like the study food, pregnant or lactating at time of the study, >20 on the Eating Attitudes Test, >40 on the Zung Self-Rating Scale	**Intervention**: Condition 1: 6-inch sandwich, 668 kcal Condition 2: 8-inch sandwich, 892 kcal Condition 3: 10-inch sandwich, 1,113 kcal Condition 4: 12-inch sandwich, 1,337 kcal **Duration**: 1 meal (lunch) once per week for 4 weeks **Compliance**: 100% compliance **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Sandwich intake**: Condition 1 (6 inch): Females: 515 (24) kcal; Males: 635 (10) kcal Condition 2 (8 inch): Females: 600 (36) kcal; Males: 804 (22) kcal Condition 3 (10 inch): Females: 619 (35) kcal; Males: 919 (31) kcal Condition 4 (12 inch): Females: 674 (41) kcal; Males: 990 (36) kcal Females: Condition 1 vs. 2, 3, 4; p<0.05; Condition 2 vs. 1, 4; p<0.05; Condition 3 vs. 1, 4; p<0.05; Condition 4 vs. 1, 2; p<0.05 Males: All conditions, p<0.05	**Model adjustments**: • TEI: NR• Other: Fixed factor: sandwich size and subject sex; subjects were random effect **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Cunningham, 2023a[37] **RCT-Crossover, U.S.** Baseline N=50, Analytic N=44 (Attrition: 12%) **Study objective**: To provide novel insights regarding how the common behaviors of switching between foods and beverages and consuming different amounts of water at a meal were related to food intake across meals varying in portion size **Participant characteristics at baseline**: Adults, age 18-70y, BMI between 18-35 kg/m^2, regularly ate 3 meals/d • Age: 43.0 (17) y • Female: 66% • Race and/or ethnicity: White: 77%; Black: 2%; Asian: 14%; Multiple races: 7%; Hispanic: 5% • Socioeconomic position: University degree: 66%; HHI >$50k: 52%; Low food security: 7% • Anthropometry: BMI: ~25 kg/m^2; Overweight or obesity: 46% • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, smokers, food allergies or restrictions, medications that affect appetite, athletes, pregnant or breastfeeding, disliked study foods, ever diagnosed with depression or an eating disorder, specialized in psychology or nutrition, not willing to refrain from drinking alcohol the day before study meals, willing to eat study food	**Intervention**: Condition 1: 100% portion size (400 g, 580 kcal) Condition 2: 125% portion size (500 g, 725 kcal) Condition 3: 150% portion size (600 g, 870 kcal) Condition 4: 175% portion size (700 g, 1015 kcal) *Entrée portion size was manipulated (pasta dish); served with water* **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: Three excluding for not liking the test food, 1 withdrew for personal reasons, 1 excluded for failure to follow meal protocols, 1 excluded for undue influence on results **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entrée intake (kcal)**: Condition 1 (100% PS): 419 (26) kcal Condition 2 (125% PS): 506 (26) kcal Condition 3 (150% PS): 560 (26) kcal Condition 4 (175% PS): 612 (26) kcal P<0.0001	**Model adjustments**: • TEI: NR • Other: Fixed factors: portion size, study week, participant sex **Limitations**: • None identified **Funding**: Jenny Craig, Inc

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Cahayadi, 2019[38] **RCT-Crossover, New Zealand** Baseline N=86, Analytic N=62 (Attrition: 28%) **Study objective**: To examine the effects of portion sizes on expected intake during pre-meal planning and actual consumption, using a within-subject design **Participant characteristics at baseline**: Adults, 18-60 y, healthy • Age: 23.7 (7.5) y • Female: 47% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.4 (3.0) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, consumed pasta at least once a month, untrustworthy questionnaire completion	**Intervention**: Condition 1: 100% (400 g) Condition 2: 150% (600 g) Condition 3: 200% (800 g) **Duration**: 1 meal (lunch) **Compliance**: Thirteen did not complete the study, 11 excluded due to untrustworthy questionnaires **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal)**: Portion size had significant main on effect energy intake, P<0.001 (Data not reported; figure only)	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; Differences in attrition not accounted for in analyses; No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Zuraikat, 2016[39] **RCT-Crossover, U.S.** Baseline N=50, Analytic N=50 (Attrition: 0%) **Study objective:** To test whether having subjects choose a portion from several options influenced the amount selected or consumed when all portion sizes were systematically increased **Participant characteristics at baseline**: Adults, age 18-45 y, regularly eat 3 meals • Age: ~27 y (17.9-45.8 y) • Female: 48% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: ~25 kg/m^2; Overweight or obesity: 50% • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, smokers, medications that affect appetite, athletes, scored high on depression scale, scored high for disordered eating, if BMI <18 or >35 kg/m^2	**Intervention**: *Subjects were offered 3 portions of macaroni and cheese, selected a portion, and consumed ad libitum:* **Women**: Condition 1: Offered 300 g, 375 g, 450 g Condition 2: Offered 375 g, 450 g, 525 g Condition 3: Offered 450 g, 525 g, 600 g **Men**: Condition 1: Offered 400 g, 500 g, 600 g Condition 2: Offered 500 g, 600 g, 700 g Condition 3: Offered 600 g, 700 g, 800 g **Duration**: 1 meal (lunch) once a week for 3 weeks **Compliance:** N/A **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal)**: Energy intake from the entree chosen from the middle set of portions (condition 2) did not differ significantly from the small set of portions (condition 1), P>0.05 Energy intake from the entree chosen from largest set of portions (condition 3) was significantly greater than from the other two sets (conditions 1, 2) (P < 0.0001) (Energy intake was 16% greater in condition 3 (661 (34) kcal) compared to conditions 1 and 2 (568 (18) kcal)	**Model adjustments**: • TEI: NR • Other: Fixed factors in model: set of portions offered, subject sex, study week **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Almiron-Roig, 2015[40] **RCT-Crossover, U.K**. Baseline N=40, Analytic N=37 (Attrition: 8%) **Study objective**: To test whether increasing the portion size of a meal would lead to an increase in bite size. Secondary objectives were to explore changes in overall eating rate, deceleration rate and meal duration **Participant characteristics at baseline**: Adult women, age 18-60 y, BMI 25-35 kg/m^2 • Age: 43.7 (10.7) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 29.2 (2.6) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Men, smokers, dieting, in athletic training, breakfast less than 5 days per week, pregnant or lactating, using medications/or having a medical condition known to affect food intake or appetite, not liking study foods, self-reported depression, mental illness, or psychiatric disorder, score high on EAT-26, excessive alcohol intake	**Intervention**: Condition 1: 57%, 229 g, 311 kcal Condition 2: 75%, 303 g, 406 kcal Condition 3: 100%, 400 g, 526 kcal Condition 4: 132%, 529 g, 693 kcal Condition 5: 175%, 700 g, 908 kcal **Duration**: 1 meal (lunch) for 5 sessions **Compliance**: Three excluded due to scheduling conflicts **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake (kcal)**: Condition 1 (57%): 301 (2) kcal Condition 2 (75%): 394 (15) kcal Condition 3 (100%): 518 (37) kcal Condition 4 (132%): 688 (17) kcal Condition 5 (175%): 889 (89) kcal P value not reported	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: Medical Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2002[41] **RCT-Crossover, U.S.** Baseline N=59, Analytic N=51 (Attrition: 14%) **Study objective**: To examine the effect of portion size on intake during a single meal **Participant characteristics at baseline**: Adults, 21-40 y, BMI of 20-28 kg/m^2 • Age: ~22 (0.5) y • Female: 49% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: ~23.5 (0.4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Following a weight-loss diet or trying to gain weight, using medication known to affect food intake or appetite, athletes in training, pregnant or lactating, food allergies or food restrictions that would affect food intake, and not regularly eating 3 meals per day, high scores on dietary restraint, hunger, disinhibition, or depression questionnaires, BMI <20 or >28kg/m^2	**Intervention**: Group 1: Received all 4 conditions on a plate Group 2: Received all 4 conditions in a serving dish, and served themselves Condition 1: 100%, 500 g, 815 kcal Condition 2: 125%, 625 g, 1019 kcal Condition 3: 150%, 750 g, 1223 kcal Condition 4: 200%, 1000 g, 1630 kcal *Entrée portion size was manipulated; subjects were served compulsory carrots and chocolate* **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: Five excluded for not liking the entrée, 2 excluded for scheduling conflicts, 1 excluded due to illness **Outcomes and assessment methods**: Weighed food intake Before and after test meal	Condition 1 (100%): 546 (25) kcal Condition 2 (125%): 610 (31) kcal Condition 3 (150%): 652 (36) kcal Condition 4 (200%): 707 (42) kcal P<0.0001 There was not significant effect of serving methods, P=NS	**Model adjustments**: • TEI: NR • Other: Fixed factor effects in the model were portion size (500, 625, 750, and 1000 g) and serving method (plate or serving dish); subjects were treated as a random effect **Limitations**: • Methods for randomization and concealment NR; Did not account for missing data; No power calculation; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rosenthal, 2017[42] **RCT-Crossover, U.S.** Baseline N=20, Analytic N=20 (Attrition: 0%) **Study objective**: To investigate the independent and interactive effects of television watching and portion size on consumption during a meal **Participant characteristics at baseline**: Adults, 18-35y, BMI 18.5-24.9 kg/m^2 • Age: 22.3 (3.7) y • Female: 85% • Race and/or ethnicity: White: 80%; Hispanic or Latino: 20% • Socioeconomic position: Education, some college or higher: 100%; Married: 15% • Anthropometry: BMI: 21.6 (2.3) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: All regularly eat before 10am **Excluded from study or analysis**: Restrained eaters, dislike for study foods, did not regularly eat before 10:00 a.m. on most days, unable to complete all sessions within 8 weeks, smokers, taking medications that affected appetite or food intake, pregnant or breastfeeding, on a dietary plan or had dietary restrictions that prevent consumption of certain types and/or amounts of food, self-reported binge eating, athlete in training	**Intervention**: Condition 1: 100% portion size, 1083 kcal, TV Condition 2: 200% portion size, 2166 kcal, TV Condition 3: 100% portion size, 1083 kcal, No TV Condition 4: 200% portion size, 2166 kcal, No TV **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: N/A **Outcomes and assessment methods**: Weighed food intake Before and after test	**Total energy intake**: 100% portion size: 734.6 (187.1) kcal 200% portion size: 903.9 (270.4) kcal P<0.0001 Main effect of TV watching: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Roe, 2016[43] **RCT-Crossover, U.S.** Baseline N=51, Analytic N=48 (Attrition: 6%) **Study objective**: To investigate the influence of food energy density on the portion size effect as well as that of palatability and subject characteristics **Participant characteristics at baseline**: Adults, women, 20-45y, BMI 18-40 kg/m^2 • Age: 28.6 (1.2) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 24.4 (0.7) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: All regularly eat 3 meals/day **Excluded from study or analysis**: Unwilling to consume study foods, did not regularly eat three meals per day, dieting to gain or lose weight, had food allergies or restrictions, were taking medications known to affect appetite, were smokers or athletes in training, pregnant or breastfeeding, symptoms of depression or disordered eating	**Intervention**: Condition 1: 100% portions, 660g, 1056 kcal Condition 2: 133% portions, 880g, 1408 kcal Condition 3: 167% portions, 1100g, 1760 kcal Condition 4: 200% portions, 1320g, 2112 kcal **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: Two participants failed to attend scheduled meals and did not complete study, 1 participant excluded for not following protocol. **Outcomes and assessment methods**: Weighed food intake Before and after test	**Energy intake at lunch**: Increasing the portion size of all foods significantly increased energy intake at the lunch meal A 33% increase in portion size led to a 24% increase in energy intake A 67% or 100% increase in portion size led to a 34% increase in energy intake (215 (28) kcal) P<0.0001 **Energy intake by food**: Doubling the portions of the medium-ED foods (pasta, cake, garlic bread) increased their intake by 182 (27) kcal Doubling the portions of the low-ED foods (tomatoes, broccoli, grapes) increased their intake by 33 (6) kcal P<0.0001	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Levitsky, 2004[44] **RCT-Crossover, U.S.** Baseline N=13, Analytic N=13 (Attrition: 0%) **Study objective**: To examine the effect of the amount of food served on the amount consumed by young adults **Participant characteristics at baseline**: Adults, undergraduate students • Age: 23 (8.6) y • Female: 31% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.3 (2.9) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Allergic to study food or restraint score >30	**Intervention**: Condition 1: 100% portion sizes Condition 2: 125% portion sizes Condition 3: 150% portion sizes **Duration**: 1 meal (lunch) 3 days per week for 3 weeks **Compliance**: 100% compliance **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy Intake, kcal** Condition 1: 698 kcal Condition 2: 863 kcal Condition 3: 971 kcal P<0.05 for all Increasing the PS for all meal components increased amount of each component consumed (P<0.01)	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Zuraikat, 2018a[45] **RCT-Crossover, U.S.** Baseline N=58, Analytic N=53 (Attrition: 9%) **Study objective**: To test how the effect of portion size on meal intake was influenced by providing the option to take away uneaten food in a "doggy bag" (to-go container) **Participant characteristics at baseline**: Adults, women, 18-60y, BMI 18.5-36 kg/m^2 • Age: 29 (12) y • Female: 100% • Race and/or ethnicity: White: 82%; Black: 4%; Asian: 14%; Hispanic or Latino: 8% • Socioeconomic position: NR; HHI >$50k: 54% • Anthropometry: BMI: 25 (4) kg/m^2 Overweight or obesity: 36% • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: All regularly consume 3 meals/day **Excluded from study or analysis**: Did not regularly ate 3 meals per day, unwilling to eat the foods served at the meal, unwilling to refrain from drinking alcohol the day before their scheduled experimental sessions, smokers, athletes in training, dieting to gain or lose weight, taking medications known to affect appetite, pregnant or breastfeeding, allergies or intolerances to the foods served, medical condition known to affect eating, signs of disordered eating as indicated by Eating Attitudes Test score	**Intervention**: **Group 1**: Control group (no option to take leftovers to-go) Condition 1: 100%, 560 g, 828 kcal Condition 2: 125%, 700 g, 1035 kcal Condition 3: 150%, 840 g, 1243 kcal Condition 4: 175%, 980 g, 1449 kcal **Group 2**: Doggy bag group (provided with a doggy bag to take leftovers to-go) Condition 1: 100%, 560 g, 828 kcal Condition 2: 125%, 700 g, 1035 kcal Condition 3: 150%, 840 g, 1243 kcal Condition 4: 175%, 980 g, 1449 kcal **Duration**: 1 meal (dinner) once a week for 4 weeks **Compliance**: Four excluded for withdrawing, and 1 excluded for failing to comply with study protocols **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total energy intake at lunch**: **Group 1**: Control group (no option to take leftovers to-go) Condition 1 (100%): 602.8 (26.6) kcal Condition 2 (125%): 679 (31.9) kcal Condition 3 (150%): 776.4 (37.1) kcal Condition 4 (175%): 759.4 (48.3) kcal **Group 2**: Doggy bag group (provided with a doggy bag to take leftovers to-go) Condition 1 (100%): 599.4 (26.5) kcal Condition 2 (125%): 606.7 (26.8) kcal Condition 3 (150%): 671 (28.9) kcal Condition 4 (175%): 686 (34.2) kcal Portion size effect: P<0.0001 Group effect: P<0.025 **Individual foods (grams), PS effect, Group effect:** Chicken: P=0.07, P<0.04 Pasta: P=0.31, P<0.03 Broccoli: P<0.0001, P=0.22 Garlic bread: P=0.0005, P=0.38 Grapes: P=0.005, P=0.91	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment not reported; No preregistered data analysis plan **Funding**: NIH, USDA, Jenny Craig, Inc.

Zuraikat, 2018c[46]
RCT-Crossover, U.S.
Baseline N=105, Analytic N=102 (Attrition: 3%)

Study objective: To evaluate whether the effect of portion size on intake in a controlled setting was attenuated in trained participants compared to untrained controls

Participant characteristics at baseline:
Adults, women, 20-65 y
- Age: 43.2 (13.6) y
- Female: 100%
- Race and/or ethnicity: White: 97%; Black: 2%; Asian: 1%; Hispanic or Latino: 4%
- Socioeconomic position: NR
- Anthropometry:
  All BMI: 28.0 (3.5) kg/m^2;
  Trained participants: 32.3 (4.8) kg/m^2;
  Controls with overweight/obesity: 29.5 (4.0) kg/m^2;
  Controls with normal weight: 22.3 (1.6) kg/m^2
- Physical activity: NR
- Smoking: 100% nonsmokers
- TEI: NR
- Habitual diet at baseline: NR

Excluded from study or analysis: Trained participants: based on Rolls et al., 2017[75] Portion Control Strategies Trial; Control: Showed evidence of disordered eating <19 on the Eating Attitudes Test or <40 on the Depression Scale, had food allergies, restrictions, or disliked study foods, did not regularly eat 3 meals per day, were dieting to gain or lose weight, were smokers, athletes in training, pregnant or breastfeeding.

Intervention:
Condition 1: 100%, 594g, 808 kcal
Condition 2: 125%, 743g, 1010 kcal
Condition 3: 150%, 891g, 1212 kcal
Condition 4: 175%, 1040g, 1414 kcal

Duration: 1 meal (lunch) once a week for 4 weeks

Compliance: Three subjects failed to attend all scheduled meals

Outcomes and assessment methods:
Weighed food intake
Before and after test meal

Breaded chicken, kcal, condition 1, 2, 3, 4
Trained Participants: 118.8 (6.7), 124.6 (8.6), 135.2 (9.5), 138.4 (10.4)
Controls with overweight and obesity: 124.6 (6.1), 135.4 (8.6), 152 (11.5), 162.8 (12.1)
Controls with normal weight: 122 (6.1), 147.7 (8.9), 174.5 (10.8), 150.5 (14.5)
Portion size effect: P=0.002
Group effect: P=0.07

Pasta, kcal, condition 1, 2, 3, 4
Trained participants: 113.3 (11.7), 105.4 (14.4), 106.8 (16), 131.7 (16.1)
Control with overweight and obesity: 130.8 (12.8), 133.2 (14.9), 133.2 (16.7), 163 (19.5)
Controls with normal weight: 134 (14.1), 155.7 (17.1), 161 (21.8), 163.3 (20.8)
Portion size effect: P=0.005
Group effect: P<0.0001; intake of trained participants<intake of controls with normal weight

Broccoli, kcal, condition 1, 2, 3, 4
Trained Participants: 32.9 (1.2), 37.7 (1.8), 44.2 (2.3), 44.9 (2.8)
Control with overweight and obesity: 31.1 (1.7), 34.9 (2.2), 40.5 (2.7), 42.7 (3.4)
Controls with normal weight: 29.6 (1.8), 33.7 (2.8), 39.1 (3), 37.8 (4)
Portion size effect: P<0.001
Group effect: P=0.09

Salad, kcal, condition 1, 2, 3, 4
Trained participants: 36.7 (2.1), 45.9 (2.2), 49.1 (3.7), 54 (4)
Control with overweight and obesity: 37 (1.8), 43.2 (2.5), 47.3 (3.3), 53.2 (4)
Control with normal weight: 31.1 (2.8), 32.8 (3.8), 43 (4.2), 38.7 (5)
Portion size effect: P<0.0001
Group effect: P<0.0001; trained participants and controls with overweight and obesity>intake of controls with normal

Model adjustments:
• TEI: NR

Limitations:
• Methods for randomization and concealment NR; No preregistered data analysis plan

Funding:
NIH, USDA

weight

Garlic bread, kcal, condition 1, 2, 3, 4
Trained participants: 73.1 (9.4), 76.7 (11.5), 87.1 (12.6), 113 (14.8)
Control with overweight and obesity: 118.1 (9.7), 125.3 (12.2), 153.4 (11.5), 137.2 (14.4)
Control with normal weight: 114.8 (10.4), 122.8 (13), 143.3 (16.6), 159.9 (16.2)
Portion size effect: P=0.043
Group effect: P=0.004; intake of trained participants<both control groups

Grapes, kcal, condition 1, 2, 3, 4
Trained participants: 42.2 (2.9), 46.5 (3.2), 51.4 (3.8), 46.6 (4.8)
Control with overweight and obesity: 38.5 (3.2), 36.3 (4.1), 43 (5.1), 45.9 (5.7)
Control with normal weight: 41.4 (3.3), 38 (4.8), 43.5 (5.9), 43.5 (6.3)
Portion size effect: P=0.11
Group effect: P=0.12

Cookie, kcal, condition 1, 2, 3, 4
Trained participants: 43.1 (7.7), 37.8 (8.2), 40.7 (9.2), 46 (11.1)
Control with overweight and obesity: 44 (8.2), 53.2 (10.2), 55.7 (11.6), 55.2 (11.6)
Control with normal weight: 61 (8.7), 55.7 (10.6), 52.3 (11.1), 70.7 (13.1)
Portion size effect: P=0.78
Group effect: P=0.69

For all groups, serving larger portion significantly increased energy intake at the meal, P<0.001

Across all meals, kcal
Trained participants: 506 (15) kcal
Controls with overweight and obesity: 592 (16) kcal
Controls with normal weight: 611 (17) kcal
P=0.026
Trained participants: No effect of energy

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
		intake according to type of portion-control intervention, P=0.39	
Long, 2023[47] **RCT-Crossover, U.S.** Baseline N=101, Analytic N=91 (Attrition: 10%) **Study objective**: To test whether manipulating PS in an iVR buffet affects the weight of food selected, and whether this response to PS is similar to participants' measured intake when PS varies at laboratory meals **Participant characteristics at baseline**: Adults, 18 y or older • Age: 29 (14) y • Female: 70% • Race and/or ethnicity: White: 56%; Asian: 31%; Other: 13% • Socioeconomic position: Advanced degree: 25%, bachelor's degree: 24%, Some college: 33%; <20k/y: 55% • Anthropometry: BMI: 25.3 (5.7) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Not fluent in English, food allergies, not open to eating all food items, prior diagnosis of cognitive or physical disabilities, dyslexia, or epilepsy	**Intervention**: Condition 1: Standard portion, 515 g, 747 kcal Condition 2: Larger portion, 917 g, 1361 kcal *Subjects participated in a virtual reality buffet portion size selection task before being served lunch in the laboratory* *All foods served were manipulated (chicken, pasta, cheese, broccoli, grapes, rolls, cookies), but only total intakes were reported* **Duration**: 1 meal once a week for 2 weeks **Compliance**: One was excluded for violating protocol, 3 were excluded for dropping out, 6 were excluded due to equipment errors **Outcomes and assessment methods**: Weighed food intake Before and after test meal	Condition 1: 547 (13) kcal Condition 2: 762 (26) kcal P<0.001	**Model adjustments**: • TEI: NR **Limitations**: • Randomization concealment NR; No pre-registered data analysis plan; Difficult to isolate the effects of portion size served on intake from the virtual reality task **Funding**: The Pennsylvania State University

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Jeffery, 2007[48] **RCT-Crossover, U.S**. Baseline N=20, Analytic N=19 (Attrition: 5%) **Study objective**: To examine the effects of repeated exposure to different meal portion sizes on energy intake **Participant characteristics at baseline**: Women, employees of a community medical center, 18-40y, 18.5-40 kg/m^2 • Age: 33 (5.2) y • Female: 100% • Race and/or ethnicity: White: 80% • Socioeconomic position: At least 4y college degree: 65%; Married: 45% • Anthropometry: BMI: 28.9 (7.8) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Pregnant or recently having given birth, actively dieting to control weight, more than 3 days a week of regular moderate or vigorous physical activity, unwillingness to consent to the conditions of study participation	**Intervention:** Condition 1: Box lunch 100%: ~767 kcal, Monday-Friday Condition 2: Box lunch 200%: ~1528 kcal, Monday-Friday *Box lunches were identical, and only portion sizes differed* **Duration**: 1 meal (lunch) for 8 weeks **Compliance**: Completion of post-lunch meal reports was 91%, and of telephone recalls of diet and activity was 98%, 1 participant withdrew early due to a health problem. **Outcomes and assessment methods**: Two 24-hr recalls during each 4-week period; Participants self-reported how much of each lunch was eaten 4 weeks	**Energy intake from lunch (kcal)**: Condition 1: 687 kcal Condition 2: 1019 kcal P<0.0001 **Total daily energy intake (kcal)**: Condition 1: 1875 kcal Condition 2: 2153 kcal P<0.0001	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; Concerns with the validity of outcome self-reporting; Did not account for the rest of the diet; No preregistered data analysis plan **Funding**: NIH; University of Minnesota Obesity Prevention Center

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2006a[49] **RCT-Crossover, U.S.** Baseline N=32, Analytic N=32 (Attrition: 0%) **Study objective**: To test the effect on energy intake of increasing the portion size of all foods and beverages served over 2 consecutive days **Participant characteristics at baseline**: Adults, 19-45 y • Age: 22.8 (0.9) y • Female: 50% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.5 (0.6) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting to gain or lose weight, athlete in training, pregnant or breastfeeding, taking medications known to affect appetite, food allergies or dislikes for the entrees and dessert served in study, not regularly consuming 3 meals per day, BMI <19 or >30 kg/m^2, scored >40 on the Zung Scale, >20 on the Eating Attitudes Test	**Intervention**: Condition 1: 100% portion sizes Condition 2: 150% portion sizes Condition 3: 200% portion sizes **Duration**: All meals and snacks on 2 consecutive days for 3 weeks **Compliance**: 100% compliance **Outcomes and assessment methods**: Weighed food intake Before and after test meals	**Energy Intake over 2 days**: Condition 1 vs. 2 and 3: Women and men, P<0.0008 Condition 2 vs. 3: Women, P=NS; Men, P<0.0008 **Energy intake per day**: Condition 1 (100%) vs. Condition 2 (150%): +335 kcal/day for women; +504 kcal/day for men; P<0.0001 Condition 1 (100%) vs. Condition 3 (200%): +530 kcal/day for women; +812 kcal/day for men; P<0.0001 Larger portion sizes significantly increased intake from all food categories (entrees, starches, fruit and vegetable side dishes, desserts, condiments, beverages, and snacks): P<0.02	**Model adjustments**: • TEI: NR • Other: Fixed factors: subject sex, portion size condition **Limitations**: • Methods for randomization and concealment NR; No power calculation; Snacks consumed at home so may limit compliance/adherence; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2006b[50] **RCT-Crossover, U.S.** Baseline N=25, Analytic N=24 (Attrition: 4%) **Study objective**: To test the combined effects of portion size and energy density on energy intake over 2 days **Participant characteristics at baseline**: Adult women, age 19-45y, BMI between 18-40 kg/m^2, regularly eat 3 meals • Age: ~22 (1) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: ~23 kg/m^2 • Physical activity: NR • Smoking: 100% non-smokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis:** Dieting, food allergies or restrictions, medications that affect appetite, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating, smokers	**Intervention**: Condition 1: 75% portion size, 75% ED Condition 2: 100% portion size, 75% ED Condition 3: 75% portion size, 100% ED Condition 4: 100% portion size, 100% ED **Duration**: 2 days **Compliance**: One participant was excluded for non-compliance **Outcomes and assessment methods**: Weighed food intake Before and after every test meal	Condition 1: 3355 (114) kcal Condition 2: 3873 (125) kcal Condition 3: 4449 (145) kcal Condition 4: 4955 (143) kcal	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Kelly, 2009[51] **RCT-Crossover, Ireland** Baseline N=44, Analytic N=43 (Attrition: 2%) **Study objective**: To determine the extent to which the availability of different-sized predefined and pre-packed food portions would affect the amounts of food consumed, EI and self-perceived appetite sensations in normal-weight and overweight adults over four consecutive days under fully residential conditions **Participant characteristics at baseline**: Adults, 18-65 y • Age: 30.7 (7.1) y • Female: 51% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 24.5 (3.1) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Smokers, vegetarians, those taking prescription medications or any drugs that might interfere with normal food intake, food allergies or dietary restrictions, chronic disease, BMI <18.5 or >30, unwilling to participate in a fully residential study, or did not like the study menu	**Intervention**: Condition 1: Standard portions Condition 2: Large portions **Duration**: 2, 4-day periods **Compliance**: One was excluded for not complying with the study protocol **Outcomes and assessment methods**: Weighed food intake Before and after each test meal	**Energy Intake, kcal per day**: Men, large vs. standard portions: +573.6 (382.4) kcal; P=0.001 Women, large vs standard portions: + 262.9 (382.4) kcal; P=0.005 **Meal Intake**: Men and Women: Larger portion>Standard; P=0.001 **Energy intake, cumulative over 4 days**: Men, large vs. standard portions: 16,300.2 (4,182.6) kcal vs. 14,005.7 (3,776.3) kcal; P=0.001 Women, large vs. standard portions: 12,022 (2,366.2) kcal vs. 9,560.2 (2,294.5) kcal; P=0.005	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: Food Standards Agency

Rolls, 2007[52]
RCT-Crossover, U.S.
Baseline N=27, Analytic N=23 (Attrition: 15%)

Study objective: To determine whether participants would compensate for excess energy intake or continue to overeat when portion sizes were increased for 11 days

Participant characteristics at baseline:
Adults, 20-40 y, BMI 18.5-30 kg/m^2
- Age: 25.3 (1.9) y
- Female: 43%
- Race and/or ethnicity: NR
- Socioeconomic position: NR
- Anthropometry: BMI: 23.8 (0.8) kg/m^2
- Physical activity: NR
- Smoking: 100% nonsmokers
- TEI: NR
- Habitual diet at baseline: NR

Excluded from study or analysis: Smokers, BMI <18 or >30; did not regularly eat 3 meals per day, were dieting to gain or lose weight, athletes in training, taking medications known to affect appetite, pregnant or breastfeeding, food allergies or restrictions, did not like or unwilling to eat study foods, not willing to refrain from drinking alcohol during study period, scored >40 on the Zung Self-Rating Scale, and >20 on Eating Attitudes Test

Intervention:
Condition 1: 100% portions
Condition 2: 150% portions

Duration: All meals and snacks for 2, 11-day periods

Compliance: Three participants excluded for failing to comply with the study schedule or protocol; 1 excluded for consuming substantially less than estimated daily energy requirements on multiple days

Outcomes and assessment methods:
Weighed food intake
Before and after meals

Total Energy Intake (kcal/d)
Women: 1 vs 2: 2073 (97), 2530 (70)
Men: 1 vs 2: 2909 (106), 3328 (114)
P<0.0001
Cumulative Energy Intake; P<0.0001

Food Energy (kcal/d)
Condition 1, 100%, Condition 2, 150%
Total food energy:
Women: 1891 (81), 2308 (66)
Men: 2709 (97), 3063 (101)
P<0.0001

Entree:
Women: 941 (51), 1077 (56);
Men: 1432 (47), 1593 (72)
P=0.003

Starches:
Women: 196 (12), 250 (19)
Men: 299 (12), 339 (15)
P<0.0001

Vegetables:
Women: 65 (11), 72 (14)
Men: 75 (11), 69 (8)
NS

Desserts and yogurts:
Women: 327 (16), 407 (22)
Men: 471 (24), 556 (27)
P<0.0001

Fruit with a meal:
Women: 47 (4), 52 (7)
Men: 71 (4), 88 (6)
P=0.0016

Fruit as a snack:
Women: 30 (5), 37 (7)
Men: 38 (6), 40 (7)
NS

Snack foods:
Women: 285 (21), 413 (28)
Men: 322 (38), 377 (43)

Model adjustments:
• TEI: NR
• Other: Fixed factors: portion size condition, menu number, and participant sex

Limitations:
• Methods for randomization and concealment NR; Not sufficiently powered; compliance/adherence on non-laboratory meals (weekend/snacks); No preregistered data analysis plan

Funding:
NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
		P<0.0001 **Beverage energy, kcal/d** Women: 183 (25), 221 (33) Men: 199 (19), 265 (25) P<0.0001	
Levitsky, 2020[53] **RCT-Crossover, U.S.** Baseline N=81, Analytic N=74 (Attrition: 9%) **Study objective**: To examine the effect of decreasing portion size of an entrée on the amount of dessert subsequently consumed **Participant characteristics at baseline**: College students in an introductory nutrition course, >18 y • Age: 19.6 (5.9) y • Female: 84% • Race and/or ethnicity: White: 50%; Nonwhite: 50% • Socioeconomic position: NR • Anthropometry: BMI: 21.6 (3.1) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies or restrictions, missing data	**Intervention**: Control: Ad libitum consumption of entrée and dessert Condition 1: 100% of entree + dessert Condition 2: 90% of entree + dessert Condition 3: 85% of entree + dessert Condition 4: 80% of entree + dessert *Dessert was not manipulated* *Subjects were served an entree portion based on 100% of what they consumed at the control session* **Duration**: 1 meal (lunch) once a week for 5 weeks **Compliance**: Seven excluded for not completing all conditions; 23 with missing dessert values that were square root transformed **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entree energy intake, kcal:** Control, Condition 1: 359 kcal Condition 2: NR Condition 3: NR Condition 4: 252.7 kcal P not reported **Dessert energy intake, kcal**: All conditions: 94.8 kcal P=NS across conditions	**Model adjustments**: • TEI: NR • Other: fixed factor effects in the model were portion size condition, height, weight, gender, age, and leftovers; subjects were treated as a random effect **Limitations**: • High loss to follow-up and missing outcome data; subjects were aware of study purpose; did not report data or results clearly for all conditions; no pre-registered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2004c[54] **RCT-Crossover, U.S.** Baseline N=50, Analytic N=42 (Attrition: 16%) **Study objective**: To test the effect on meal intake of varying the energy density and portion size of a compulsory first course salad **Participant characteristics at baseline**: Women, age 19-45 y, BMI between 18-40 kg/m^2, regularly eat 3 meals • Age: 26.3 (1.2) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.7 (0.6) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, smokers, medications that affect appetite, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating	**Intervention**: Condition 1: 100% portion size, low energy density (0.33 kcal/g) preload salad Condition 2: 100% portion size, medium energy density (0.67 kcal/g) preload salad Condition 3: 100% portion size, high energy density (1.33 kcal/g) preload salad Condition 4: 200% portion size, low energy density (0.33 kcal/g) preload salad Condition 5: 200% portion size, medium energy density (0.67 kcal/g) preload salad Condition 6: 200% portion size, high energy density (1.33 kcal/g) preload salad Condition 7: No preload salad *Subjects were required to consume the entire salad preload, and then consumed an entree (pasta) ad libitum* **Duration**: 1 meal (lunch) once a week for 7 weeks **Compliance**: Three dropped out due to scheduling, 5 were excluded because the consumed the entire entrée **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Entree intake**: PS Conditions 4, 5, 6 vs. 1, 2,3: -98 (30) kcal; P<0.001 ED Conditions 3, 6 vs. 2, 5 and 1, 4; P=0.06 **Total meal intake**: Condition 1 vs. 7: -64 (26) kcal; P<0.05 Condition 2 vs. 7; NS Condition 3 vs. 7: +71 (27) kcal; P<0.05 Condition 4 vs. 7: -107 (29) kcal; P<0.001 Condition 5 vs. 7; NS Condition 6 vs. 7: +145 (22) kcal; P<0.001 ED alone: P<0.001 Condition 3 vs. Condition 6: +74 (24) kcal; P=0.002 Condition 2 vs Condition 4: -55 (24) kcal; P=0.02 Condition 3 vs Condition 5: -97 (25) kcal; P<0.0001	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; Excluded data for subjects who consumed the entire entrée, so unclear how that would have affected results; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Williams, 2014[55] **RCT-Crossover, U.S.** Baseline N=53, Analytic N=46 (Attrition: 13%) **Study objective**: To test the effects of varying the energy density and portion size of food consumed after a preload on energy intake **Participant characteristics at baseline**: Women, age 20-45 y, BMI between 18-40 kg/m^2, regularly eat 3 meals • Age: 25.4 (0.8) y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.6 (0.5) kg/m^2 • Physical activity: NR • Smoking: 100% non-smokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Dieting, food allergies or restrictions, medications that affect appetite, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating, did not regularly eat 3 meals per day, smoked	**Intervention**: Condition 1: 100% energy density 1.25 kcal/g), 100% portion size (450g, 563 kcal) Condition 2: 100% energy density 1.25 kcal/g), 133% portion size (600g, 750 kcal) Condition 3: No salad preload, 100% energy density 1.25 kcal/g), 133% portion size (600g, 750 kcal) Condition 4: 133% energy density 1.66 kcal/g), 100% portion size (450g, 747 kcal) Condition 5: 133% energy density 1.66 kcal/g), 133% portion size (600g, 750kcal) Condition 6: No salad preload, 133% energy density 1.66 kcal/g), 133% portion size (600g, 750 kcal) *Subjects were served a compulsory salad preload (300g, 100 kcal), followed by an ad libitum pasta dish (ED was manipulated by changing proportions of pasta cheese, cream, sauce, and pureed vegetables).* *Standard breakfast was served to participants: bagel and yogurt* **Duration**: 1 meal (lunch) once a week for 6 weeks **Compliance**: Three participants were excluded for not following procedures, 3 were excluded for eating the entire test meal on 2 or more occasions; 1 was excluded for highly variable intakes **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total pasta intake (kcal), total lunch intake (kcal)**: Condition 1: 329 (18), 429 (18) Condition 2: 351 (20), 451 (20) Condition 3: 476 (16), 476 (16) Condition 4: 457 (20), 557 (20) Condition 5: 523 (22), 623 (23) Condition 6: 649 (23), 649 (23) Energy density: P<0.0001, P<0.0001 Portion size: P<0.02, P<0.02 Preload: P<0.0001; NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Shimpo, 2018[56] **RCT-Crossover, Japan** Baseline N=NR, Analytic N=21 (Attrition: NR) **Study objective**: To investigate the effects of portion size and bowl size and possible interactions between these variables on food intake and fullness **Participant characteristics at baseline**: Adult men, age 20-60 y • Age: 39.9 (9.8) y • Female: 0% • Race and/or ethnicity: Likely majority Japanese • Socioeconomic position: NR • Anthropometry: BMI: 23.6 (2.4) kg/m^2 • Physical activity: 29% low, 67% moderate, 5% high • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies to the meals provided	**Intervention**: Condition 1: 100%, 150 g in small bowl + lunch Condition 2: 100%, 150 g in large bowl + lunch Condition 3: 166%, 250 g in small bowl + lunch Condition 4: 166%, 250 g in large bowl + lunch *The same lunch was served in all conditions (445 kcal): fried chicken, tomato salad, coleslaw, green tea* *Subjects were permitted to obtain refills* **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: NR **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Intake of rice (g)**: Condition 1: 166.7 (45) g Condition 2: 161.9 (37.6) g Condition 3: 245.5 (20.7) g Condition 4: 245.2 (22) g Portion size: P<0.001 Bowl size: P=NS **Energy intake from the meal (kcal)**: Condition 1: 725 kcal Condition 2: 717 kcal Condition 3: 857 kcal Condition 4: 857 kcal Portion size: P<0.001 Bowl size: P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Randomization concealment NR; Did not describe or account for those lost to follow-up; No pre-registered data analysis plan **Funding**: JSPS KAKENHI

Rolls, 2004a[57]
RCT-Crossover, U.S.
Baseline N=68, Analytic N=60 (Attrition: 12%)

Study objective: To determine how the portion size of a packaged snack affects energy intake of the snack and of the subsequent meal

Participant characteristics at baseline:
Adults, age 20-45 y, BMI between 20-40 kg/m^2

- Age: ~23 (1) y
- Female: 57%
- Race and/or ethnicity: NR
- Socioeconomic position: NR
- Anthropometry: BMI: ~23 (1) kg/m^2
- Physical activity: NR
- Smoking: 100% nonsmokers
- TEI: NR
- Habitual diet at baseline: NR

Excluded from study or analysis: Dieting, food allergies or restrictions, medications that affect appetite, athletes, pregnant or breastfeeding, disliked study foods, scored high on depression scale, scored high for disordered eating, did not regularly snack between meals, smokers

Intervention:
Condition 1: 100%, 28 g, 151 kcal
Condition 2: 150%, 42 g, 227 kcal
Condition 3: 300%, 85 g, 459 kcal
Condition 4: 457%, 128 g, 691 kcal
Condition 5: 600%, 170 g, 918 kcal

The same dinner was served ~3hrs later (pasta, salad, bread, chocolate bars, chocolate cookies, water)

Duration: 2 meals (snack, dinner) for 5 sessions

Compliance: Five excluded for personal or schedule reasons, 3 excluded for repeated low snack intakes

Outcomes and assessment methods:
Weighed food intake
Before and after test meal

WOMEN:
Energy intake, snack (kcal):
Condition 1 (100%): 136 (5) kcal
Condition 2 (150%): 185 (9) kcal
Condition 3 (300%): 271 (19) kcal
Condition 4 (457%): 295 (22) kcal
Condition 5 (600%): 319 (26) kcal
P<0.05 for 1 vs 2, 3, 4, 5; 2 vs 3, 4, 5; P=NS for 3 vs 4, 5; 4 vs 5

Energy intake, dinner (kcal):
Condition 1 (100%): 928 (47) kcal
Condition 2 (150%): 914 (41) kcal
Condition 3 (300%): 873 (44) kcal
Condition 4 (457%): 833 (30) kcal
Condition 5 (600%): 886 (35) kcal
P=NS for all comparisons

Energy intake, snack + dinner (kcal):
Condition 1 (100%): 1063 (49) kcal
Condition 2 (150%): 1099 (46) kcal
Condition 3 (300%): 1145 (53) kcal
Condition 4 (457%): 1129 (41) kcal
Condition 5 (600%): 1206 (43) kcal
P<0.05 for 1 vs 5, all other comparisons P=NS

MEN:
Energy intake, snack (kcal):
Condition 1 (100%): 142 (4) kcal
Condition 2 (150%): 212 (7) kcal
Condition 3 (300%): 330 (27) kcal
Condition 4 (457%): 443 (31) kcal
Condition 5 (600%): 452 (45) kcal
P<0.05 for 1 vs 2, 3, 4, 5; 2 vs 3, 4, 5; 3 vs 4, 5; P=NS for 4 vs. 5

Energy intake, dinner (kcal):
Condition 1 (100%): 1241 (63) kcal
Condition 2 (150%): 1179 (69) kcal
Condition 3 (300%): 1167 (47) kcal
Condition 4 (457%): 1229 (66) kcal
Condition 5 (600%): 1079 (46) kcal
P<0.05 for 1, 2, 4 vs 5, all other comparisons P=NS

Model adjustments:
• TEI: NR
• Other: Fixed factors in model: snack package size, subject sex

Limitations:
• Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan

Funding:
NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
		Energy intake, snack + dinner (kcal): Condition 1 (100%): 1383 (63) kcal Condition 2 (150%): 1390 (71) kcal Condition 3 (300%): 1497 (59) kcal Condition 4 (457%): 1671 (85) kcal Condition 5 (600%): 1531 (73) kcal P<05 for 1 vs 3, 4, 5; 2 vs 4, 5; 3 vs 4; 4 vs 5	
Flood, 2006[58] **RCT-Crossover, U.S.** Baseline N=40, Analytic N=33 (Attrition: 18%) **Study objective**: To test the effects of increasing beverage portion size on beverage intake, as well as on food and energy intake, during a meal **Participant characteristics at baseline**: Adults, 18-45 y • Age: 22.5 (0.3) y • Female: 55% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.6 (0.3) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Taking medications that are known to affect appetite or food intake, smokers, do not regularly consume 3 meals a day, dieting to gain or lose weight, athletes in training, pregnant or breastfeeding, food allergies and food restrictions, don't like soda, score high on the dietary restraint, hunger, disinhibition, or depression questionnaires	**Intervention**: Condition 1: 100% (360 g, 0 kcal) water + lunch Condition 2: 150% (540 g, 0 kcal) water + lunch Condition 3: 100% (360 g, 0 kcal) diet cola + lunch Condition 4: 150% (540 g, 0 kcal) diet cola + lunch Condition 5: 100% (360 g, 150 kcal) cola + lunch Condition 6: 150% (540 g, 225 kcal) cola + lunch *Lunch consisted of pasta with tomato sauce, salad, a roll, and chocolate chip cookies* **Duration**: 1 meal (lunch) once a week for 6 weeks **Compliance**: Four excluded for consuming the entire lunch meal, 3 excluded for not following protocol or missing meals **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Beverage intake (kcal)**: Condition 5 (100% cola): 128 (4) kcal Condition 6 (150% cola): 151 (8) kcal P<0.004 **Food intake (kcal)**: Food intake at lunch did not differ significantly by condition (for portion size or type of beverage), P=NS **Total meal intake (kcal)**: Total energy intake at lunch was significantly greater for conditions 5, 6 (cola) vs conditions 1, 2, 3, 4 (water or diet cola), P<0.001	**Model adjustments**: • TEI: NR • Other: fixed factor effects in the model were beverage type, beverage portion size, and subject sex; awareness of the purposes of the study was also tested as an independent factor in the model **Limitations**: • Randomization concealment NR; Did not account for those lost to follow-up; No pre-registered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Zuraikat, 2018b[59] **RCT-Crossover, U.S.** Baseline N=82, Analytic N=79 (Attrition: 4%) **Study objective**: To test whether the amount of money paid for a meal influenced the portion size effect at a lunch served in a controlled restaurant-style setting **Participant characteristics at baseline**: Adults, 20-65 y • Age: 33.9 (12.7) y • Female: 70% • Race and/or ethnicity: White: 79%; Black or African American: 6%; Asian: 9%; Mixed or unreported race: 5%; Hispanic or Latino: 6% • Socioeconomic position: HHI >$50,000: 61% • Anthropometry: BMI: 25.6 (5.0) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: 2205 (392) • Habitual diet at baseline: All regularly consume 3 meals/day **Excluded from study or analysis**: Were not willing to refrain from eating between 10pm the evening before a test day and breakfast on the day of the test and to refrain from consuming alcohol the day before the test session, don't regularly eat 3 meals per day, they disliked or were unable to eat test foods (allergies, intolerances, dietary restrictions), smokers, taking medication that affected appetite, were diagnosed with a health condition that affects appetite, were dieting to gain or lose weight, athlete in training, pregnant or breastfeeding.	**Intervention**: Condition 1: 100% (400g, 636 kcal), $8 Condition 2: 100% (400g, 636 kcal), $16 Condition 3: 150% (600g, 954 kcal), $8 Condition 4: 150% (600g, 954 kcal), $16 **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: Three subjects withdrew due to scheduling conflicts **Outcomes and assessment methods**: Weighed food intake Before and after test	**Lunch intake (kcal)** Condition 1, 2 vs. Condition 3, 4: +133 (16) kcal, P<0.0001 **Pasta Intake (kcal)** Condition 1, 2 vs. Condition 3, 4: +140 (15) kcal; P<0.0001 **Bread roll intake (kcal)** Condition 1, 2 vs. Condition 3, 4: -4.2 (2) kcal; P<0.019 **Salad with dressing intake**: NS Cost of meal did not affect response to PS of the pasta dish.	**Model adjustments**: • TEI: 2205 (392) • Other: Meal cost, study week, subject sex **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NIH, USDA, Jenny Craig, Inc.

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Ziylan, 2016[60] **RCT-Crossover, The Netherlands** Baseline N=120, Analytic N=120 (Attrition: 0%) **Study objective**: To assess the effect of size reduction or protein enrichment of readymade meals on protein and energy intakes at lunchtime and on subsequent ratings of satiety in vital older adults **Participant characteristics at baseline**: Adults, 65y or older • Age: 70.5 (4.5) y • Female: 47% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 27.2 (4.4) kg/m^2 • Physical activity: Physical activity level: 68.4 (15.4) • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Not proficient in using the computer, participating in any other related research, not following a normal diet without dietary restrictions (including voluntary weight management restrictions), dislike the meal components	**Intervention**: Condition 1: Normal size, lower protein (100%, 450 g, 432 kcal) Condition 2: Normal size, higher protein (100%, 450 g, 498 kcal) Condition 3: Reduced size, lower protein (89%, 400 g, 429 kcal) Condition 4: Reduced size, higher protein (89%, 400 g, 491 kcal) **Duration**: 1 meal (lunch) once a week for 4 weeks **Compliance**: N/A **Outcomes and assessment methods**: Weighed food intake Before and after test	**Chicken Meal Energy intake** Condition 1: 382 (6) kcal Condition 2: 423 (6) kcal Condition 3: 375 (6) kcal Condition 4: 441 (6) kcal Condition 4 vs 1, 2, 3: P<0.05 Condition 2 vs 1, 3: P<0.05 Condition 1 vs 3: P=NS **Beef Meal Energy Intake** Condition 1: 341 (8) kcal Condition 2: 427 (8) kcal Condition 3: 340 (8) kcal Condition 4: 416 (8) kcal Condition 1 vs. 2, 4; P<0.05 Condition 2 vs. 3; P<0.05 Condition 3 vs. 5; P<0.05 Condition 1 vs. 3; P=NS and Condition 2 vs. 4; P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; Unclear why total energy served was similar between conditions, regardless of portion size and protein content; No preregistered data analysis plan **Funding**: Wageningen UR IPOP

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Lewis, 2015[61] **RCT-Crossover, U.K.** Baseline N=33, Analytic N=33 (Attrition: 0%) **Study objective**: To investigate the impact of reducing breakfast portion size on subsequent energy intake, postprandial gastrointestinal hormone responses, and appetite ratings **Participant characteristics at baseline**: Adults, 18-60 y • Age: 42.5 (2) y • Female: 55% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 29.0 (0.4) kg/m^2 • Physical activity: Vigorous PA (min/week): 65 (13); Moderate PA (min/week): 142 (21); Walking (min/week): 254 (30) • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Disordered eating (>11 on Eating Attitudes Test), depressive symptoms (>70 on Zung Depression Scale), smoking, excessive alcohol intake, weight loss/gain within last 3 months, or actively trying to lose/gain weight, medical conditions/medications potentially affecting appetite, inflammatory conditions, diabetes or fasting plasma glucose, pregnancy, breastfeeding, or planning pregnancy, extremely high levels of exercise, unable to eat study food, not regularly consuming breakfast (<3/week).	**Intervention**: Condition 1: 100% Breakfast, Men: 791 kcal; Women: 607 kcal Condition 2: 80% Breakfast, Men: 633 kcal; Women: 485 kcal Condition 3: 60% Breakfast, Men: 475 kcal; Women: 363 kcal *Breakfast was compulsory, and followed by an ad libitum lunch (1978 kcal Men; 1518 kcal Women) and snack (10 digestive biscuits)* **Duration**: 2 meals and a snack (breakfast, followed by ad libitum lunch and snack) for 3 sessions **Compliance**: 100% compliance **Outcomes and assessment methods**: Weighed food intake and weighed diet diary to record remainder of the day's intake Before and after test meal; completed diet diaries	**Lunch Energy intake, kcal** Condition 1, 100%: 700.3 (48.5) kcal Condition 2, 80%: 681.9 (47.3) kcal Condition 3, 60%: 695.7 (42.8) kcal Condition 1 vs. 2; P=0.429 Condition 2 vs. 3; P=0.547 Condition 1 vs. 3; P=0.850 **Total Energy Intake (except breakfast), kcal** Condition 1, 100%: 1762.4 (86.3) kcal Condition 2, 80%: 1808.3 (111.9) kcal Condition 3, 60%: 1771.8 (99.7) kcal Condition 1 vs. 2; P=0.555 Condition 2 vs. 3; P=0.639 Condition 1 vs. 3; P=0.904 **Total Energy Intake (with breakfast), kcal** Condition 1, 100%: 2458.7 (94.4) kcal Condition 2, 80%: 2365.4 (117.4) kcal Condition 3, 60%: 2189.5 (104.4) kcal P=NR	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: UK Medical Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Burger, 2011[62] **RCT-Crossover, U.S.** Baseline N=30, Analytic N=30 (Attrition: 0%) **Study objective**: To test possible mechanisms of the portion size effect, i.e., bite size and visual cues **Participant characteristics at baseline**: Adults, 18-60 y • Age: 37.4 (11.1) y • Female: 50% • Race and/or ethnicity: Non-Hispanic White: 93%; Asian: 4%; Hispanic: 4% • Socioeconomic position: Education: 16.1 (1.5) y • Anthropometry: BMI: 25.9 (4.5) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Not willing to eat study foods, not able to read and understand English language at a 6th grade level, pregnancy, restrictive dietary practices, taste or visual impairment that could interfere with data collection	**Intervention**: Condition 1: Small portion, 100%, 410 (10)g; 1,255kcal; Not blindfolded Condition 2: Small portion, 100%, 410 (10)g; 1,255kcal; Blindfolded Condition 3: Large portion, 200%, 820 (10)g; 2,509kcal; Not blindfolded Condition 4: Large portion, 200%, 820 (10)g; 2,509kcal; Blindfolded **Duration**: 1 meal (lunch) for 4 sessions **Compliance**: Three males were excluded for being identified as plate cleaners (left <20g of the large portion in blindfolded condition) **Outcomes and assessment methods**: Weighed food intake Before and after test meals	**Entree intake** Condition 1 vs. 3, main effect of portion size: 220 kcal (71.9g), p<0.05 Condition 2 vs. 4, main visual effect: NS (p=0.29) **Total Energy Intake** Condition 1 vs. 3: +220 kcal from small to large portion, p<0.001 Condition 2 vs. 4: -102kcal for blindfolded, p<0.01 **Complementary foods** NS	**Model adjustments**: • TEI: NR • Other: blindfolding **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: Colorado State University and USDA

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Kral, 2004[63] **RCT-Crossover, U.S.** Baseline N=42, Analytic N=39 (Attrition: 7%) **Study objective**: To determine the combined effects of energy density and portion size on energy intake in women **Participant characteristics at baseline**: Women, age 20-45y in good health • Age: 23.4 (1)y • Female: 100% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 23.1 (0.4) kg/m^2 • Physical activity: NR • Smoking: 100% nonsmokers • TEI: NR • Habitual diet at baseline: All regularly consumed meals at regular intervals **Excluded from study or analysis**: Men, smokers, dieting, in athletic training, pregnant/lactating, using medications known to affect food intake or appetite, not consuming regular meals (including breakfast), change in body weight (4.5kg) in previous 6 months, food allergies/restrictions, high scores for dietary restraint or depressive symptoms	**Intervention**: Condition 1: 5.23kJ/g ED & 500g PS Condition 2: 5.23kJ/g ED & 700g PS Condition 3: 5.23kJ/g ED & 900g PS Condition 4: 7.32kJ/g ED & 500g PS Condition 5: 7.32kJ/g ED & 700g PS Condition 6: 7.32kJ/g ED & 900g PS **Duration**: All meals for 1 day x 6 weeks **Compliance**: Three excluded, 1 for personal reasons after second session and 2 for not meeting minimum requirements for intake (>100g) and ratings of pleasantness of taste (>35mm) of manipulated entree **Outcomes and assessment methods**: Weighed food intake Before and after each meal for all foods	**Energy intake at lunch (kcal)**: Condition 1: 398 (16) Condition 2: 472 (22) Condition 3: 482 (24) Condition 4: 526 (28) Condition 5: 560 (32) Condition 6: 620 (32) PS effect: P<0.0001 ED effect: P<0.0001 PS, ED interaction: P=0.27 **Total daily energy intake (kcal)**: Condition 1: 1671 (48) Condition 2: 1734 (50) Condition 3: 1763 (51) Condition 4: 1819 (65) Condition 5: 1829 (52) Condition 6: 1947 (56) PS effect: P=0.003 ED effect: P<0.0001 PS, ED interaction: P=NS **Energy intake at breakfast**: P=NS **Energy intake at dinner**: P=NS	**Model adjustments**: • TEI: NR • Other: Fixed factors: ED, PS, subjects were random **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Haynes, 2020b[64] **RCT-Crossover, U.K.** Baseline N=39, Analytic N=30 (Attrition: 23%) **Study objective**: To test whether reductions to portion size would result in a significant reduction to daily energy intake when the resulting portion was visually perceived as 'normal' in size, but that a reduction resulting in a 'smaller than normal' portion size would cause immediate or later additional eating **Participant characteristics at baseline**: Adults, 18-60 y, BMI 22.5-32.5 kg/m^2 • Age: 31.6 (10.3) y • Female: 50% • Race and/or ethnicity: NR • Socioeconomic position: Education, bachelor's degree or higher: 83% • Anthropometry: BMI: 26.0 (2.3) kg/m^2; Weight status: 37% normal weight, 63% overweight • Physical activity: Moderate to vigorous physical activity: ~71 minutes per day • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Food allergies or intolerance, special dietary requirements, currently dieting, history of eating disorders, taking medication which affected appetite, not willing to consume each of the test foods, participation in a weight loss trial in last 4 weeks or portion size study in past 12 months	**Intervention**: Condition 1: Small-normal lunch and dinner entrees (339 kcal/entrée, 5074 kcal/d) Condition 2: Normal lunch and dinner entrees (543 kcal/entrée, 5485 kcal/d) Condition 3: Large-normal lunch and dinner entrees (747 kcal/entrée, 5897 kcal/d) **Duration**: 3 conditions for 5 days (Monday-Friday) **Compliance**: Three participants did not commence study after enrollment, 6 withdrew for time commitments/schedule, disliked study food, illness, change in diet **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Total daily energy intake**: Condition 1: 2238 (490) kcal Condition 2: 2448 (584) kcal Condition 3: 2543 (592) kcal P<0.001 **Energy intake at lunch: entrée, additional entree, total**: Condition 1: 313 (13), 339 (196), 653 (203) kcal Condition 2: 501 (56), 194 (190), 695 (221) Condition 3: 658 (97), 110 (140), 768 (210) kcal Entree: P value NR Additional entree intake: P<0.0001 Lunch: P<0.0001 **Energy intake at dinner: entrée, additional entree, total**: Condition 1: 338 (22), 275 (154), 613 (162) Condition 2: 486 (79), 266 (147), 752 (181) Condition 3: 628 (119), 223 (149), 851 (214) Entree: P value NR Additional entree intake: P=0.004 Dinner: P<0.0001	**Model adjustments**: • TEI: NR **Limitations**: • Did not account for those lost to follow-up in analyses **Funding**: Medical Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Ellahi, 2022[65] **RCT-Crossover, U.K.** Baseline N=51, Analytic N=31 (Attrition: 39%) **Study objective**: To assess the efficacy, acceptance, and weight change of two guided/calibrated commercially available portion control tools (Utensil set and Crockery Set) used in free-living conditions **Participant characteristics at baseline**: Adults, women, 18 y and older, BMI >23 kg/m^2, wanting to lose or maintain weight • Age: 18-29 y: 19% 30-39 y: 32% 40-49 y: 32% 50+y: 16% • Female: 100% • Race and/or ethnicity: South Asian: 100%, Asian: 64.5%; Asian British: 35.5% • Socioeconomic position: High school education: 58%, University education: 19%; Married: 83.9% • Anthropometry: BMI: all >23 kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Males, already on a commercial weight loss diet, previously or presently using tools to measure portion size, suffering from active cancer, pregnant or lactating, or been diagnosed with an eating disorder, mental illness, or psychiatric disorder within the last 12 months that required active treatment	**Intervention**: Condition 1: Portion-control utensil set Condition 2: Portion-control crockery set *+ general nutrition advice* **Duration**: 4 weeks for each condition; last 8 weeks participants preferred tools were used **Compliance**: 61% retention rate. The majority reported that the utensils and the crockery set aided portion self-served, self-control, particularly of starchy foods, and aided learning about portions. For overall tool use, the crockery set scored higher in all areas of acceptance, ease of use, and perceived efficacy. **Outcomes and assessment methods**: 3-day food diaries Baseline, week 3, 7, 15 (final week)	Energy intake, mean: 1504.7 kcal Baseline energy intake, mean: 1521.3 kcal Week 16 energy intake, mean: 1501.7 kcal P=NS	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR; Baseline energy intake was not reported, so unable to determine if tools were effective; Some concerns due to potential carryover effects; Did not account for missing data; Did not clearly report outcome data; No preregistered data analysis plan **Funding**: Tools were donated by Precise Portions Nutrition Control Systems and Jokari Healthy Steps; University of Chester

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Robinson, 2015[66] **RCT-Parallel, U.K.** Baseline N=88, Analytic N=88 (Attrition: 0%) **Study objective**: To test whether the amount of food participants intended to consume was similar to the amount they subsequently ate **Participant characteristics at baseline**: Adults • Age: ~33 (11)y • Female: 50% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 25 (4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: History of food allergy, disliking of study foods	**Intervention**: Group 1: 100%, 75 g, 62 kcal Group 2: 233%, 175 g, 145 kcal *All subjects were provided with a sandwich before being served dessert* **Duration**: 1 meal (lunch) **Compliance**: 100% **Outcomes and assessment methods**: Weighed food intake Before and after meal	**Energy intake (kcal), Males**: Group 1: 54.8 (13.9) kcal Group 2: 111.7 (36) kcal p<0.001 **Energy intake (kcal), Females**: Group 1: 50.5 (17.4) kcal Group 2: 59.5 (33.7) kcal p=0.28	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization concealment NR; No preregistered data analysis plan **Funding**: Wellcome Trust

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Marchiori, 2014[67] **RCT-Parallel, The Netherlands** Baseline N=121, Analytic N=110 (Attrition: 9%) **Study objective**: To test whether a brief mindfulness manipulation can prevent the portion size effect, and reduce overeating on unhealthy snacks when hungry **Participant characteristics at baseline**: Adults, university students • Age: 20.9 (2.3) y • Female: 71% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 22.3 (2.5) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Feel asleep during intervention, allergy to study foods, not following instructions	**Intervention**: Group 1: Small portion (100%, 51 g, 10 cookies, 247.5 kcal), audio book Group 2: Small portion (100%, 51 g, 10 cookies, 247.5 kcal), body scan Group 3: Large portion (300%, 153 g, 30 cookies, 742.5 kcal), audio book Group 4: Large portion (300%, 153 g, 30 cookies, 742.5 kcal), body scan **Duration**: 1 meal (snack) **Compliance**: Seven excluded for sleeping during the study, 3 excluded for not following all the instructions, 1 excluded for an allergy to the study food **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake**: Group 1+2 (100%): 139.53 (72.26) kcal Group 3+4 (300%): 222.77 (124.88) kcal Portion size effect, P<0.001 (No significant effect of audio book vs body scan, P>0.05)	**Model adjustments**: • TEI: NR • Other: Results did not change when controlling for participant and food-related characteristics **Limitations**: • Methods for randomization concealment NR; No preregistered data analysis plan **Funding**: National Research Fund, Luxembourg; Netherlands Organization for Scientific Research

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Reily, 2016[68] **RCT-Parallel, Australia** Baseline N=164, Analytic N=154 (Attrition: 6%) **Study objective**: To investigate whether contextual size information moderates the portion size effect, participants were served small or large portions of pasta for lunch in the presence or absence of contextual size information **Participant characteristics at baseline**: Adult women, first year psychology students or community members • Age: 19.9 (2.84) y • Female: 100% • Race and/or ethnicity: Caucasian: 35.1%; Asian: 52.6%; Aboriginal or Pacific Islander: 0.6%; Other: 11.7% • Socioeconomic position: NR • Anthropometry: BMI: 22.1 (3.55) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Correctly identified study purpose, failed attention check, technical difficulties	**Intervention:** Group 1: Small portion (100%, 300 g, 748 kcal), no context Group 2: Large portion (200%, 600 g, 1496 kcal), no context Group 3: Small portion (100%, 300 g, 748 kcal), label only Group 4: Large portion (200%, 600 g, 1496 kcal), label only Group 5: Small portion (100%, 300 g, 748 kcal), label + visual comparison Group 6: Large portion (200%, 600 g, 1496 kcal), label + visual comparison **Duration:** 1 meal (lunch) **Compliance**: Seven excluded for guessing study purpose, 2 excluded for failing the attention check, 1 excluded for technical difficulties **Outcomes and assessment methods**: Weighed food intake Before and after test meal	**Energy intake**: Group 1, 3, 5: 545 (165) kcal Group 2, 4, 6: 688 (235) kcal P<0.0001 There was no main effect of context on food intake	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No power calculation; No preregistered data analysis plan **Funding**: Australian Research Council

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Raghoebar, 2019[69] **RCT-Parallel, Netherlands** Baseline N=140, Analytic N=132 (Attrition: 6%) **Study objective**: To explore the role of social (descriptive and injunctive) and personal portion size norms on the effect of portion size **Participant characteristics at baseline**: Adults, women • Age: 21 (2) y • Female: 100% • Race and/or ethnicity: Dutch nationality: 95% • Socioeconomic position: NR • Anthropometry: BMI: 21.9 (2.3) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Not willing to eat study food, following a diet, allergies, intolerances, or dietary specific requirements, those who participated in the pilot study.	**Intervention**: **Group 1** Condition 1: 60%, 180g, 292 kcal Condition 2: Self-serve family-style, 978g, 1584 kcal **Group 2** Condition 1: 180%, 540g, 875 kcal Condition 2: Self-serve family-style, 978g, 1584 kcal *Side salad (10g or 30g) was also served, but salad consumption in kcal not provided* **Duration**: 2 sessions **Compliance**: In the smaller PS condition: 1 was excluded for not following directions and 2 were excluded for guessing study aim; In the larger PS condition: 4 were excluded for not following directions and 1 for guessing study aim. **Outcomes and assessment methods**: Weighed food intake Before and after test	Group 1 (60%): 619.8 (169.6) kcal Group 2 (180%): 764.3 (195.9) kcal P<0.001	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; Groups were not exposed to both small and large portion sizes **Funding**: The Netherlands Organization for Scientific Research; Wageningen School of Social Sciences

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Diliberti, 2004[70] **NRCT, U.S.** Baseline N=180, Analytic N=180 (100% PS: 89; 150% PS: 91) (Attrition: 0%) **Study objective**: To examine whether increasing the portion size of an entree affected energy intake at a restaurant meal **Participant characteristics at baseline**: Customers who purchased the pasta entree on study days and completed a short survey; mostly between 25-34 years and graduate students • Age: 18-34 y • Female: 54% • Race and/or ethnicity: NR • Socioeconomic position: 100% PS: 40% faculty/staff; 150% PS: 37% graduate students • Anthropometry: Estimated overweight or obesity: 100% PS: 31%; 150% PS: 36% • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Customer that did not select the pasta dish	**Intervention**: Group 1: 100% (248g, 422 kcal) Group 2: 150% (377 g, 634 kcal) *Entrée served with half tomato with pesto and white bread roll with butter* **Duration**: 1 meal (lunch) (10 test days over 5 months) **Compliance**: NA **Outcomes and assessment methods**: Weighed food intake Before and after meal	**Energy intake from the entree, kcal (mean (SE))**: Condition 1: 399 (3) kcal Condition 2: 571 (8) kcal P<0.0001 **Energy intake from accompaniments, optional items, kcal (mean (SE))**: Condition 1: 121 (9) kcal, 109 (23) kcal Condition 2: 146 (8) kcal, 71 (16) kcal Entree accompaniments: P<0.015 Optional items: P=NS **Energy intake from the meal, kcal (mean (SE))**: Condition 1: 630 (24)kcal Condition 2: 789 (19) kcal P<0.0001	**Model adjustments**: • TEI: NR • Key confounders: Sex, Age, Education • Other: Subgroup analysis: excluding those who ate the entire entree - PS effect remained significant (p<0.001). Mean meal EI increased for all subject characteristics (men, women, normal weight, overweight, age groups and university affiliations) **Limitations**: • Not all key confounders accounted for; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Fisher (adults), 2007[21] **RCT-Crossover, U.S.** Baseline N=59, Analytic N=58 (Attrition: 2%) **Study objective**: To examine the effects of large portions on daily energy intake in 5y old Hispanic and African American children from low-income families **Participant characteristics at baseline**: Mother-child pairs, with 5y children attending Head Start • Age: 30 (5) y • Female: 100% • Race and/or ethnicity: African American: 48%; Hispanic: 53% • Socioeconomic position: Education, HS or less: 53%; Current employment: 55%; Low household food security: ~33% • Anthropometry: BMI: 34 (9) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Presence of severe food allergies or chronic illnesses affecting food intake, dislike of the study foods, and self-reported previous diagnosis of maternal depression or eating disorders	**Intervention** Condition 1: Reference portion (100%) Condition 2: Large portion (200%) All foods were provided to participants. The following foods varied in portion size: *Lunch*: Macaroni and cheese *Afternoon snack*: Apple juice, graham crackers *Dinner*: Chicken, rice *Breakfast*: Cereal All other foods served were held constant across conditions. **Duration**: 1 day (breakfast, lunch, dinner, snacks) **Compliance**: 1 exclude due to child's loose tooth **Outcomes and assessment methods**: Weighed food intake Before and after test meals	**Morning snack**: No PS manipulation, P=NS between conditions **Energy intake at lunch** (macaroni and cheese, kcal; all other foods, kcal): Condition 1: 363 (146) kcal; 289 (128) kcal Condition 2: 424 (185) kcal; 251 (141) kcal Manipulated food: P<0.05 All other foods: P=NS **Energy intake afternoon snack** (apple juice, kcal; graham cracker, kcal): Condition 1: 120 (45) kcal; 211 (79) kcal Condition 2: 168 (87) kcal; 247 (137) kcal Manipulated food: Apple juice, P<0.001; Graham crackers, P=NS **Energy intake at dinner** (chicken, kcal; rice, kcal; all other foods, kcal): Condition 1: 279 (75) kcal; 109 (44) kcal; 401 (114) kcal Condition 2: 367 (128) kcal; 128 (63) kcal; 365 (108) kcal Manipulated food: Chicken, P<0.05; Rice, P=NS All other foods: P<0.05 **Evening snack**: No PS manipulation, P=NS between conditions **Energy intake at breakfast**: (cereal, kcal; all other foods, kcal): Condition 1: 203 (95) kcal; 256 (75) kcal Condition 2: 218 (103) kcal; 250 (83) kcal Manipulated food: P=NS All other foods: P=NS **Total energy intake**: Condition 1: 2819 (502) kcal Condition 2: 2965 (616) kcal P<0.01	**Model adjustments**: • TEI: NR **Limitations**: • Methods for randomization and concealment NR; No preregistered data analysis plan **Funding**: USDA

Table 19. Risk of bias for randomized controlled trials examining portion size and energy intake in adults and older adults[b]

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Haynes, 2020a[29]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Gough, 2021[30]	LOW	NOT APPLICABLE	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Cunningham, 2023b[31]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Robinson, 2018[32]	SOME CONCERNS	NOT APPLICABLE	LOW	SOME CONCERNS	LOW	LOW	SOME CONCERNS
Rolls, 2010[33]	SOME CONERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Langfield, 2023[35]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Rolls, 2004b[36]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Cunningham, 2023a[37]	LOW	LOW	LOW	LOW	LOW	LOW	LOW
Cahaydi, 2019[38]	SOME CONCERNS	LOW	LOW	HIGH	LOW	SOME CONCERNS	HIGH
Zuraikat, 2016[39]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Almiron-Roig, 2015[40]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Rolls, 2002[41]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Rosenthal, 2017[42]	SOME CONCERNS	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Roe, 2016[43]	SOME CONERNS	LOW	LOW	LOW	LOW	LOW	SOME CONCERNS
Levitsky, 2004[44]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Zuraikat, 2018a[45]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Zuraikat, 2018c[46]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Long, 2023[47]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Jeffery, 2007[48]	SOME CONCERNS	LOW	SOME CONCERNS	LOW	HIGH	SOME CONCERNS	HIGH
Rolls, 2006a[49]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Rolls, 2006b[50]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Kelly, 2009[51]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Rolls, 2007[52]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Levitsky, 2020[53]	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Rolls, 2004c[54]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Williams, 2014[55]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Shimpo, 2018[56]	SOME CONCERNS	LOW	LOW	HIGH	LOW	SOME CONCERNS	HIGH
Rolls, 2004a[57]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Flood, 2006[58]	SOME CONCERNS	LOW	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Zuraikat, 2018b[59]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Ziylan, 2016[60]	SOME CONCERNS	LOW	SOME CONCERNS	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Lewis, 2015[61]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Burger, 2011[62]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Kral, 2004[63]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Haynes, 2020b[64]	LOW	LOW	LOW	SOME CONCERNS	LOW	LOW	SOME CONCERNS
Ellahi, 2022[65]	LOW	SOME CONCERNS	LOW	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Robinson, 2015[66]	SOME CONCERNS	NOT APPLICABLE	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Marchiori, 2014[67]	SOME CONCERNS	NOT APPLICABLE	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Reily, 2016[68]	SOME CONCERNS	NOT APPLICABLE	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Raghoebar, 2019[69]	SOME CONCERNS	NOT APPLICABLE	LOW	LOW	LOW	LOW	SOME CONCERNS
Fisher, 2007a[21]	SOME CONCERNS	LOW	LOW	LOW	LOW	SOME CONCERNS	SOME CONCERNS

Table 20. Risk of bias for non-randomized controlled trials examining portion size and energy intake in adults and older adults[c]

Article	Confounding	Exposure measurement	Selection of participants	Post-exposure interventions	Missing data	Outcome measurement	Selection of the reported result	Overall risk of bias
Berkowitz, 2016[34]	CRITICAL	LOW	LOW	SERIOUS	LOW	MODERATE	LOW	VERY HIGH
Diliberti, 2004[70]	SERIOUS	LOW	LOW	LOW	LOW	LOW	MODERATE	HIGH

[a] Abbreviations: RCT: Randomized Controlled Trial; U.K.: United Kingdon; U.S.: United States; y: years; BMI: Body Mass Index; kg/m^2: Kilograms per meters squared; kJ: kilojoule; kcal/d: kilocalories per day; SE: Standard Error; SD: Standard Deviation; NR: Not Reported; HHI: Household Income; HS: High school; iVR: Virtual reality; PA: Physical activity; mm: millimeters; TEI: Total Energy Intake; g: gram; Kcal: kilocalorie; fl. oz: Fluid ounce; NS: Not significant; NA: Not applicable; NRCT: non-randomized controlled trial; EAT: Eating Attitudes Test; PS: Portion size; ED: Energy density; SEP: socioeconomic position; Inc: incorporated; NIH: National Institutes of Health; NIFA: National Institute of Food and Agriculture; USDA: United States Department of Agriculture; JSPS: Japan Society for the Promotion of Science; TV: Television; $50k: $50,000; vs.: versus; ~: approximately; meals/d: meals per day; UR: University and Research

[b] Possible ratings of low, some concerns, or high determined using the "Cochrane Risk-of-bias 2.0" (RoB 2.0) (August 2019 version)" (Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366**: l4898. doi:10.1136/bmj.l4898.)

[c]Possible ratings of low, moderate, serious, critical, or no information determined using the "Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool" (Sterne JAC, Hernán MA, Reeves BC, et al. ROBINS-I: a tool for assessing risk of bias in non-randomized studies of interventions. *BMJ* 2016; 355; i4919. doi: 10.1136/bmj.i4919.)

Table 21. Evidence examining the relationship between pre-portioned foods and energy intake in young children, children, and adolescents[a]

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Marchiori, 2012[28] **RCT-Parallel, Belgium** Baseline N=85, Analytic N=77 (Attrition: 9% **Study objective**: To examine the influence of altering the size of snack food (i.e., small vs large cookies) on short-term energy intake. **Participant characteristics at baseline**: Children • Age: 9.2 (2.5) y • Female: 55% • Race and/or ethnicity: Belgian nationality: 86% • Socioeconomic position: NR • Anthropometry: BMI percentile: 41 (20.9) % • Physical activity: Exercise (h/wk): 3.8 (2) • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Presence of food allergies, overweight, weight problems, dieting behavior, food intake control in order to gain or lose weight, and lack of hunger	**Intervention**: Group 1: Small cookie size, 36 half-sized (3.5g/each) (126 g total) Group 2: Large cookie size, 18 normal-sized (7g/each) (126 g total) *Snack (cookies)* **Duration**: 1 snack for 2 sessions **Compliance**: Eight excluded based on exclusion criteria **Outcomes and assessment methods**: Subtracted the number of cookies left from initial count. Before and after test meal.	**Energy intake from the snack**: Group 1 (small cookies): 274 Group 2 (large cookies): 342 p<0.05	**Limitations**: Methods for randomization and concealment NR; Concerns with validity and reliability of outcome assessment method; No preregistered data analysis plan **Funding**: National Research Fund, Luxembourg

[a] Abbreviations: RCT: Randomized controlled trial; y: years; NR: Not reported; BMI: body mass index; h/wk: hours per week; TEI: total energy intake; g: grams

Table 22. Risk of bias for randomized controlled trials examining pre-portioned foods and energy intake in young children, children, and adolescents*

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
Marchiori, 2012[28]	SOME CONCERNS	NOT APPLICABLE	LOW	LOW	HIGH	SOME CONCERNS	HIGH

* Possible ratings of low, some concerns, or high determined using the "Cochrane Risk-of-bias 2.0" (RoB 2.0) (August 2019 version)" (Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366**: l4898. doi:10.1136/bmj.l4898.)

Table 23. Evidence examining the relationship between pre-portioned foods and energy intake in adults and older adults[a]

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
French, 2014[71] **RCT-Parallel, U.S.** Baseline N=233, Analytic N=229 (Attrition: 2%) **Study objective**: To examine the effect of weekday exposure over 6 months to different lunch sizes on energy intake and body weight in a free-living sample of working adults **Participant characteristics at baseline**: Adults • Age: 42.6 (11.2) y • Female: 67% • Race and/or ethnicity: White: 69% • Socioeconomic position: College degree or more: 52%; Income, $40-80k: 42%; >$80k: 37%; Married/living with partner: 59% • Anthropometry: BMI: 29.8 (6.4) kg/m^2 • Physical activity: Moderate/vigorous, mins/d: 27.5 (17.2) • Smoking: 100% nonsmokers • TEI: Baseline: 2012 (679) kcal/d • Habitual diet at baseline: NR **Excluded from study or analysis**: Smokers, non-English speaking, taking medications that affect appetite or body weight; unable to pick up lunches; allergic to or unwilling to eat study foods; currently on a diet to lose weight; eating disorder; planning to move; currently taking part in another research study; currently pregnant, nursing, or pregnant in the last 12 months	**Intervention**: Box lunch: 400kcal, Mon-Fri Box lunch: 800kcal, Mon-Fri Box lunch: 1600kcal, Mon-Fri Control: Habitual lunch intake *Lunch (sandwiches or salads)* **Duration**: 6 months **Compliance**: 91% of the lunches were picked up **Outcomes and assessment methods**: 3, 24-hour recalls Baseline, 1 month, 3 months, 6 months	**Energy intake at lunch, total and rate of change**: 400kcal box lunch: 417 (30), -16.2 800kcal box lunch: 557 (29), 0.5 1600kcal box lunch: 636 (30), 16.9 Control: 492 (28), -7.9 Between groups: 1600kcal vs other conditions: P<0.05 800kcal vs 400 kcal: P<0.05 Within groups: Rate of change was significant for 400kcal and 1600 kcal, P<0.05 **Energy intake, total daily and rate of change:** 400kcal box lunch: 1718 (70), -40.1 800kcal box lunch: 1792 (68), -33.2 1600kcal box lunch: 1996 (71), -0.66 Control: 1938 (66), -11.1 Between groups: 1600kcal vs 400kcal, 800kcal: P<0.05 1600kcal vs control: P=NS 800kcal vs 400kcal, control: P=NS 400kcal vs control: P<0.05 Within groups: Rate of change was significant for 400kcal and 800 kcal, P<0.05	**Limitations**: Methods for randomization concealment NR, and concerns that randomization was not successful due to baseline differences; Minimal information provided about adherence to the study protocol; Unclear why rate of change outcomes were reported but mean data at the same timepoints were not; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Haire, 2014[72] **RCT-Parallel, U.S.** Baseline N=67, Analytic N=64 (Attrition: 4%) **Study objective**: To examine whether weight and restraint status influence the relationship between package size and consumption **Participant characteristics at baseline**: Adults • Age: ~24 (3) y • Female: 47% • Race and/or ethnicity: White: ~81% • Socioeconomic position: Some college education: ~78% • Anthropometry: BMI: ~22 kg/m^2 ("normal weight" group) ~30 kg/m^2 (overweight-obesity group) • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: High or low dietary restraint scores, does not like or allergic to the study food, health condition or medication use that affects eating or requires a therapeutic diet, unable to attend study visits, pregnant or breastfeeding	**Intervention**: Group 1: Single serving packages, 22, 0.9 oz packages of pretzels Group 2: Standard packages, 2, 10 oz packages of pretzels *Snack (pretzels)* **Duration**: 4 days **Compliance**: Three excluded for non-compliance (didn't return pretzels or ate all the pretzels) **Outcomes and assessment methods**: Weighed food intake Before and after 4 day test session	**Energy intake from the snack**: Condition 2 (Large package): 1150 (81) kcal Condition 1 (Control): 1030 (71) kcal P=0.04	**Limitations**: Subjects ate pretzels in a free-living setting, so unaccounted for non-compliance or measurement error is possible; Did not account for the rest of the diet **Funding**: No funding

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Raynor, 2009[73] **RCT-Parallel, U.S.** Baseline N=24, Analytic N=19 (Attrition: 21%) **Study objective**: To examine the effects of providing breakfast foods in single-serving packages and non-portioned packages on energy intake of these foods during an 8-week behavioral weight-loss program **Participant characteristics at baseline**: Adults • Age: ~50.5 (9) y • Female: 95% • Race and/or ethnicity: White: 100%; Non-Hispanic: 100% • Socioeconomic position: Some college or above: ~89%; NR; Married: ~63% • Anthropometry: BMI: 31.8 (4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: All regularly consumed breakfast 4 d/wk or more **Excluded from study or analysis**: Do not consume breakfast at least 4 d/week, lactose-intolerant, allergic to or would not eat the provided foods, could not engage in physical activity, were participating in a weight-loss program and/or taking weight-loss medication or lost 5% of body weight during the past 6 months, unavailable for weekly meetings during the program, or were either pregnant, lactating, or <6 months postpartum, or planned to become pregnant during the investigation	**Intervention**: Group 1: Single-serve portion breakfast + behavioral intervention Group 2: Standard, non-portioned breakfast + behavioral intervention All subjects received the same breakfast foods: Cereal (22, 0.68oz boxes vs 1, 15oz box) and peaches (12, 4oz cans vs 3, 15oz cans) (weeks 1, 3, 5, 7) Applesauce (12, 4oz cans vs. 3, 15oz cans) and cheese (16, 1oz blocks vs 2, 10oz blocks) (weeks 2, 4, 6, 8) Breakfast (cereal and peaches; cheese and applesauce) **Duration**: 8 weeks **Compliance**: Five excluded for scheduling conflicts **Outcomes and assessment methods**: Weighed food intake Weekly	**Energy intake per day from cereal and peaches (combined, cereal, peaches)**: Group 1: 117.0 (3.2) kcal, 80.2 (2.9) kcal, 36.8 (0.3) kcal Group 2: 143.5 (39.3), 106.3 (22.9) kcal, 37.2 (18.4) kcal Combined, P<0.05 Cereal, P<0.01 Peaches, P=0.10 **Energy intake per day from applesauce and cheese (combined, applesauce, cheese)**: Group 1: 174.2 (13.5) kcal, 44.5 (0.6) kcal, 129.7 (13.4) kcal Group 2: 199 (29.4) kcal, 59.3 (5) kcal, 139.6 (26.1) kcal Combined, P<0.05 Applesauce, P<0.01 Cheese, P=0.10	**Limitations**: Methods for randomization and concealment NR; Did not describe dietary intake of non-study foods, so effects on total energy intake are not known; Power NR; Due to the free-living study design, compliance is not clear; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Reister, 2022[74] **RCT-Crossover, U.S.** Baseline N=31, Analytic N=30 (Attrition: 3%) **Study objective**: To examine whether snack package size and variety influence free-living snacking behavior in healthy adults **Participant characteristics at baseline**: Adults • Age: 23.6 (0.8) y • Female: 93% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 22.8 (0.5) kg/m^2 • Physical activity: NR • Smoking: 100% non-smokers • TEI: NR • Habitual diet at baseline: All regularly consumed snacks between lunch and dinner **Excluded from study or analysis**: Diabetic or other disease, following or previously followed in the past 6 months a weight loss or other special diet, smokers, eating disorder, not habitual snackers	**Intervention**: Condition 1: Control, provided with commonly consumed snacks Condition 2: Large package, provided with snacks in larger package sizes Subjects were provided with all food consumed over each 3-d session (compulsory breakfast, lunch, and dinner) *Snack (variety)* **Duration**: 3 days for 3 sessions **Compliance**: One excluded for snack intake data that was an extreme outlier **Outcomes and assessment methods**: Weighed food intake Before and after each 3-day session	**Energy intake from the snack**: Condition 2: 1150 (81) kcal Condition 1: 1030 (71) kcal P=0.04	**Limitations**: Methods for randomization and concealment NR; Did not describe compliance **Funding**: Sabra Dipping Company, LLC

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Rolls, 2017[75] **RCT-Parallel, U.S.** Baseline N=186, Analytic N=151 (Attrition: 19%) **Study objective**: To test whether the efficacy of a behavioral weight-loss program was improved by incorporating either of the two portion-control strategies instead of standard advice about eating less **Participant characteristics at baseline**: Adults • Age: 50 (11) y • Female:100% • Race and/or ethnicity: White: 98%; African American: 1%; More than 1 race: 1%; Hispanic: 1% (Not Hispanic: 99%) • Socioeconomic position: Some college: 30%, College degree: 31%, Graduate degree: 25% • Anthropometry: BMI: ~34 kg/m^2 • Physical activity: Steps per day: ~6500 • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: Blood pressure >160/100 mm Hg, reported a weight change >4.5 kg in the past 3 months, had a medical condition that precluded participation or that limited the physical activity, were following a special diet or weight-loss program, were pregnant or lactating, scored >19 on the Eating Attitudes Test or >25 on the Beck Depression Inventory, did not complete all activities during 2-week run-in	**Intervention**: **Pre-portioned foods**: Instructed to structure their meals and to learn appropriate food portions by using pre-portioned foods, such as individual servings of main dishes, side dishes, snacks, yogurt and whole fruits. Participants were instructed to eat pre-portioned main dishes daily for lunch and dinner during months 1–3 of the trial and were encouraged to continue this practice subsequently. Given pre-paid vouchers for single-serving main dishes (14 vouchers per week in month 1) Portion selection: Instructed to choose food portions based on ED in order to eat satisfying portions of low-ED foods and to control portions of higher-ED foods. Were provided with portion-selection tools (food scale, household measures, placemat for appropriate portions, card for portion estimations using common objects) Standard advice: Follow dietary guidelines that emphasized eating less while making healthy choices from all food groups; Self-selected foods **Duration**: 12 months **Compliance**: Thirty-five were lost to follow-up at 1 year **Outcomes and assessment methods**: 3, 24-hour recalls Baseline, 3 months	**Change in energy intake from baseline to 3mo, all groups combined:** -387 (686) kcal per day Within groups, P<0.0001 **Change in energy intake (kcal), baseline vs. 3 month, between groups:** Standard advice: 1968 (661) kcal vs. 1518 (495) kcal Portion selection: 1799 (635) kcal vs. 1539 (525) kcal Pre-portioned: 1887 (593) kcal vs. 1458 (487) kcal Between groups, P=NS	**Limitations**: None **Funding**: NIH; Food vouchers from ConAgra Foods, Inc, Nestlé USA.

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Devitt, 2004[76] **RCT-Crossover, U.S**. Baseline N=26, Analytic N=20 (Attrition: 23%) **Study objective**: To examine the effects of food unit size (FU) and energy density (ED) on food consumption **Participant characteristics at baseline**: Adults • Age: 22.6 (5.8) y • Female: 45% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 25.3 (4.3) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: All regularly consumed 3 meal/d **Excluded from study or analysis**: Did not like study foods, did not follow a typical meal pattern of 3 meal/d	**Intervention**: Condition 1: Small food unit, low energy density Condition 2: Small food unit, high energy density Condition 3: Customary food unit, low energy density Condition 4: Customary food unit, high energy density *Entrees (omelet, wraps, pizza)* **Duration**: 1 day (breakfast, lunch, dinner) **Compliance**: Six excluded for not completing all sessions **Outcomes and assessment methods**: Weighed food intake Before and after each test meal	**Energy intake at breakfast**: Condition 1: 299 (22) kcal Condition 2: 655 (38) kcal Condition 3: 378 (30) kcal Condition 4: 595 (53) kcal Main effect of unit size: P=NS Main effect of ED: P=0.0003 **Energy intake at lunch**: Condition 1: 273 (25) kcal Condition 2: 613 (70) kcal Condition 3: 229 (33) kcal Condition 4: 595 (98) kcal Main effect of unit size: P=NS Main effect of ED: P=0.045 **Energy intake at dinner**: Condition 1: 819 (62) kcal Condition 2: 983 (100) kcal Condition 3: 1004 (340) kcal Condition 4: 1074 (76) kcal Main effect of unit size: P=NS Main effect of ED: P=NS **Total daily energy intake**: Condition 1: 1391 (64) kcal Condition 2: 2250 (147) kcal Condition 3: 1611 (98) kcal Condition 4: 2264 (168) kcal Main effect of unit size: P=NS Main effect of ED: P=0.008	**Limitations**: Methods for randomization and concealment NR; Did not describe whether assignments were counterbalanced; Did not describe compliance; No preregistered data analysis plan **Funding**: NR

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
Raynor, 2007[77] **RCT-Parallel, U.S.** Baseline N=40, Analytic N=28 (Attrition: 30%) **Study objective:** To examine the independent effects of package unit size and amount of food on intake **Participant characteristics at baseline**: Adults • Age: 20 (1.6) y • Female: 57% • Race and/or ethnicity: White: 68% • Socioeconomic position: NR • Anthropometry: BMI: ~23 (2) kg/m^2 • Physical activity: NR • Smoking: 100% non-smokers • TEI: NR • Habitual diet at baseline: All regularly snack **Excluded from study or analysis**: Not healthy, smokers, following a weight loss diet, athlete in training, pregnant, breastfeeding, health condition or medication that affects eating or requires diet therapy, consumed snack foods <3 times/week, allergies to or dislike for study foods, restrained eater, binge eater	**Intervention**: Group 1: Small unit, small amount (5 bags of chips, 5 bags of crackers, 6 bags of cookies, 5 bags of candies), 4320 kcal Group 2: Small unit, large amount (10 bags of chips, 9 bags of crackers, 12 bags of cookies, 11 bags of candies), 8820 kcal Group 3: Large unit, small amount (1 bag of chips, 1 bag of crackers, 1 bag of cookies, 1 bag of candies), 4374 kcal Group 4: Large unit, large amount (2 bags of chips, 2 bags of crackers, 2 bags of cookies, 2 bags of candies), 8748 kcal Small and large unit conditions provided the same g weight of food, in different package/unit sizes Small and large amount conditions provided larger portions of the same foods *Snack (chips, cookies, crackers, candy)* **Duration**: 3-day period for 1 snack session **Compliance**: Six excluded for not attending a session, 4 rated the foods poorly, 2 had a BMI >30 kg/m^2 **Outcomes and assessment methods**: Weighed food intake Before and after the 3-day session	**Energy intake from the snack**: Portion size effect (Group 1/3 vs 2/4): 5028.1 (2596.1) vs. 2782.2 (1174.5) kcal, P<0.01 Unit size effect (Group 1/2 vs 3/4): 4026.8 (2313.1) kcal vs. 3783.4 (2335.1) kcal, P=NS Unit size/amount interaction, P=NS	**Limitations**: Methods for randomization and concealment NR; Baseline differences between groups in mean BMI may suggest problems with randomization; Did not account for consumption of other foods or snacking context during the 3-day session; Did not account for those who did not complete the study; Underpowered to detect a unit size effect; No preregistered data analysis plan **Funding**: NIH

Study and Population Characteristics	Intervention, Comparator, and Outcomes	Results	Confounding and Study Limitations
van Kleef, 2014[78] **RCT-Parallel, The Netherlands** Baseline N=165, Analytic N=NR (Attrition: NR) **Study objective**: To explore how perceptions of impulsivity mediate consumption effects of unit size. **Participant characteristics at baseline**: Adults • Age: 21.0 (2.4) y • Female: 63% • Race and/or ethnicity: NR • Socioeconomic position: NR • Anthropometry: BMI: 21.6 (2.4) kg/m^2 • Physical activity: NR • Smoking: NR • TEI: NR • Habitual diet at baseline: NR **Excluded from study or analysis**: NR	**Intervention**: Group 1: Large unit, no wrapper, 3 chocolate bars, 153 g, 684 kcal Group 2: Large unit, wrapper, 3 chocolate bars, 153 g, 684 kcal Group 3: Small unit, no wrapper, 15 chocolate bars, 150g, 675 kcal Group 4: Small unit, wrapper, 15 chocolate bars, 150g, 675 kcal *Snack (chocolate bars)* **Duration**: 1 snack session **Compliance**: NR **Outcomes and assessment methods**: Weighed food intake Before and after the test session	**Energy intake from the snack**: Group 1: 247.4 (108.9) kcal Group 2: 197.3 (118.8) kcal Group 3: 153.7 (91.1) kcal Group 4: 186.1 (97.8) kcal Main effect of unit size: P<0.01 (220.0 kcal vs. 170.5 kcal) Main effect of wrapper: P=0.44 Interaction effect of unit size and packaging: P<0.01, the unit size effect was primarily due to the unwrapped chocolate	**Limitations**: Methods for randomization and concealment NR; Participant inclusion and exclusion criteria not described; Did not describe compliance; No preregistered data analysis plan **Funding**: NR

Table 24. Risk of bias for randomized controlled trials examining pre-portioned foods and energy intake in adults and older adults[b]

Article	Randomization	Period and carryover effects	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of the reported result	Overall risk of bias
French, 2014[71]	HIGH	NOT APPLICABLE	SOME CONCERNS	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Haire, 2014[72]	LOW	NOT APPLICABLE	SOME CONCERNS	LOW	LOW	LOW	SOME CONCERNS
Raynor, 2009[73]	SOME CONCERNS	NOT APPLICABLE	SOME CONCERNS	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Reister, 2022[74]	SOME CONCERNS	LOW	SOME CONCERNS	LOW	LOW	LOW	SOME CONCERNS
Rolls, 2017[75]	LOW	NOT APPLICABLE	LOW	LOW	LOW	LOW	LOW
Devitt, 2004[76]	SOME CONCERNS	LOW	SOME CONCERNS	LOW	LOW	SOME CONCERNS	SOME CONCERNS
Raynor, 2007[77]	SOME CONCERNS	NOT APPLICABLE	SOME CONCERNS	SOME CONCERNS	LOW	SOME CONCERNS	SOME CONCERNS
Van Kleef, 2014[78]	SOME CONCERNS	NOT APPLICABLE	SOME CONCERNS	HIGH	LOW	SOME CONCERNS	SOME CONCERNS

[a] Abbreviations: RCT: Randomized controlled trial; y: years; $50k: $50,000; NR: Not reported; BMI: body mass index; kg/m^2: kilograms per meters squared; mins/d: minutes per day; kcal/d: kilocalories per day; kcal: kilocalories; NS: Not significant; NIH: National Institutes of Health; oz: ounces; d/wk: days per week; TEI: total energy intake; mo: month; wks: weeks; mm HG: millimeters of mercury; kg: kilograms; ED: Energy density; U.S./USA: United States/United States of America; Mon-Fri: Monday through Friday; LLC: Limited liability company; Inc.: Incorporated; meal/d: meal per day

[b] Possible ratings of low, some concerns, or high determined using the "Cochrane Risk-of-bias 2.0" (RoB 2.0) (August 2019 version)" (Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; **366**: l4898. doi:10.1136/bmj.l4898.)

Acknowledgments and funding

The Committee members were involved in establishing all aspects of the protocol, which presented the plan for how they would examine the scientific evidence, including the inclusion and exclusion criteria; reviewing all studies that met the criteria they set; deliberating on the body of evidence for each question; and writing and grading the conclusion statements. The NESR team, with assistance from Federal Liaisons and Project Leadership, supported the Committee by facilitating, executing, and documenting the work necessary to ensure the reviews were completed in accordance with NESR methodology.

The Committee and NESR staff thank staff from the National Institutes of Health (NIH), for coordinating the peer review of this systematic review, and the peer reviewers for their time and expertise.

The Committee and NESR staff thank other members of the NESR team (Brittany Kingshipp, PhD, Natasha Chong Cole, PhD, MPH, RD, Allison Webster, PhD, RD), Federal staff from USDA and HHS (Chinwe Obudulu, MS, RD, LD, Emily Levin, MPH, RDN, Elizabeth Rahavi, RD, Rachel Inman, RD, Sarah Karp, MNSP, RD, LDN, Dana DeSilva, PhD, RD, Meghan Adler, MS, RDN; Carolyn Chung, PhD), Contractor support by Panum Telecom, LLC, a wholly owned subsidiary of Aretum (Megan Lawless, PhD), and Project Leadership (Eve Stoody, PhD, Janet de Jesus, MS, RD).

Funding: United States Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Alexandria, VA

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Appendices

Appendix 1: Abbreviations

Table A 1. List of abbreviations

Abbreviation	Full name
BMI	Body Mass Index
FNS	Food and Nutrition Service
HHS	United States Department of Health and Human Services
NESR	Nutrition Evidence Systematic Review
NIH	National Institutes of Health
NICHD	National Institutes of Child Human Development
NRCT	Non-randomized Controlled Trial
RCT	Randomized Controlled Trial
USDA	United States Department of Agriculture

Appendix 2: Literature search strategy

This search was first run on June 26, 2023, and then periodically run using NESR's continuous evidence monitoring methods* until January 2024.

Database: PubMed
Provider: U.S. National Library of Medicine
Date(s) Searched: June 26, 2023 (initial search); June 26, 2023 – January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 2. Search for PubMed

Search #	Concept	String
#1	Portion size	Portion Size[MeSH] OR Serving Size[MeSH] OR serving size*[tiab] OR "size portion"[tiab:~3] OR "size portions"[tiab:~3] OR "size meal"[tiab:~3] OR "size meals"[tiab:~3] OR "size snack"[tiab:~3] OR "size snacks"[tiab:~3] OR "meal portion*"[tiab] OR "food portion*"[tiab] OR "portion control*"[tiab] OR "energy dens*"[tiab] OR "Caloric dens*"[tiab] OR "calorie dens*"[tiab] OR "nutrient dens*"[tiab] OR preportioned[tiab] OR "pre portioned"[tiab]
#2	Growth, body composition, and risk of obesity	"Adipose Tissue"[Mesh] OR "Body Composition"[Mesh] OR "Body Weights and Measures"[MeSH:NoExp] OR "Body Fat Distribution"[Mesh] OR "Body Mass Index"[Mesh] OR "Body Size"[Mesh] OR "Skinfold Thickness"[Mesh] OR "Waist-Hip Ratio"[Mesh] OR "Overnutrition"[Mesh] OR "Growth"[Mesh:NoExp] OR anthropometr*[tiab] OR body fat[tiab] OR fat mass[tiab] OR fat free mass[tiab] OR lean mass[tiab] OR obese[tiab] OR obesity[tiab] OR underweight[tiab] OR overweight[tiab] OR weight status[tiab] OR head circumference[tiab] OR arm circumference[tiab] OR calf circumference[tiab] OR neck circumference[tiab] OR thigh circumference[tiab] OR waist circumference[tiab] OR waist to hip ratio[tiab] OR waist hip ratio[tiab] OR body mass index[tiab] OR BMI[tiab] OR adipos*[tiab] OR body weight[tiab] OR body height[tiab] OR body size[tiab] OR body composition[tiab] OR overnutrition[tiab] OR wasting[tiab] OR healthy weight[tiab] OR skin fold[tiab] OR skin folds[tiab] OR skinfold[tiab] OR skinfolds[tiab] OR "Weight Reduction Programs"[Mesh] OR "Body-Weight Trajectory"[Mesh] OR "Weight Gain"[MeSH] OR "Weight Loss"[MeSH:NoExp] OR "Diet, Reducing"[Mesh] OR weight gain*[tiab] OR diet reduc*[tiab] OR weight cycling[tiab]

* USDA Nutrition Evidence Systematic Review Branch. Chapter 10: Continuous Evidence Monitoring. In: *USDA Nutrition Evidence Systematic Review: Methodology Manual*. February 2023. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. Available at: https://nesr.usda.gov/methodology-overview.

		OR weight decreas*[tiab] OR weight watch*[tiab] OR weight control*[tiab] OR weight retention[tiab] OR weight management[tiab] OR "maintain weight"[tiab:~4] OR "maintains weight"[tiab:~4] OR "maintaining weight"[tiab:~4] OR "maintained weight"[tiab:~4] OR "weight maintenance"[tiab:~4] OR "reduce weight"[tiab:~4] OR "reduces weight"[tiab:~4] OR "reducing weight"[tiab:~4] OR "reduced weight"[tiab:~4] OR "weight reduction"[tiab:~4] OR "lose weight"[tiab:~4] OR "loses weight"[tiab:~4] OR "losing weight"[tiab:~4] OR "lost weight"[tiab:~4] OR "weight loss"[tiab:~4] OR "change weight"[tiab:~4] OR "changes weight"[tiab:~4] OR "changing weight"[tiab:~4] OR "changed weight"[tiab:~4] OR "Growth Charts"[Mesh] OR growth chart*[tiab]OR stunting[tiab] OR stunted[tiab] OR weight for height[tiab] OR stature for age[tiab] OR weight for age[tiab] OR height for age[tiab] OR length for age[tiab] OR weight for length[tiab] OR failure to thrive[tiab]
#3	Energy intake	"Energy Intake"[MeSH] OR "energy intake"[tiab] OR "calorie intake"[tiab] OR "caloric intake"[tiab] OR "total energy"[tiab] OR "total calorie*"[tiab] OR "total caloric*"[tiab] OR "energy consum*"[tiab] OR "calorie consum*"[tiab] OR "caloric consum*"[tiab]
#4		#1 AND (#2 OR #3)
#5	Limits	#4 NOT ("Animals"[Mesh] NOT ("Animals"[Mesh] AND "Humans"[Mesh])) NOT (editorial[ptyp] OR comment[ptyp] OR commentary[tiab] OR news[ptyp] OR letter[ptyp] OR review[ptyp] OR systematic review[ptyp] OR systematic review[ti] OR meta-analysis[ptyp] OR meta-analysis[ti] OR meta-analyses[ti] OR protocol[ti] OR retracted publication[ptyp] OR retraction of publication[ptyp] OR retraction of publication[tiab] OR retraction notice[ti] OR "retracted publication"[ti] OR "Congress"[Publication Type] OR "Consensus Development Conference"[Publication Type] OR "conference abstract*"[tiab] OR "conference proceeding*"[tiab] OR "conference paper*"[tiab] OR "practice guideline"[ptyp] OR "practice guideline"[ti]) Filters applied: English, from 2000/1/1 - 3000/12/12.

Database: Embase

Provider: Elsevier
Date(s) Searched: June 26, 2023 (initial search); June 26, 2023 – January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 3. Search for Embase

Search #	Concept	String
#1	Portion Size	'Portion Size'/exp OR 'serving size*':ab,ti OR (size NEAR/4 (portion* OR meal* OR snack*)):ab,ti OR 'meal portion*':ab,ti OR 'food portion*':ab,ti OR 'portion control*':ab,ti OR 'energy dens*':ab,ti OR 'Caloric dens*':ab,ti OR 'calorie dens*':ab,ti OR 'nutrient dens*':ab,ti OR preportioned:ab,ti OR 'pre portioned':ab,ti
#2	Growth, body composition, and risk of obesity	'adipose tissue'/exp OR 'body composition'/exp OR 'anthropometry'/de OR 'body mass'/exp OR 'anthropometric parameters'/exp OR 'skinfold thickness'/exp OR 'overnutrition'/exp OR 'growth'/de OR 'anthropometr*':ab,ti OR 'body fat':ab,ti OR 'fat mass':ab,ti OR 'fat free mass':ab,ti OR 'lean mass':ab,ti OR 'obese':ab,ti OR 'obesity':ab,ti OR 'underweight':ab,ti OR 'overweight':ab,ti OR 'weight status':ab,ti OR 'head circumference':ab,ti OR 'arm circumference':ab,ti OR 'calf circumference':ab,ti OR 'neck circumference':ab,ti OR 'thigh circumference':ab,ti OR 'waist circumference':ab,ti OR 'waist to hip ratio':ab,ti OR 'waist hip ratio':ab,ti OR 'body mass index':ab,ti OR 'BMI':ab,ti OR 'adipos*':ab,ti OR 'body weight':ab,ti OR 'body height':ab,ti OR 'body size':ab,ti OR 'body composition':ab,ti OR 'overnutrition':ab,ti OR 'wasting':ab,ti OR 'healthy weight':ab,ti OR 'skin fold*':ab,ti OR 'skinfold*':ab,ti OR 'body weight management'/exp OR 'body weight change'/exp OR 'weight gain*':ab,ti OR 'diet reduc*':ab,ti OR 'weight cycling':ab,ti OR 'weight watch*':ab,ti OR 'weight control*':ab,ti OR 'weight retention':ab,ti OR 'weight management':ab,ti OR (weight NEAR/4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*)):ab,ti OR 'weight chart'/exp OR 'growth chart*':ab,ti OR stunting:ab,ti OR stunted:ab,ti OR 'weight for height':ab,ti OR 'stature for age':ab,ti OR 'weight for age':ab,ti OR 'height for age':ab,ti OR 'length for age':ab,ti OR 'weight for length':ab,ti OR ' failure to thrive':ab,ti
#3	Energy intake	'caloric intake'/exp OR 'energy intake':ab,ti OR 'calorie intake':ab,ti OR 'caloric intake':ab,ti OR 'total energy':ab,ti OR 'total calorie*':ab,ti OR 'total caloric*':ab,ti OR 'energy consum*':ab,ti OR 'calorie consum*':ab,ti OR 'caloric consum*':ab,ti
#4		#1 AND (#2 OR #3)
#5	Limits	#4 AND ([article]/lim OR [article in press]/lim) NOT ([animals]/lim NOT ([animals]/lim AND [humans]/lim)) AND [english]/lim

		NOT ([conference abstract]/lim OR [conference paper]/lim OR [conference review]/lim OR [editorial]/lim OR [erratum]/lim OR [letter]/lim OR [note]/lim OR 'retraction of publication':ab,ti OR 'retraction notice':ti OR 'retracted publication':ab,ti OR [review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR 'practice guideline':ti OR 'protocol':ti) AND [2000-2024]/py

Database: Cochrane Central Register of Controlled Trials (CENTRAL)

Provider: John Wiley & Sons
Date(s) Searched: June 26, 2023 (initial search); June 26, 2023 – January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 4. Search for Cochrane CENTRAL

Search #	Concept	String
#1	Portion size	[mh “Portion Size”] OR [mh “Serving Size”] OR ((serving NEXT size*) OR (size NEAR/4 (portion* OR meal* OR snack*)) OR (meal NEXT portion*) OR (food NEXT portion*) OR (portion NEXT control*) OR (energy NEXT dens*) OR (Caloric NEXT dens*) OR (calorie NEXT dens*) OR (nutrient NEXT dens*) OR preportioned OR "pre portioned"):ti,ab,kw
#2	Growth, body composition, and risk of obesity	([mh "Adipose Tissue"] OR [mh "Body Composition"] OR [mh ^"Body Weights and Measures"] OR [mh "Body Fat Distribution"] OR [mh "Body Mass Index"] OR [mh "Body Size"] OR [mh "Skinfold Thickness"] OR [mh "Waist-Hip Ratio"] OR [mh Overnutrition] OR [mh ^Growth] OR anthropometr* OR “body fat” OR “fat mass” OR “fat free mass” OR “lean mass” OR obese OR obesity OR underweight OR overweight OR “weight status” OR “head circumference” OR “arm circumference” OR “calf circumference” OR “neck circumference” OR “thigh circumference” OR “waist circumference” OR “waist to hip ratio” OR “waist hip ratio” OR “body mass index” OR BMI OR adipos* OR “body weight” OR “body height” OR “body size” OR “body composition” OR overnutrition OR wasting OR “healthy weight” OR “skin fold” OR “skin folds” OR skinfold OR skinfolds):ti,ab,kw OR ([mh "Weight Reduction Programs"] OR [mh "Body-Weight Trajectory"] OR [mh "Weight Gain"] OR [mh ^“Weight Loss”] OR [mh "Diet, Reducing"] OR “diet reduc*” OR “weight cycling” OR “weight watch*” OR “weight control*” OR “weight retention” OR “weight management”):ti,ab,kw OR ((weight NEAR/4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*)) OR [mh “Growth Charts”] OR “growth chart*” OR stunting OR stunted OR “weight for height” OR “stature for age” OR “weight for age” OR “height for age” OR

		“length for age” OR “weight for length” OR “ failure to thrive”):ti,ab,kw
#3	Energy intake	[mh "Energy Intake"] OR ("energy intake" OR "calorie intake" OR "caloric intake" OR "total energy" OR (total NEXT calorie*) OR (total NEXT caloric*) OR (energy NEXT consum*) OR (calorie NEXT consum*) OR (caloric NEXT consum*)):ti,ab,kw
#4		#1 AND (#2 OR #3) In Trials. Word variations have been searched. Year First Published: 2000-2024

Database: CINAHL

Provider: EBSCO
Date(s) Searched: June 26, 2023 (initial search); June 26, 2023 – January 9, 2024 (continuous evidence monitoring)
Dates Covered: January 1, 2000 – January 9, 2024

Table A 5. Search for CINAHL

Search #	Concept	String
#1	Portion size	(MH “Portion Size”) OR AB (“serving size*” OR (size NEAR/4 (portion* OR meal* OR snack*)) OR “meal portion*” OR “food portion*” OR “portion control*” OR “energy dens*” OR “Caloric dens*” OR “calorie dens*” OR “nutrient dens*” OR preportioned OR “pre portioned”) OR TI (“serving size*” OR (size NEAR/4 (portion* OR meal* OR snack*)) OR “meal portion*” OR “food portion*” OR “portion control*” OR “energy dens*” OR “Caloric dens*” OR “calorie dens*” OR “nutrient dens*” OR preportioned OR “pre portioned”)
#2	Growth, body composition, and risk of obesity	(MH “Adipose Tissue+”) OR (MH "Body Composition+") OR (MH "Body Weights and Measures") OR (MH "Arm Circumference") OR (MH "Body Height") OR (MH "Body Mass Index") OR (MH "Body Size") OR (MH "Body Weight+") OR (MH "Crown-Rump Length") OR (MH "Waist Circumference") OR (MH "Waist-Hip Ratio") OR (MH "Skinfold Thickness") OR (MH "Obesity+") OR (MH "Overnutrition") OR (MH "Growth") OR (TI anthropometr* OR “body fat” OR “fat mass” OR “fat free mass” OR “lean mass” OR obese OR obesity OR underweight OR overweight OR “weight status” OR “head circumference” OR “arm circumference” OR “calf circumference” OR “neck circumference” OR “thigh circumference” OR “waist circumference” OR “waist to hip ratio” OR “waist hip ratio” OR “body mass index” OR BMI OR adipos* OR “body weight” OR “body height” OR “body size” OR “body composition” OR overnutrition OR wasting OR “healthy weight”

		OR “skin fold” OR “skin folds” OR skinfold OR skinfolds) OR (AB anthropometr* OR “body fat” OR “fat mass” OR “fat free mass” OR “lean mass” OR obese OR obesity OR underweight OR overweight OR “weight status” OR “head circumference” OR “arm circumference” OR “calf circumference” OR “neck circumference” OR “thigh circumference” OR “waist circumference” OR “waist to hip ratio” OR “waist hip ratio” OR “body mass index” OR BMI OR adipos* OR “body weight” OR “body height” OR “body size” OR “body composition” OR overnutrition OR wasting OR “healthy weight” OR “skin fold” OR “skin folds” OR skinfold OR skinfolds) OR (MH “Weight Reduction Programs”) OR (MH "Body Weight Changes") OR (MH "Weight Gain+") OR (MH "Weight Loss") OR (MH "Diet, Reducing") OR (TI “diet reduc*” OR “weight cycling” OR “weight watch*” OR “weight control*” OR “weight retention” OR “weight management”) OR (AB “diet reduc*” OR “weight cycling” OR “weight watch*” OR “weight control*” OR “weight retention” OR “weight management”) OR (TI (weight N4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*))) OR (AB (weight N4 (decreas* OR gain* OR maint* OR reduc* OR loss* OR chang*))) OR (TI “growth chart*” OR stunting OR stunted OR “weight for height” OR “stature for age” OR “weight for age” OR “height for age” OR “length for age” OR “weight for length” OR “failure to thrive”) OR (AB “growth chart*” OR stunting OR stunted OR “weight for height” OR “stature for age” OR “weight for age” OR “height for age” OR “length for age” OR “weight for length” OR “failure to thrive”)
#3	Energy intake	(MH "Energy Intake") OR TI ("energy intake" OR "calorie intake" OR "caloric intake" OR "total energy" OR "total calorie*" OR "total caloric*" OR "energy consum*" OR "calorie consum*" OR "caloric consum*") OR AB ("energy intake" OR "calorie intake" OR "caloric intake" OR "total energy" OR "total calorie*" OR "total caloric*" OR "energy consum*" OR "calorie consum*" OR "caloric consum*")
#4		S1 AND (S2 OR S3)
#5	Limits	S4 NOT ((MH "Animals+") OR (MH "Animal Studies")) NOT ((MH "Literature Review") OR (MH "Meta Analysis") OR (MH "Systematic Review") OR (MH "News") OR (MH "Retracted Publication") OR (MH "Retraction of Publication)) Limiters - English Language, Expanders - Apply equivalent subject Published Date: 20000101-20240109

Appendix 3: Excluded articles

The following table lists the articles excluded after full-text screening for this systematic review question. At least one 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.

Table A 6. Articles excluded after full-text screening

	Citation	Exclusion Reason
1	Factors influencing restaurant portion sizes and subsequent energy intake. *Nat Clinic Pract Endocrinol Metab.* 2007.3:792. doi:10.1038/ncpendmet0656	Publication status
2	High-tech approach to portion control aids kids. *Care Management*. 2010.16:27-27.	Study design
3	Portion markers aid weight loss. *Nursing Times*. 2007.103:7-7	Study design
4	Portion-control plate is an effective tool to induce weight loss. *Nat Clin Pract Endocrinol Metab*. 2007. 3:675-676. doi:10.1038/ncpendmet0604	Publication status; Study design
5	Abeywickrema, S.,Peng, M. The Role of Tableware Size in Healthy Eating-Effects on Downstream Food Intake. *Foods*. 2023;12(6):1230. doi:10.3390/foods12061230	Intervention/exposure
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	Approach. *Int J Environ Res Public Health*. 2021;18(20):10582. doi:10.3390/ijerph182010582	
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142	Libotte E, Siegrist M, Bucher T. The influence of plate size on meal composition. Literature review and experiment. *Appetite*. 2014;82:91-96. doi:10.1016/j.appet.2014.07.010	Outcome; Intervention/exposure
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202	Raynor HA, Van Walleghen EL, Bachman JL, Looney SM, Phelan S, Wing RR. Dietary energy density and successful weight loss maintenance. *Eat Behav*. 2011;12(2):119-125. doi:10.1016/j.eatbeh.2011.01.008	Intervention/exposure; Study design
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204	Reynolds JP, Ventsel M, Kosīte D, et al. Impact of decreasing the proportion of higher energy foods and reducing portion sizes on food purchased in worksite cafeterias: A stepped-wedge randomised controlled trial. *PLoS Med*. 2021;18(9):e1003743. doi:10.1371/journal.pmed.1003743	Outcome
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208	Robinson E, Haynes A. Individual differences and moderating participant characteristics in the effect of reducing portion size on meal energy intake: Pooled analysis of three randomized controlled trials. *Appetite*. 2021;159:105047. doi:10.1016/j.appet.2020.105047	Study design
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	Healthy. *J Spec Pediatr Nurs*. 2012;17(4):312-320. doi:10.1111/j.1744-6155.2012.00340.x	
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242	Smith KR. Weight loss through behavior modification. *Health Care Food Nutr Focus*. 2005. 22:8-11.	Study design
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246	Sossen L, Bonham M, Porter J. An investigation of recommended serve food portions and attaining energy and protein requirements in older adults living in residential care. *J Hum Nutr Diet*. 2021;34(2):374-383. doi:10.1111/jhn.12824	Comparator; Intervention/exposure
247	Spill MK, Birch LL, Roe LS, Rolls BJ. Hiding vegetables to reduce energy density: an effective strategy to increase children's vegetable intake and reduce energy intake. *Am J Clin Nutr*. 2011;94(3):735-741. doi:10.3945/ajcn.111.015206	Intervention/exposure
248	Spiro A, Chambers L, Miller R. Childhood obesity and portion control in preschool children. Nursing in Practice: The Journal for Today's Primary Care Nurse. 2016.1-3	Publication status; Study design
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259	Tey SL, Salleh N, Henry CJ, Forde CG. Effects of Consuming Preloads with Different Energy Density and Taste Quality on Energy Intake and Postprandial Blood Glucose. *Nutrients*. 2018;10(2):161. Published 2018 Jan 31. doi:10.3390/nu10020161	Intervention/exposure
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262	Torbahn G, Gellhaus I, Koch B, et al. Reduction of Portion Size and Eating Rate Is Associated with BMI-SDS Reduction in Overweight and Obese Children and Adolescents: Results on Eating and Nutrition Behaviour from the Observational KgAS Study. *Obes Facts*. 2017;10(5):503-516. doi:10.1159/000480517	Study design
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274	Vargas-Alvarez MÁ, Brunstrom JM, Díaz AE, Navas-Carretero S, Martínez JA, Almiron-Roig E. Portion control tableware differentially impacts eating behaviour in women with and without overweight. *Appetite*. 2023.(185):106542. doi:10.1016/j.appet.2023.106542	Intervention/exposure
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278	Vermeer WM, Steenhuis IH, Leeuwis FH, Bos AE, de Boer M, Seidell JC. View the label before you view the movie: a field experiment into the impact of portion size and Guideline Daily Amounts labelling on soft drinks in cinemas. *BMC Public Health*. 2011;11:438. Published 2011 Jun 6. doi:10.1186/1471-2458-11-438	Intervention/exposure
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280	Vermote M, Versele V, Stok M, et al. The effect of a portion size intervention on French fries consumption, plate waste, satiety and compensatory caloric intake: an on-campus restaurant experiment. *Nutr J*. 2018;17(1):43. Published 2018 Apr 13. doi:10.1186/s12937-018-0352-z	Outcome
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291	Wilkinson LL, Ferriday D, Bosworth ML, et al. Keeping Pace with Your Eating: Visual Feedback Affects Eating Rate in Humans. *PLoS One*. 2016;11(2):e0147603. doi:10.1371/journal.pone.0147603	Intervention/exposure
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294	Wolever TMS, van Klinken BJ, Spruill SE, Jenkins AL, Chu Y, Harkness L. Effect of serving size and addition of sugar on the glycemic response elicited by oatmeal: A randomized, cross-over study. *Clin Nutr ESPEN*. 2016;16:48-54. doi:10.1016/j.clnesp.2016.07.003	Outcome; Intervention/exposure
295	Yeomans MR, Gould NJ, Leitch M, Mobini S. Effects of energy density and portion size on development of acquired flavour liking and learned satiety. *Appetite*. 2009;52(2):469-478. doi:10.1016/j.appet.2008.12.010	Comparator; Intervention/exposure
296	Yip W, Wiessing KR, Budgett S, Poppitt SD. Using a smaller dining plate does not suppress food intake from a buffet lunch meal in overweight, unrestrained women. *Appetite*. 2013;69:102-107. doi:10.1016/j.appet.2013.05.017	Intervention/exposure
297	Young MD, Lubans DR, Collins CE, Callister R, Plotnikoff RC, Morgan PJ. Behavioral mediators of weight loss in the SHED-IT community randomized controlled trial for overweight and obese men. *Ann Behav Med*. 2015;49(2):286-292. doi:10.1007/s12160-014-9657-0	Intervention/exposure
298	Zhao L, Teong XT, Liu K, et al. Eating architecture in adults at increased risk of type 2 diabetes: associations with body fat and glycaemic control. *Br J Nutr*. 2022;128(2):324-333. doi:10.1017/S0007114521002944	Outcome; Intervention/exposure; Study design
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303	Zuraikat FM, St-Onge MP, Makarem N, Boege HL, Xi H, Aggarwal B. Evening Chronotype Is Associated with Poorer Habitual Diet in US Women, with Dietary Energy Density Mediating a Relation of Chronotype with Cardiovascular Health. *J Nutr*. 2021;151(5):1150-1158. doi:10.1093/jn/nxaa442	Outcome; Intervention/exposure
304	Żurakowski A, Zahorska-Markiewicz B, Olszanecka-Glinianowicz M, Kocelak P. Effect of Meal Volume on Hunger and Satiety in Obese Subjects: Volume of meal and satiety. *EJIFCC*. 2006;17(4):167-176. Published 2006 Dec 1.	Outcome