

# Part D. Chapter 2: Dietary Patterns

## Introduction

Nutritional science investigates dietary exposures as the consumption of individual foods, nutrients, and distinct patterns of food combinations. Dietary patterns can be described by the foods that comprise them or their relative distribution of macro- and micronutrients, and the nutrient profile for any given dietary pattern can vary significantly.<sup>1</sup> For example, both plant-based and animal-based foods contribute to protein intake, but the nutrient profiles for each can differ substantially. Dietary or food patterns reflect cultural and population norms and preferences and are influenced by many factors including food availability, cooking methods and food processing techniques, climate and agricultural production, socioeconomic factors, advertising and marketing, and religious beliefs.<sup>2</sup>

Dietary patterns comprise usual quantities and frequencies of foods and beverages that are consumed during a given time frame or life stage (e.g., past year, during pregnancy), and can also be specific to eating occasions (e.g., breakfast or snacks).<sup>3</sup> Research that evaluates exposure to the consumption of a dietary pattern can capture individuals' collinear eating behaviors, as well as any additive, synergistic, or antagonistic effects between foods and nutrients in the overall diet matrix. Further, because people consume foods rather than individual nutrients, reviewing the evidence for consumption of habitual diet as an overall eating pattern can translate into practical dietary guidance that may be readily incorporated into daily living.

This chapter provides key background information about dietary patterns and presents evidence from systematic reviews on the relationships between dietary patterns and the following health outcomes: growth, body composition, and risk of obesity; cardiovascular disease; type 2 diabetes; breast cancer; colorectal cancer; and cognitive decline, dementia, Alzheimer's disease, and mild cognitive impairment. In addition, this chapter provides evidence on the relationships between dietary patterns consumed during pregnancy and outcomes in the pregnant individual or infant, including risk of hypertensive disorders of pregnancy, risk of gestational diabetes mellitus, gestational age at birth, and birth weight. The chapter also integrates and discusses the results of those systematic reviews and provides the Dietary Guidelines Advisory Committee's (Committee) advice to the Departments, based on these systematic reviews, for developing the *Dietary Guidelines for Americans, 2025-2030*.



### Box D.2.1: Data Analysis Highlight

U.S. dietary intake patterns, as assessed by the Healthy Eating Index-2020 (HEI-2020) and HEI-Toddlers-2020, generally fail to align with the *Dietary Guidelines for Americans, 2020-2025*. The mean HEI-2020 score for the total population ages 2 years and older is 56 out of 100, and the mean HEI-Toddlers score for young children ages 12 through 23 months is 63 out of 100. **Part D, Chapter 1: Current Dietary Intakes and Prevalence of Nutrition-Related Chronic Health Conditions** provides additional details on data analysis findings for dietary intake patterns.

## Why the *Dietary Guidelines for Americans* Recommend Dietary Patterns

The 2010 Dietary Guidelines Advisory Committee was the first Committee to recommend as a future direction that systematic reviews be conducted to examine the association of dietary patterns with health outcomes.<sup>4</sup> Following that recommendation, USDA's Nutrition Evidence Systematic Review (NESR) team (formerly Nutrition Evidence Library) collaborated with a technical expert collaborative to conduct a series of systematic reviews on dietary patterns and health.<sup>5</sup> This foundational work has been built upon and expanded by subsequent Committees. The 2015 Dietary Guidelines Advisory Committee conducted several systematic reviews for dietary patterns and health outcomes.<sup>6</sup> Dietary patterns that were associated with better health outcomes included higher intakes of vegetables, fruits, whole grains, low- or non-fat dairy, seafood, legumes, and nuts; moderate intake of alcohol (in adults only); and lower intakes of red and processed meat, refined grains, and sugar-sweetened foods and drinks. After examining the evidence, and considering the results of systematic reviews along with the results from food pattern modeling, the 2015 Committee proposed 3 dietary patterns that illustrated various flexibilities for a healthy diet: the Healthy U.S.-Style Dietary Pattern, the Healthy Mediterranean-style Dietary Pattern, and the Healthy Vegetarian Dietary Pattern.<sup>6</sup> The focus on dietary patterns has continued and a paper detailing the history and evolution of dietary patterns systematic reviews conducted to inform the *Dietary Guidelines for Americans* has been published.<sup>4</sup>

An approach focused on dietary patterns allows examination of the totality of the diet and facilitates the comparison of various patterns of eating for their relationship(s) with beneficial or adverse health outcomes, while also capturing cultural norms and food preferences.<sup>2</sup> Previous Committees have drawn conclusion statements for dietary patterns that have generally been consistent over time, across health outcomes and populations.<sup>4</sup> Further, the ability to harmonize the dietary pattern systematic review findings with food pattern modeling and data analysis strengthens the evidence base of the Committee's recommendations.

The *Dietary Guidelines* are also used as the basis for federal food assistance programs; thus, defining overall healthy dietary patterns is useful to guide development and implementation of federal programs such as the National School Lunch Program (NSLP), the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the Child and Adult Care Food Program (CACFP). These

programs include menu planning approaches, which can benefit from determination of healthy food patterns, as well as setting norms for the populations who participate.

## Key Concepts and Methodological Approaches

Dietary patterns in the research setting are derived using selected foods, beverages, and nutrients defined *a priori* by investigators, whereas data-driven *a posteriori* patterns identify correlated patterns of foods, beverages, and nutrients that exist within the specific study population through various methods.<sup>4</sup> *A priori* dietary patterns are hypothesis-driven and include pre-determined indices, such as the Healthy Eating Index (HEI), to quantify an individual's adherence to a set of dietary guidelines or cultural eating patterns, metric(s) of high or low dietary quality, or collective intake of a set of foods, beverages, or nutrients prioritized for their hypothesized relationship with a health outcome.<sup>7</sup> Standardized scores are assigned to foods or nutrients consumed, with an overall score providing a quantitative rating of adherence to the overall dietary pattern that can then be used for descriptively characterizing a population's diet or evaluating pattern-outcome relationships. In contrast, *a posteriori* approaches use statistical methods such as principal component analysis (PCA), exploratory factor analysis (EFA), and cluster analysis to determine dietary patterns based on empirical data within a given study population,<sup>7</sup> from various sources of dietary data, including food frequency questionnaires (FFQs). Because data are obtained from existing dietary intakes, the patterns represented may not always reflect current dietary guidance,<sup>8</sup> are not always generalizable, and may be arbitrary depending on how the foods or food groups were measured and analyzed.<sup>4</sup> This methodology can be hypothesis-generating and highlight latent food and beverage correlations and trends. Hybrid approaches include a combination of methods, such as reduced-rank regression and treelet transformation.<sup>4</sup> The term hybrid is applied because these methods are based on prior knowledge of a mechanism or pathway associated with disease (e.g., inflammation, hyperinsulinemia) and the diet is formed *a posteriori* on the basis of optimally predicting level of a biomarker (e.g., C-reactive protein for inflammation, C-peptide or insulin for hyperinsulinemia).<sup>4,7</sup>

A recent systematic review examined methods to derive and report dietary patterns. Of the 410 studies identified, 62.7 percent used *a priori* index methods and 30.5 percent used PCA or EFA *a posteriori* approaches. Less than 10 percent of the studies used reduced rank regression (6.3 percent), cluster analysis (5.6 percent), or combination methods (4.6 percent).<sup>9</sup> A challenge of synthesizing evidence among dietary pattern analyses is harmonizing the similarities and differences in the foods and nutrients (de)emphasized, which are often highly variable. The NESR review methodology used for the 2025 Committee's report incorporated detailed synthesis of dietary pattern food and nutrient composition from studies using both *a priori* and *a posteriori* methods. Identifying major foods or food groups classified in these studies allowed the Committee to compare dietary patterns derived using different methodology and population-specific diets.

## Prioritizing the Systematic Reviews

The Committee prioritized the systematic reviews by listing the questions that were recommended for this review and using an iterative prioritization and refinement process. Questions for the systematic reviews were initially evaluated by Committee members based on relative importance to the field, past

systematic reviews and grades, and feasibility based on time and magnitude of the available literature. During subsequent meetings, several additional questions were de-prioritized based on workload and other factors identified during the review, such as the number of new studies identified since the last question update. [Table D.2.1](#) provides a more detailed overview of the rationale for each deprioritized review. The full process yielded 11 questions for dietary patterns systematic reviews that included several life stages.

**TABLE D.2.1**  
**DEPRIORITIZED DIETARY PATTERNS SYSTEMATIC REVIEWS**

<b>Deprioritized Systematic Review</b>	<b>Rationale for Deprioritization</b>
Dietary patterns and risk of sarcopenia	The Committee determined that a lack of research was available to update the existing NESR systematic review.
Dietary patterns and all-cause mortality	The recent existing NESR systematic review had a conclusion statement graded as “strong” and the Committee chose to prioritize other outcomes in relation to dietary patterns.
Dietary patterns before/during pregnancy and lactation and developmental milestones	The Committee determined that a lack of research was available to update the existing NESR systematic review.
Dietary patterns and risk of lung cancer	The Committee determined that a lack of research was available to update the existing NESR systematic review and also identified challenges with smoking as a confounder.
Dietary patterns and risk of depression	The Committee consulted federal subject matter experts on this topic and based on concerns from those experts about reverse causality and/or the plausibility of the relationship between dietary patterns and risk of depression, the Committee decided to discontinue this systematic review.

## Expansion of Previous Reviews

Most of the systematic review questions on dietary patterns and health outcomes for this report were reviewed by previous Committees, except for 1 new systematic review of dietary patterns with varying levels of ultra-processed foods and growth, body composition, and risk of obesity. That new systematic review included the following life stages: infants and young children up to age 24 months, children and adolescents, adults and older adults, and individuals during pregnancy and postpartum. This report includes updated health outcomes evaluated in 2020, as well as updated systematic reviews of diet during pregnancy. Other features of the current Committee’s dietary pattern systematic reviews include the focus on different age and developmental stages from early childhood to older adulthood.

Where possible, conclusion statements were developed separately for different life stages. In particular, the relationships between dietary patterns consumed during pregnancy and risk of hypertensive disorder during pregnancy, risk of gestational diabetes mellitus, infant gestational age at birth, and infant birth weight were also examined. Further, throughout this chapter, the term “adults” refers to individuals ages 19 years and older, including older adults. This is because the bodies of evidence for adults included

studies that enrolled participants across the adult age span, including older adults, but did not allow for drawing separate conclusions for older adults in any of the questions reviewed. One of the challenges in systematic reviews of chronic diseases that manifest primarily, but not exclusively, in older adults is the lack of data that indicates when during the lifespan does diet impact health as we age. Until the role of diet across the lifespan is better understood, it can be assumed that the healthy diet pattern in younger adulthood will have similar positive influences on health in older adulthood for the questions examined. However, that is an assumption not based on empirical evidence.

The Committee applied a health equity lens to all its systematic reviews and identified an opportunity to consider health equity to an even greater extent in its review on dietary patterns consumed by adults and older adults and risk of cardiovascular disease ([Box D.2.2](#)). Several advantages to using that systematic review for this purpose were present, including the well-established and extensive body of literature on the topic, the existing strong conclusion for the relationship, and the number of studies that included outcomes for diverse populations. To further examine the systematic review question, the evidence was limited to studies conducted in the United States. Because most studies did not include comparable measures of socioeconomic position, criteria for diversity included race and/or ethnicity, as well as other socioeconomic measures, where applicable. The Committee considered studies with participants of  $\leq 40$  percent Non-Hispanic White as having population diversity.



### Box D.2.2: Dietary Patterns and Risk of Cardiovascular Disease

The 2020 Dietary Guidelines Advisory Committee's Scientific Report carried forward the conclusion about dietary patterns consumed by adults and older adults and cardiovascular disease from the 2015 Report, with a suggestion that the evidence be systematically reviewed in 2025. The 2025 Committee's review confirmed the strong association between a healthy dietary pattern among adults and older adults and lower risk of cardiovascular disease. It also afforded the opportunity to examine health equity in the research on dietary patterns and cardiovascular disease among adults and older adults. Equity considerations are important because the impacts of dietary patterns are mediated by the conditions under which people live and implement recommendations. Although the *Dietary Guidelines for Americans, 2020-2025* include consideration for budget, food preferences, and culture, they stop short of examining systems and structures that impact food intake and adherence to guidelines—as evidenced by Americans' persistently low Healthy Eating Index scores.

## List of Questions

1. What is the relationship between dietary patterns consumed and growth, body composition, and risk of obesity?<sup>10</sup>
2. What is the relationship between dietary patterns consumed and risk of cardiovascular disease?<sup>11</sup>
3. What is the relationship between dietary patterns consumed and risk of type 2 diabetes?<sup>12</sup>
4. What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?<sup>13</sup>
5. What is the relationship between dietary patterns consumed and risk of breast cancer?<sup>14</sup>
6. What is the relationship between dietary patterns consumed and risk of colorectal cancer?<sup>15</sup>
7. What is the relationship between dietary patterns consumed and risk of cognitive decline, dementia, Alzheimer’s disease, and mild cognitive impairment?<sup>16</sup>
8. What is the relationship between dietary patterns consumed during pregnancy and risk of hypertensive disorders of pregnancy?<sup>17</sup>
9. What is the relationship between dietary patterns consumed during pregnancy and risk of gestational diabetes mellitus?<sup>18</sup>
10. What is the relationship between dietary patterns consumed during pregnancy and gestational age at birth?<sup>19</sup>
11. What is the relationship between dietary patterns consumed during pregnancy and birth weight?<sup>20</sup>

## Conclusion Statements

Question 1. What is the relationship between dietary patterns consumed and growth, body composition, and risk of obesity?

### Approach to Answering Question: Systematic Review

#### Infants and Young Children Up to Age 24 Months

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months and growth, body composition, and risk of obesity because of substantial concerns with consistency. (Grade: Grade Not Assignable)

#### Children and Adolescents

Dietary patterns consumed by children and adolescents that are characterized by higher intakes of vegetables, fruit, legumes, nuts, whole grains, fish/seafood, and dairy (low-fat, unsweetened) and lower intakes of red and processed meats, sugar-sweetened beverages, and sugar-sweetened or savory/salty snack foods are associated with favorable growth patterns, lower adiposity, and lower risk of obesity later

in childhood and early adulthood. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

Dietary patterns consumed by children and adolescents that are characterized by higher intakes of red and processed meats, refined grains, sugar-sweetened beverages, sugar-sweetened or savory/salty snack foods, and fried potatoes and lower intakes of vegetables, fruit, and whole grains are associated with unfavorable growth patterns, higher adiposity, and higher risk of obesity later in childhood and early adulthood. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

### **Adults and Older Adults**

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes, nuts, whole grains, and fish/seafood and lower intakes of meats (including red and processed meats), refined grains and sugar-sweetened foods and beverages are associated with lower adiposity (body fat, body weight, BMI, and/or waist circumference) and lower risk of obesity. These dietary patterns also included higher intakes of unsaturated fats and lower intakes of saturated fats and sodium. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

### **Individuals During Pregnancy**

Dietary patterns consumed during pregnancy may be associated with a lower risk of excessive gestational weight gain. These patterns tend to emphasize higher intakes of vegetables, fruits, legumes, nuts, whole grains, fish, and dairy and lower intakes of added sugars. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy and risk of inadequate gestational weight gain because there are substantial concerns with consistency in the body of evidence. (Grade: Grade Not Assignable)

### **Individuals During Postpartum**

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during postpartum and postpartum weight change because there are substantial concerns with consistency, precision, risk of bias and generalizability in the body of evidence. (Grade: Grade Not Assignable)



**View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_growth-obesity](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_growth-obesity)**



Question 2. What is the relationship between dietary patterns consumed and risk of cardiovascular disease?

### Approach to Answering Question: Systematic Review

#### Children and Adolescents

Dietary patterns consumed by children and adolescents that are characterized by higher intakes of vegetables, fruits, legumes, nuts, whole grains, fish and/or seafood, and unsaturated fats and oils and lower intakes of red and processed meats and sugar-sweetened foods and beverages are associated with lower systolic and diastolic blood pressure and triglycerides later in life. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes, nuts, whole grains, unsaturated relative to saturated fats and lower sodium, and lower intakes of red and processed meat, refined grains, and sugar-sweetened foods and beverages are associated with lower risk of cardiovascular disease, including clinically meaningful improvements in blood lipids and blood pressure. Some of these dietary patterns also included low-fat dairy and seafood. These findings were consistent across diverse racial/ethnic groups and socioeconomic positions. This conclusion statement is based on evidence graded as strong. (Grade: Strong)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at <https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns-cardiovascular-disease>

Question 3. What is the relationship between dietary patterns consumed and risk of type 2 diabetes?

### Approach to Answering Question: Systematic Review

#### Children and Adolescents

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by children and adolescents and risk of type 2 diabetes because of substantial concerns with directness. (Grade: Grade Not Assignable)

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes, nuts, whole grains, and fish/seafood and lower intakes of red and processed meats, high-fat dairy products, refined grains, and sugar-sweetened foods and beverages are associated with lower risk of type 2 diabetes. This conclusion statement is based on evidence graded as strong. (Grade: Strong)





View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at <https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns-type-2-diabetes>

Question 4. What is the relationship between consumption of dietary patterns with varying amounts of ultra-processed foods and growth, body composition, and risk of obesity?

### Approach to Answering Question: Systematic Review

#### Infants and Young Children up to 24 Months

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed by infants and young children up to age 24 months with varying amounts of ultra-processed food and growth, body composition, and risk of obesity because of substantial concerns with consistency and directness in the body of evidence. (Grade: Grade Not Assignable)

#### Children and Adolescents

Dietary patterns consumed by children and adolescents with higher amounts of food classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and greater risk of overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults with higher amounts of food classified as ultra-processed food are associated with greater adiposity (fat mass, waist circumference, BMI) and greater risk of obesity and/or overweight. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

#### Individuals During Pregnancy

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy with varying amounts of ultra-processed food and gestational weight gain because there is not enough evidence available. (Grade: Grade Not Assignable)

#### Individuals During Postpartum

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during postpartum with varying amounts of ultra-processed food and postpartum weight change because there is not enough evidence available. (Grade: Grade Not Assignable)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at <https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns-ultraprocessed-growth-obesity>

Question 5. What is the relationship between dietary patterns consumed and risk of breast cancer?

### Approach to Answering Question: Systematic Review

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes and nuts, and whole grains and lower intakes of red and processed meats, refined grains, and sugar-sweetened foods and beverages are associated with lower risk of postmenopausal breast cancer relative to other dietary patterns. The data regarding dietary patterns and risk of premenopausal breast cancer point in the same direction, but the evidence is less consistent. This conclusion statement is based on evidence for postmenopausal breast cancer graded as moderate.

(Grade: Moderate)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at <https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns-breast-cancer>

Question 6. What is the relationship between dietary patterns consumed and risk of colorectal cancer?

### Approach to Answering Question: Systematic Review

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes and nuts, and whole grains and lower intakes of red and processed meats, refined grains, fried potatoes, saturated fat, and sugar-sweetened foods and beverages are associated with lower risk of colon and rectal cancer. Some of these dietary patterns also included fish, low-fat dairy, tea and coffee. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at <https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns-colorectal-cancer>

Question 7. What is the relationship between dietary patterns consumed and risk of cognitive decline, dementia, Alzheimer's disease, and mild cognitive impairment?

### Approach to Answering Question: Systematic Review

#### Adults and Older Adults

Dietary patterns consumed by adults and older adults that are characterized by higher intakes of vegetables, fruits, legumes or beans, nuts, fish and/or seafood, and unsaturated vegetable oils/fats and lower in red and processed meats and sugar-sweetened beverages, are associated with lower risk of age-related cognitive decline, mild cognitive impairment, dementia and/or Alzheimer's disease. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_neurocognitive-health](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_neurocognitive-health)

Question 8. What is the relationship between dietary patterns consumed during pregnancy and risk of hypertensive disorders of pregnancy?

### Approach to Answering Question: Systematic Review

#### Individuals During Pregnancy

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy and risk of hypertensive disorders of pregnancy because of substantial concerns with consistency, directness, and precision in the body of evidence. (Grade: Grade Not Assignable)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_hypertensive-disorders-pregnancy](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_hypertensive-disorders-pregnancy)

Question 9. What is the relationship between dietary patterns consumed during pregnancy and risk of gestational diabetes mellitus?

### Approach to Answering Question: Systematic Review

#### Individuals During Pregnancy

Dietary patterns consumed during pregnancy that are characterized by higher intakes of vegetables, fruits, legumes, nuts and seeds, whole grains, fish/seafood, and unsaturated fats, and lower intakes of red and processed meat, added sugars, and saturated fats are associated with lower risk of gestational diabetes mellitus. This conclusion statement is based on evidence graded as limited. (Grade: Limited)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_gestational-diabetes](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_gestational-diabetes)

Question 10. What is the relationship between dietary patterns consumed during pregnancy and gestational age at birth?

### Approach to Answering Question: Systematic Review

#### Individuals During Pregnancy

Dietary patterns consumed during pregnancy may not be associated with risk of preterm birth. This conclusion statement is based on evidence graded as limited. (Grade: Limited)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_gestational-age](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_gestational-age)

Question 11. What is the relationship between dietary patterns consumed during pregnancy and birth weight?

### Approach to Answering Question: Systematic Review

#### Individuals During Pregnancy

Dietary patterns consumed during pregnancy that are characterized by higher intakes of vegetables, fruits, legumes, nuts and seeds, grains, fish/seafood, dairy, and unsaturated fats, and lower intakes of red and processed meat, added sugars, and saturated fats may be associated with lower risk of small-for-gestational age in infants. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

A conclusion statement cannot be drawn about the relationship between dietary patterns consumed during pregnancy and risk of large-for-gestational age, low birth weight, and macrosomia in infants because of substantial concerns with consistency, risk of bias, and generalizability in the body of evidence. (Grade: Grade Not Assignable)



View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at [https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns\\_birthweight](https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/dietary-patterns_birthweight)

## Integration

In this section the Committee integrates evidence across this chapter's systematic review conclusion statements by organizing its findings on relationships between dietary patterns and health outcomes: associations with favorable health outcomes, associations with unfavorable health outcomes, no relationship with health outcomes, and relationships for which a conclusion statement could not be drawn. The studies reviewed included a variety of dietary patterns from multiple countries, which is consistent with the aim of the *Dietary Guidelines* to provide nutrition advice that represents a variety of cultural foodways. Because the systematic reviews included several distinct dietary patterns, it was necessary to describe a composite dietary pattern representing conclusion statements collectively. Dietary patterns are represented by specific foods and beverages, food groups, and nutrients, so the Committee examined dietary patterns for these commonalities.

### Dietary Patterns Associated with Favorable Health Outcomes

Eleven conclusion statements were drawn that associated dietary patterns with favorable health outcomes: 2 in children and adolescents, 6 in adults and older adults, and 3 in pregnant individuals. Two

were based on evidence graded as strong, 5 were based on evidence graded as moderate, and 4 were based on evidence graded as limited. All these dietary patterns included higher intakes of vegetables, fruits, legumes, and nuts; most had higher intakes of whole grains and fish or seafood; and some had higher intakes of low-fat dairy or unsaturated fats ([Table D.2.2](#)). In contrast, these dietary patterns were lower in intakes of refined grains, red and processed meats, sugar-sweetened foods and beverages, and saturated fat.

Associations graded as strong included adult health outcomes for cardiovascular disease and type 2 diabetes, chronic diseases that have repeatedly been shown to be associated with dietary consumption.<sup>6,21-23</sup> The association between dietary patterns and cardiovascular disease has remained robust, with strong grades and a large body of evidence for the 2015 and 2020 Dietary Guidelines Advisory Committee Scientific Reports. The conclusion statement for cardiovascular disease specifically focused on health equity, as discussed later in this chapter ([Box D.2.3](#)), and the evidence remained graded as strong.

Associations graded as moderate included the conclusion statements for dietary patterns in children and cardiovascular disease, and dietary patterns in adults and adiposity and risk of obesity; colorectal cancer; breast cancer; and cognitive decline, dementia, Alzheimer's disease, and mild cognitive impairment. The conclusion statement for dietary patterns and cardiovascular disease in children and adolescents was the only conclusion statement graded as moderate in that age group.

Conclusion statements graded as limited included dietary patterns in children and adolescents and growth, adiposity, and risk of obesity, and all 3 of the conclusion statements examining associations in individuals who are pregnant for dietary patterns and lower risk of excessive gestational weight gain, lower risk of gestational diabetes mellitus, and lower risk of small-for-gestational age in infants.

## **Dietary Patterns Associated with Unfavorable Health Outcomes**

Three conclusion statements were associated with unfavorable health outcomes, all of which were related to growth, body composition, and risk of obesity. Two of these conclusion statements included dietary patterns associated with higher amounts of foods classified as ultra-processed foods in children and adolescents, and adults and older adults. The third conclusion statement examined the relationship between a dietary pattern higher in red and processed meats, refined grains, fried potatoes, sugar-sweetened beverages, and sugar-sweetened or savory/salty snack foods, and unfavorable growth patterns and higher adiposity and risk of obesity in children and adolescents ([Table D.2.2](#)). Many of the foods identified in the latter dietary pattern overlap with the foods classified as ultra-processed.

The conclusion statements for dietary patterns with ultra-processed foods and growth, body composition, and risk of obesity was based on evidence graded as limited for children and adolescents and for adults. This body of evidence was difficult to assess, largely because of the lack of clear definition of ultra-processed foods.

## No Associations Between Dietary Patterns and Health Outcomes

One conclusion statement found no association between a dietary pattern and a health outcome. This conclusion statement was related to dietary patterns consumed during pregnancy and the risk of preterm birth, which was based on evidence graded as limited.

## Dietary Patterns and Health Outcomes for Which a Conclusion Statement Could Not Be Drawn

Conclusion statements could not be drawn for some life stages within the prioritized questions: 2 were for infants and young children up to age 24 months, 1 was for children and adolescents, 4 were for individuals who are pregnant, and 2 were for individuals who are postpartum. Together, the lack of evidence in these populations reflects the paucity of research examining dietary patterns and health outcomes at different developmental stages. For some of these questions, it can be challenging to study dietary patterns and health outcomes in these populations because of difficulty with data collection, participant recruitment, or ethical considerations. In addition, definitions of dietary patterns can be difficult to discern in infants who predominantly consume human milk or infant formula.

## Summary

As the Committee considered collectively the systematic reviews, which encompassed multiple life stages, a dietary pattern emerged that was consistently related to beneficial health. This healthy dietary pattern for individuals ages 2 years and older is higher in vegetables, fruits, legumes, nuts, whole grains, fish/seafood, and vegetable oils higher in unsaturated fat, and lower in red and processed meats, sugar-sweetened foods and beverages, refined grains, and saturated fat. Some of these healthy dietary patterns also include consumption of low- or non-fat dairy and foods lower in sodium, as noted in specific systematic review conclusion statements. [Tables D.2.2](#) and [D.2.3](#) provide an overview of the dietary patterns systematic review topics and foods or food groups identified in each conclusion statement.

**TABLE D.2.2**  
**SUMMARY OF SYSTEMATIC REVIEW CONCLUSION STATEMENTS THAT DESCRIBE DIETARY PATTERNS ASSOCIATED WITH FAVORABLE HEALTH OUTCOMES BY LIFE STAGE**

Life Stage	Adults and Older Adults						Children and Adolescents		Pregnancy		
	Lower risk of cardiovascular disease (CVD)	Lower risk of type 2 diabetes	Lower risk of age-related cognitive decline, dementia, Alzheimer's disease	Lower risk of colorectal cancer	Lower risk of breast cancer	Lower adiposity and risk of obesity	Lower CVD risk factors	Favorable growth patterns, lower body composition, and lower risk of obesity	Lower risk of gestational diabetes	Lower risk of excess gestational weight gain	Lower risk of small-for-gestational-age
Grade	Strong	Strong	Moderate	Moderate	Moderate	Moderate	Moderate	Limited	Limited	Limited	Limited
Vegetables	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Fruit	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Legumes	▲	▲	▲ or Beans	▲	▲	▲	▲	▲	▲	▲	▲
Nuts	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
Whole Grains	▲	▲		▲	▲	▲	▲	▲	▲	▲	▲ 'Grains'
Fish or Seafood	▲	▲	▲	▲		▲	▲	▲	▲	▲	▲
Unsaturated Fats	▲		▲			▲	▲		▲		▲
Tea, Coffee				▲							
Dairy	▲ Low-fat, Non-fat	▼ Whole fat		▲ Low-fat, Non-fat				▲ Unsweetened, Low-fat, Non-fat		▲	▲
Meats	▼ Red and Processed	▼ Red and Processed	▼ Red and Processed	▼ Red and Processed	▼ Red and Processed	▼	▼ Red and Processed	▼ Red and Processed	▼ Red and Processed		▼ Red and Processed
Refined Grains	▼	▼		▼	▼	▼					▲ 'Grains'
Sugar-Sweetened Foods	▼	▼		▼	▼	▼	▼	▼	▼ Added Sugars	▼ Added Sugars	▼ Added Sugars
Sugar-Sweetened Beverages	▼	▼	▼	▼	▼	▼	▼	▼	▼ Added Sugars	▼ Added Sugars	▼ Added Sugars
Saturated Fats	▼			▼		▼			▼		▼
Sodium	▼					▼					
Sweetened and Savory/Salty Snack Foods								▼			
Fried Potatoes				▼							

No entry in a cell means that the foods, food group, or component was not included in the conclusion statement for that health outcome.

- ▲ Higher intake of this component as part of the pattern are related to health **favorably**
- ▼ Lower intake of this component as part of the pattern are related to health **favorably**



**TABLE D.2.3**

SUMMARY OF SYSTEMATIC REVIEW CONCLUSION STATEMENTS THAT DESCRIBE DIETARY PATTERNS ASSOCIATED WITH UNFAVORABLE HEALTH OUTCOMES BY LIFE STAGE

Life Stage	Children, adolescents		Adults, older adults
Outcome	Unfavorable growth and higher adiposity and risk of obesity	Unfavorable growth and higher adiposity and risk of obesity	Higher adiposity and risk of obesity
Grade	Limited	Limited	Limited
<b>Dietary pattern components</b>			
Vegetables	▼		
Fruit	▼		
Whole Grains	▼		
Refined Grains	▲		
Meats	▲ Red and Processed		
Sugar-Sweetened Foods	▲		
Sugar-Sweetened Beverages	▲		
Fried Potatoes	▲		
Sweetened and Savory/salty Snack Foods	▲		
Ultra-Processed Food		▲	▲

No entry in a cell means that the foods, food group, or component was not included in the conclusion statement for that health outcome.

▲ Higher intakes of this component as part of the pattern are related to health **unfavorably**

▼ Lower intakes of this component as part of the pattern are related to health **unfavorably**

## Discussion

Conclusion statements were developed for the systematic reviews on dietary patterns and various health outcomes across multiple life stage groups as follows.

- Fifteen of the conclusion statements were graded: 7 for adults, 4 for children and adolescents, and 4 for individuals who are pregnant.
  - For adults and older adults, 2 of the conclusion statements were graded as strong, 4 were moderate, and 1 was limited.
  - For children and adolescents, the only conclusion statement graded as moderate was for the systematic review of dietary patterns and risk factors for cardiovascular disease. Three additional conclusion statements were graded as limited.
  - For individuals who are pregnant, 4 conclusion statements were graded as limited.
- Nine conclusion statements did not receive a grade due to lack of evidence or heterogeneity of results: 2 in infants and young children, 1 in children and adolescents, 4 in individuals who are pregnant, and 2 in individuals who are postpartum.
- No conclusion statements specific to only older adults were developed due to discrepancies in classifying ages in this group based on the evidence pooling adults and older adults together, not conducting stratification by age, and/or a lack of evidence examining only older adults.

The conclusion statements illustrate the relatively robust body of evidence for adults and older adults compared to other life stages. Some conclusion statements graded the evidence as limited or could not assign a grade; the majority of these were in infants and young children, children and adolescents, individuals who are pregnant, and individuals who are postpartum.



### Box D.2.3: Health Equity-Based Synthesis of Evidence

The Committee conducted a systematic review to examine the relationship between dietary patterns consumed by adults and older adults and risk of cardiovascular disease, updating conclusions from the 2015 Committee's report. The Committee identified this review as an opportunity to consider health equity in its synthesis of evidence given the extensive literature on the topic supporting existing strong conclusions for the relationship. The Committee included only studies conducted in the U.S. to prioritize evidence most applicable to the U.S. population in terms of dietary intake, risk of cardiovascular disease, and other factors (e.g., race and/or ethnicity, socioeconomic position) that may impact the relationship examined in the review. The Committee used the NESR methodology to synthesize the entire body of evidence (n=110) and confirmed the strong association between a healthy dietary pattern consumed by adults and older adults and lower risk of cardiovascular disease. Next, per the Committee's protocol, health equity was considered to understand whether the findings applied to participants from diverse racial or ethnic groups or of varied socioeconomic positions by considering the results from a subset of the articles; these articles included a majority of non-White participants (n=43). It was noted that beneficial dietary patterns were similar across these studies, which included diverse population groups. The Committee determined that the findings reported in this subset of articles were also consistent with findings from the overall body of evidence, especially for race and/or ethnicity. Findings were generally consistent across different socioeconomic positions based on various indicators, such as levels of educational attainment or household income, although these data were not available for all studies. The conclusion statement acknowledged the health equity-based synthesis and noted the consistency in outcomes among population groups.

Overall, the Committee's findings reaffirm the healthy dietary patterns presented in the 2015 and 2020 Committee reports, with a few minor changes or updates. Although the systematic reviews included a significant number of studies, many studies were conducted in other countries or in majority white populations, which limited the generalizability of the findings and contributed to several of the moderate or limited grades for the conclusion statements. Several of the studies identified in the systematic reviews also focused on plant-based dietary patterns or on new dietary indices.

The systematic review for ultra-processed foods was a new question for the Committee. Because several methods have been developed to characterize ultra-processed foods, the foods and dietary patterns included in the articles were not consistent. The definition of ultra-processed foods was determined by the authors of the articles included in the review, leading to differences in the dietary patterns, especially in non-U.S. populations with different food supplies. Many foods designated as ultra-

processed were higher in saturated fat, sodium, and added sugars, especially in contrast to foods identified as part of the comparator pattern, and food composition—specifically, food additives, emulsifiers, and colorants—was not specified. Dietary tools such as FFQs do not adequately distinguish between processing levels, i.e., a homemade meal versus a frozen dinner. Because of these inconsistencies, conclusion statements were developed with a grade of limited.

Despite an increase during the past 5 years in the number of studies that addressed specific outcomes—and that were, for the most part, consistent in findings with the studies included in the 2020 Committee’s report—this Committee’s conclusion statements upgraded the strength of evidence in only 3 cases, 2 in adults and 1 in children and adolescents. This is because most of the new research included prospective cohort studies that were similar in the procedures used to assess diets, the frequency of dietary assessment, and the measurement of other study variables; therefore, their limitations were largely the same. Such limitations are further described in the following paragraphs and include measurement error, residual confounding, and reverse causation.

For some life stages, such as pregnancy, dietary intake data can be difficult to collect for a variety of reasons. These include timing of the measurement (e.g., pre-conception, month of pregnancy), difficulty in the representativeness of the diet unless measured at multiple time points during pregnancy, and reverse causation if dietary intake is collected concurrently or post-diagnosis for conditions such as gestational diabetes mellitus. Postpartum measurements of dietary intake can have similar concerns. For infants and young children, measurements are conducted by parents or other caregivers, and amounts of foods and beverages consumed, especially human milk, may be difficult to assess. It can also be difficult to measure school-aged children’s dietary intake, especially foods that are consumed at schools or after-school programs.

Most studies relied on FFQs, which are based on self-report of diet and are prone to measurement error. Furthermore, most studies collected a single dietary assessment during the lifespan, even though most chronic diseases may have a long development period and specific periods of susceptibility or sensitivity to diet. A single measure would incur substantial error in capturing the etiologic relevant time of exposure. Nonetheless, because the questionnaires were completed before overt disease, such misclassification is typically random or non-directional in regard to the outcome, so this type of measurement error should typically attenuate any true association instead of inflating or creating false associations. However, for some outcomes such as cognitive decline, subtle cognitive changes may occur before diagnosis of the outcome, which could theoretically be differential in the direction of the outcome. In this case, the rate of type 1 errors, or a false positive, may increase, or associations could be exaggerated.

Potential for residual confounding is the primary limitation of prospective cohort dietary studies. Although studies statistically adjusted for various factors deemed to be important confounders (such as tobacco use and physical activity), it is possible that those factors had substantial measurement error—which would make complete statistical adjustment infeasible—and/or that there were factors unaccounted for entirely. For example, assessments of physical activity were typically self-reported, which has measurement error, and may not capture subtle features such as sedentary behavior. For cancer

outcomes, screening (typically mammography for breast cancer and colonoscopy for colorectal cancer) was accounted for in many but not all studies. Consistency of an association observed across many studies in diverse settings would generally be important in supporting a true association, because it might be less likely for the same confounding structure to be consistent across all settings, so the potential for residual confounding should differ across studies. Thus, consistency across populations was an important factor to consider in addressing the potential for residual confounding, but it was difficult to assess, because heterogeneity in study population was generally limited.

Reverse causation can result when the disease itself or a strong susceptibility to develop the disease in the future causes a change in the dietary pattern, which can produce a spurious association or accentuate or attenuate the association between the dietary pattern and the disease. For example, a diagnosis of pre-diabetes might prompt an individual to adopt a better diet. Although the individual may now be classified as having a healthy diet, he or she may be at higher-than-average risk for diabetes because a diagnosis of pre-diabetes is a strong risk factor for diabetes. In this scenario, there will tend to be a bias toward making a healthy diet appear to increase risk of diabetes. Statistical adjustment is possible if information about pre-diabetes is available, but such information is not often available.

## Comparison to Prior Dietary Guidelines Advisory Committee Findings

The 2025 Committee continued to build on the body of evidence produced by previous Committees. For example, the Committee introduced a new question about the relationship between consumption of different amounts of ultra-processed foods and growth, body composition, and risk of obesity. Also new was the application of a health equity lens to the systematic review on dietary patterns and cardiovascular disease, as discussed earlier in this chapter. In addition, this Committee updated several systematic reviews conducted by prior (2015 and/or 2020) Committees and was able to modify those reviews' conclusion statements based on availability of new or more consistent findings in the body of evidence. For some conclusion statements, the evidence grade was also strengthened. The following paragraphs describe how these systematic review conclusion statements have evolved (or in some cases, stayed the same) since publication of the 2015 Committee's report.

For the relationship between dietary patterns and cardiovascular risk factors among children and adolescents, the 2020 Committee was the first Committee to have evidence on this topic and graded it as limited. This Committee was able to update this systematic review with new evidence, now graded as moderate, and modified the conclusion statement by adding higher intakes of nuts, seafood, and unsaturated fats and oils, adding lower intakes of red meats, and removing low-fat dairy. Many of the studies were conducted in non-U.S. settings, and data regarding dairy products did not consistently indicate the type or fat content of dairy consumed. Other systematic reviews specifically examining the consumption of dairy can be found in [Part D. Chapter 3: Beverages](#).

For the relationship between dietary patterns and type 2 diabetes outcomes in adults and older adults, the 2015 Committee graded the evidence as moderate. The 2020 Committee completed an evidence scan and determined that the conclusion drawn by the 2015 Committee generally reflected the current state of the science at the time, reaffirming the grade of moderate. The 2025 Committee updated the 2015

systematic review and updated the grade from moderate to strong, as the new evidence encompassed studies with more consistent outcomes conducted in more diverse populations. Based on the dietary patterns examined, the conclusion statement was modified to reflect higher consumption of legumes, nuts, and fish/seafood, and lower consumption of sugar-sweetened foods and sugar-sweetened beverages. For the association between dietary patterns and type 2 diabetes in children, a grade could not be assigned, which is consistent with the 2020 Committee's determination. Although an expanded set of outcomes was available compared to the 2020 Committee's review, significant concerns with directness of the studies were present. Longer-term prospective cohort studies beginning in youth with type 2 diabetes-related outcomes would be helpful in establishing a more robust body of evidence, as well as incorporation of other intermediate diabetes outcomes, such as hemoglobin A1c.

For the relationship between dietary patterns and colorectal cancer, the 2020 Committee graded the evidence as moderate, and this Committee maintained that grade. The 2020 Committee's conclusion statement, however, described a dietary pattern associated with higher risk for colorectal cancer as well as dietary components that associated with lower risk. This Committee combined the findings into a single conclusion statement that is in the direction of lower risk only, to simplify the dietary guidance and avoid confusion. Several of the newer studies in this Committee's systematic review included newer indices that represented particular foods and food groups that were not explicitly examined compared to previous reviews. For example, the empirical dietary index for hyperinsulinemia (EDIH) or the empirical dietary index for inflammation insulin (ELIP), which are based on foods that predict insulin and inflammatory responses and may not reflect an intuitive dietary pattern, included fried potatoes as part of the index. This contributed to the Committee including lower intakes of fried potatoes in the conclusion statement, acknowledging that given the dietary index, it is difficult to determine if the food (e.g., the potato) or its method of preparation drives the association. Additionally, this Committee's systematic review included many plant-based indices, all of which rated animal-based products negatively regardless of whether the other foods and food components in the indices were indicative of lower risk of colorectal cancer.

For the relationship between dietary patterns and breast cancer, the 2015 and 2020 Committees developed conclusion statements that referred to both pre- and postmenopausal breast cancer and graded evidence for premenopausal breast cancer (limited in both 2015 and 2020) separately from evidence for postmenopausal breast cancer (moderate for both 2015 and 2020). This Committee also developed a single conclusion statement and retained the moderate grade of the evidence for postmenopausal breast cancer but did not assign a specific grade to the evidence for premenopausal breast cancer, and instead shifted the rationale for the conclusion statement from a general lack of evidence to concerns with consistency in the body of evidence available.

For the relationship between dietary patterns and cognitive decline, dementia, Alzheimer's disease, and mild cognitive impairment in adults and older adults, this Committee graded the evidence as moderate, which strengthens the grade of limited assigned by the 2020 Committee. The dietary pattern described in the 2020 Committee's conclusion statement was updated with the following additional components: higher intakes from legumes or beans and lower intakes from red/processed meats and sugar-sweetened

beverages. Most studies did not have a consistent age cut point to define older adulthood; therefore, the conclusion statement encompasses both adults and older adults.

For the relationship between dietary patterns during pregnancy and gestational weight gain (which was examined by this Committee as part of the systematic review on dietary patterns and growth, body composition, and risk of obesity), the 2020 Committee and this Committee examined evidence on dietary patterns consumed during pregnancy. When examining the relationship between dietary patterns in individuals who are pregnant and growth, body composition, and risk of obesity health outcomes, gestational weight gain (both excessive weight gain and inadequate weight gain) was used as the primary health outcome. Appropriate gestational weight gain is associated with better maternal and infant outcomes.<sup>24</sup> The Committee maintained a grade of limited for dietary patterns and lower risk of excessive gestational weight gain; the identified dietary patterns were similar, supporting higher intakes of vegetables, fruits, legumes, nuts, and fish, and lower intakes of added sugars. This Committee's conclusion statement added higher intakes of whole grains and dairy and removed lower intakes of red and processed meat. The Committee also examined the relationship between dietary patterns and inadequate gestational weight gain, but a grade was not assigned because of lack of evidence. The outcome of inadequate gestational weight gain was not examined by the 2020 Committee.

For the remaining 4 pregnancy outcomes of hypertensive disorders of pregnancy, gestational diabetes mellitus (GDM), gestational age at birth, and birth weight, this Committee updated prior systematic reviews that were conducted by NESR in collaboration with groups of external experts as part of the Pregnancy and Birth to 24 months Project (P/B-24 Project).<sup>25</sup> The 2020 Committee used these prior systematic reviews to address the scientific questions in its report.

For the relationship between dietary patterns and hypertensive disorders of pregnancy, the conclusion from the prior P/B-24 systematic review was limited for dietary patterns consumed before and during pregnancy and reduced risk of hypertensive disorders of pregnancy among healthy Caucasian women with access to healthcare; and a grade was not assigned for dietary patterns before and during pregnancy and hypertensive disorders of pregnancy among minority women and those of lower socioeconomic status. This Committee examined evidence only for dietary patterns during pregnancy but was not able to assign a grade for this conclusion statement because of concerns of heterogeneity, risk of bias, and lack of generalizability.

For the relationship between dietary patterns and risk of GDM, the conclusion from the prior P/B-24 systematic review was limited for dietary patterns consumed before pregnancy and lower risk of GDM, and grade not assignable for dietary patterns during pregnancy. This Committee examined evidence only for dietary patterns during pregnancy and graded its conclusion statement as limited for dietary patterns during pregnancy and lower risk of GDM.

For the relationship between dietary patterns and gestational age at birth, the conclusion from the prior P/B-24 systematic review was limited for dietary patterns consumed during pregnancy and reduced risk of preterm birth, and grade not assignable for dietary patterns consumed before pregnancy and gestational age at birth and risk of preterm birth. This Committee examined evidence only for dietary patterns during



pregnancy and graded its conclusion statement as limited for no association between dietary patterns during pregnancy and preterm birth.

For the relationship between dietary patterns and birth weight outcomes, a conclusion statement could not be drawn in the prior P/B-24 systematic review for dietary patterns consumed either before or during pregnancy and the outcomes examined. This Committee examined evidence only for dietary patterns during pregnancy, and graded the evidence as limited for its conclusion statement on lower risk of small-for-gestational age. This Committee was not able to assign a grade for dietary patterns consumed during pregnancy and the outcomes of large-for-gestational age, macrosomia, or low birth weight.

Both the 2020 and this Committee examined the relationship between dietary patterns and postpartum weight change (the 2020 Committee considered dietary patterns among lactating persons only), and neither Committee was able to assign a grade because of the dearth of available evidence.

## Comparison to Other Systematic Reviews

Several other published systematic reviews have assessed relationships between dietary patterns and health outcomes.<sup>1,16,26-30</sup> Many such reviews have focused on specific dietary patterns, such as Mediterranean, vegan or vegetarian, or other patterns. Several of the reviews did not clearly define the dietary pattern they set out to investigate, which made it difficult for the Committee to identify the dietary pattern being examined. Most reviews focused on a specific health outcome, although several focused on multiple outcomes, especially related to cardiometabolic and type 2 diabetes outcomes. The most robust body of published evidence on dietary patterns and health outcomes is the literature that evaluates associations between dietary patterns and cardiovascular disease or diabetes.

A comprehensive 2023 review of popular dietary patterns assessed their relative alignment with the American Heart Association's (AHA) dietary guidance based on 10 features of evidence-based dietary guidance to promote cardiovascular health. The popular dietary patterns examined included Dietary Approaches to Stop Hypertension (DASH)-style, Mediterranean style, vegetarian style (pescetarian, lacto-/ovo-, and vegan), low fat, very low fat, low carbohydrate, very low carbohydrate, and paleolithic.<sup>1</sup> A scoring process was developed to evaluate whether dietary pattern components met 9 of the 10 features of AHA dietary guidelines (excluding energy balance, given that many of the diet types do not prescribe an energy level). The DASH-style, Mediterranean, and vegetarian patterns more closely met the dietary guidelines, while dietary patterns that emphasized high consumption of meats and animal products scored lower.<sup>1</sup> The components of the AHA dietary guidelines are consistent with many of the findings of the Committee's systematic reviews, which include emphasis on consuming vegetables, fruits, whole grains, legumes, fish or seafood, use of oils with higher levels of unsaturated fatty acids, and low-fat dairy.

A 2023 umbrella review of systematic reviews and meta-analyses examining DASH dietary patterns and cardiometabolic outcomes found that consumption of a DASH diet was associated with several outcomes. Among prospective cohort studies, these results included decreased incident cardiovascular disease (relative risk [RR]=0.80, 95% CI: 0.76, 0.85), and among trials, these results included lower low-density lipoprotein cholesterol and decreased body weight. One 2023 systematic review evaluated the

effects of the Mediterranean diet on primary and secondary prevention of cardiovascular disease.<sup>28</sup> Higher adherence to the Mediterranean diet was associated with decreased overall mortality, as well as decreased risk for heart attacks, stroke, and cardiovascular mortality. Many of the components assessed for adherence to a Mediterranean diet were similar to the Committee's overall findings—fruits, vegetables, legumes, fish, olive oil, and nuts. Another systematic review and meta-analysis of controlled trials to examine the effect of the Mediterranean diet on metabolic health found that, compared to other diets, it resulted in lower risk of incidence of cardiovascular disease (RR=0.61, 95% CI: 0.42, 0.80). These studies confirm this Committee's findings, which graded the evidence on dietary patterns and cardiovascular disease as strong in adults and older adults using a health equity focus. The 2015 and 2020 Committees also graded the evidence on dietary patterns and cardiovascular disease as strong.

Several dietary patterns were found to improve metabolic outcomes in type 2 diabetes mellitus in a systematic review of randomized clinical trials.<sup>31</sup> In particular, the Mediterranean dietary pattern showed improved body weight and hemoglobin A1c levels, the vegan diet showed improved glycemic control, and the vegetarian diet was related to greater body weight loss.<sup>31</sup> That study confirms the findings of a previous systematic review with meta-analyses that examined the association of the Mediterranean diet with better glycemic control.<sup>27</sup> The Committee graded the current evidence on dietary patterns and type 2 diabetes as strong in adults and older adults, corroborating these reviews demonstrating an effect of dietary patterns higher in fruits, vegetables, legumes, fish, and nuts.

Two systematic reviews evaluated the association between consumption of dietary patterns that included ultra-processed foods and childhood obesity, while another review examined the role of ultra-processed food consumption on children's health.<sup>32-34</sup> Both of those systematic reviews included cross-sectional studies, which were not included in the Committee's methodology.<sup>32,33</sup> One of the reviews found an obesogenic dietary pattern that included cheeses, sugary drinks, processed foods, fast food, candies, snacks, cakes, animal products, whole milk, and refined grains. In contrast, the foods associated with lowest risk of obesity included fruits, vegetables, whole grains, fish, nuts, legumes, and yogurt.<sup>33</sup> The other review found a positive association between ultra-processed foods (as defined by the Nova food processing classification) and adiposity in children and adolescents, but only in longitudinal studies.<sup>32</sup>

A systematic review conducted with adults found that higher intakes of ultra-processed foods (as defined by Nova) were associated with risk of obesity and increased risk of non-communicable diseases.<sup>29</sup> Another comprehensive review reported associations between consumption of ultra-processed foods and health outcomes such as risk of overweight and obesity and body composition in both adults and children.<sup>35</sup>

A 2021 umbrella review of meta-analyses of studies of dietary patterns and colorectal cancer concluded suggestive evidence for the association of dietary patterns with reduced risk for colorectal cancer including adherence to the Mediterranean diet, adherence to a healthy diet, adherence to a pesco-vegetarian diet, and adherence to a semi-vegetarian diet.<sup>36</sup>

The association between dietary patterns and breast cancer risk was examined among Asian populations in a systematic review and meta-analysis.<sup>37</sup> Healthy dietary patterns, as defined by vegetables

and ‘prudent’ dietary patterns compared to meat and animal food dietary patterns, and higher scores on Healthy Eating Index, were associated with lower risk of breast cancer.<sup>36,37</sup>

An umbrella review examined associations between dietary patterns, foods, and supplements and cognitive outcomes in mild cognitive impairment.<sup>16</sup> Although most of the reviews were of low quality and the trials tended to have small sample sizes, the Mediterranean diet was found to be the most promising for addressing cognitive decline. Several of the foods identified in the Committee’s conclusion statement are consistent with a Mediterranean diet: higher in vegetables, fruits, legumes or beans, nuts, fish or seafood, and unsaturated vegetable oils, and lower in processed or red meat and sugar-sweetened beverages.<sup>32-34</sup>

A prior systematic review and meta-analysis of maternal dietary patterns and birth outcomes included both a *posteriori* and index-based dietary patterns.<sup>35,38</sup> Healthier dietary patterns during pregnancy, which included higher intakes of vegetables, fruits, whole grains, low-fat dairy, and lean protein foods (seafood, lean meat/poultry, eggs, legumes, nuts/seeds, and soy), were associated with a lower risk of preterm birth. This finding is different than the Committee’s conclusion, which found that dietary patterns may not be associated with preterm birth; however, the conclusion was based on evidence graded as limited. Notably, healthy *a posteriori* dietary patterns were associated with higher birth weight, but *a priori* healthy dietary patterns were not.<sup>38</sup> No associations were seen between dietary patterns during pregnancy and small-for-gestational age or large-for-gestational age, although the number of studies for these analyses was small.

Overall, the Committee’s conclusions are generally consistent with the findings of prior systematic reviews that examined relationships between dietary patterns and various health outcomes, especially for adults. Differences in inclusion and exclusion criteria and definition of outcomes of interest, for example, help explain some of the nuances that may exist between prior reviews and the Committee’s findings. Data examining associations between dietary patterns and health outcomes continue to evolve but are still relatively limited for other life stages and the diversity of the U.S. population.

## Committee’s Advice to the Departments

The systematic reviews covered in this chapter largely confirm the findings of previous Committees. At the same time, the current systematic reviews included new evidence and conclusion statements that could be translated for incorporation into the *Dietary Guidelines for Americans, 2025-2030*. Concepts that the Committee recommends the Departments include are as follows:

- Emphasize consumption of vegetables, fruits, legumes (beans, peas, lentils), whole grains, nuts, and fish/seafood, which were common components found in dietary patterns that were associated with more desirable health outcomes.
- Continue to emphasize consumption of low-fat or non-fat dairy and unsaturated fats, which were frequently found in dietary patterns that were associated with more desirable health outcomes. This advice is consistent with the findings discussed in **Part D. Chapter 3: Beverages**.

- Limit consumption of red and processed meats, foods high in saturated fat, and salty/savory snacks. When consuming grains, encourage mostly whole grains and lower refined grains.
- Continue to limit foods high in added sugars, including sweetened beverages and foods. This advice is consistent with the findings discussed in **Part D. Chapter 3 Beverages**.
- Include more nutrient-dense plant-based meal and dietary recommendation options. Many of the articles reviewed include plant-based dietary patterns, with fish and seafood or low-fat dairy. These findings are consistent with the findings discussed in **Part D. Chapter 4: Food Sources of Saturated Fat**, and **Part D. Chapter 10: Food Group and Subgroup Analyses**.
- Recommend that future Committees consider examining the association of ultra-processed foods with growth, body composition, and risk of obesity. In the Committee’s review, ultra-processed foods were defined by the authors of the articles included in the review, which led to inconsistency among definitions. Despite this inconsistency, most of the foods categorized as ultra-processed were higher in saturated fat, sodium, and added sugars, as well as other food additives and preservatives. The current conclusion statements for both adults and older adults and children and adolescents were based on evidence graded as limited but might change if a more rigorous definition of ultra-processed foods is developed and further studies are conducted. In addition, it would be relevant to examine the consumption of dietary patterns higher in ultra-processed foods and other health outcomes, such as type 2 diabetes mellitus, cardiovascular disease, cancer, and cognitive decline.
- Encourage consumption of healthy dietary patterns at all stages of life and for diverse populations.
- Encourage consumption of healthy dietary patterns and maintain existing guidance that emphasizes intakes of iron, folate/folic acid, iodine, and choline among individuals who are pregnant and postpartum. These dietary patterns were associated with lower risk of excessive gestational weight gain, gestational diabetes mellitus, and small-for-gestational age in infants.
- Consider recognizing that although a healthy dietary pattern is proposed as part of the systematic review process, the nutrition research studies that support this evidence comprise a variety of countries and cultures. Thus, the dietary pattern proposed in this chapter should serve as a core for cultural adaptations (**Part D. Chapter 8: Culturally Responsive Interventions to Improve Diet**) and flexibilities in food choices (**Part E. Chapter 1: Overarching Advice to the Departments**).
- Consider conducting more implementation science research to increase consumption of dietary patterns associated with decreased cardiovascular disease and type 2 diabetes, given the strength of the evidence. Despite the strong conclusion statements, adherence to these dietary patterns is still low in the U.S. population.

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