

## PART D. CHAPTER 13: FREQUENCY OF EATING

### INTRODUCTION

Eating is a behavior that provides humans with nutrients for growth, function, and body maintenance. Eating behaviors can support or weaken health and strongly influence the quality and length of life. Although eating behavior is usually thought of in terms of the types and amounts of foods ingested, the frequency of eating is an equally important factor. A person's daily nutrient intake and overall nutritional status are determined by a complex interplay of these three factors. Eating more or less frequently might influence the types or amounts of foods eaten or alter digestive and metabolic processes. Thus, changes in frequency of eating could lead to changes in a person's nutritional and health status.

This chapter examines the available data concerning the relationships between frequency of eating and: achieving nutrient and food group recommendations; growth, body size and composition, overweight and obesity, cardiovascular disease, type 2 diabetes, and all-cause mortality. The available data on frequency of eating during pregnancy and gestational weight gain is addressed in ***Part D. Chapter 2: Food, Beverage, and Nutrient Consumption During Pregnancy*** and data on frequency of eating during lactation and post-partum weight loss are addressed in ***Part D. Chapter 3: Food, Beverage, and Nutrient Consumption During Lactation***.

### Importance and Relevance of this Topic

The traditional American diet is organized around 3 meals/day (i.e., breakfast, lunch, and dinner). This 3-meal frequency of eating pattern is deeply embedded in popular culture, although Americans now report a mean of more than 5 meals or snacks per day.<sup>1</sup> This greater eating frequency is largely due to an increase in snacking, though consensus on clear definitions or distinctions between a meal versus a snack remains elusive. Forty-year trends in eating behaviors from the What We Eat In America (WWEIA), National Health and Nutrition Examination Surveys (NHANES) conducted from 1971 to 2010 found that American adults report an average of 2.8 meals and 2.3 snacks per day.<sup>1</sup> Similar patterns are also observed in children.<sup>2</sup> Of interest, some evidence suggests that eating frequency varies by time of day and days of the week.<sup>3,4</sup>

Although no previous editions of the *Dietary Guidelines for Americans* have made specific eating frequency recommendations, they have promoted the consumption of nutrient-dense

breakfasts and snacks for improved health outcomes.<sup>5,6</sup> Increasing public awareness and research activity related to selected aspects of eating frequency, such as "grazing," intermittent fasting, meal skipping, and late-night eating reflects a high level of interest in the evolving science of eating frequency. An emerging scientific evidence base is now beginning to allow examination of eating frequency and health over varied populations, conditions, and health indices. Thus, an examination of whether eating frequency directly affects diet quality and health outcomes is warranted and is the focus of this chapter.

## Setting the Scope of the Review

As alluded to above, studies vary widely in defining and measuring the eating occasions that are the unit of measure for frequency of eating. A critical first step before examining the scientific literature for the 2020 Dietary Guidelines Advisory Committee, therefore, was to establish a definition for eating occasions. When considering how to appropriately define eating occasions, the Committee considered the following kinds of issues:

- Should snacking be considered an eating occasion?
- Should meals and snacks be examined separately?
- Should an eating occasion include instances where no energy is consumed (e.g., water intake or low or no energy beverage intake alone)?
- Should energy, nutrients, or type of food be considered?
- Should beverage intake be considered an eating occasion when occurring alone?
- When does one eating occasion stop and another start?
- What time duration or interval is needed to accurately assess eating frequency?
- Should the time of the eating occasion (e.g., morning or first eating occasion, late night) and/or the time interval between eating occasions (e.g., time-restricted eating, intermittent fasting) be considered?

After careful deliberation, the Committee concurred that an eating occasion be defined as "any ingestive event (solid food or beverage, including water) that is either energy yielding or non-energy yielding." Accordingly, frequency of eating was defined by the Committee as "the number of daily eating occasions." No minimal or maximal time criteria between eating occasions was imposed, as no standard intervals have been used in the literature.

The following types of instruments are used in scientific studies to quantify the number of daily ingestive events: 24-hour dietary recall, 24-hour dietary record, and eating frequency

questionnaires. Food frequency questionnaires, in general, assess the frequency of specific foods and/or beverages consumed and not the number of ingestive events over a given amount of time. However, a study was included if specific questions related to ingestive events were coupled with the food frequency questionnaire.

As previously mentioned, this is the first Committee to directly evaluate the effect of frequency of eating on health outcomes and the Committee wanted to ensure the studies included in the systematic review collected enough data from which to ascertain that it was the frequency of eating, and not other dietary aspects, that were related to any health outcome. The literature on frequency of eating generally examines two experimental designs, those based on observational studies and those based on intervention studies. Therefore, the Committee set unique minimum criteria for studies to be included in the systematic review that answered Questions 2 through 5 in this Chapter (see Methodology section).

## LIST OF QUESTIONS

1. What is the relationship between the frequency of eating and achieving nutrient and food group recommendations?
2. What is the relationship between the frequency of eating and growth, size, body composition, and risk of overweight and obesity?
3. What is the relationship between the frequency of eating and all-cause mortality?
4. What is the relationship between the frequency of eating and risk of cardiovascular disease?
5. What is the relationship between the frequency of eating and risk of type 2 diabetes?

## METHODOLOGY

### Data Analysis Methodology

Question 1 in this chapter was answered using data analysis. The Committee developed a protocol for the question, which described how the Committee would use data analyses to answer the question. The protocol included an analytic framework that describes the overall scope of the analyses, including the population and type of analyses and data sources identified to answer the question. It also includes the definitions of key terms.

Data from nationally representative federal datasets were analyzed by the Data Analysis Team (DAT). More information about the data analysis methodology is provided in **Part C**.

**Methodology**, including more detail on the data sources. Complete documentation of the data analysis protocol and the referenced results is available on the following website: [place holder for site]. Below is a summary of the unique elements of the protocols developed to answer the questions addressed in this chapter.

The data analyses considered for this question include the average number of ingestive events. Other analyses include data from the WWEIA, NHANES on named eating events as identified by the participant during a 24-hour dietary recall (e.g., breakfast, lunch, snack).<sup>7</sup> The definition of each ingestive event label in both English and Spanish are defined in the key terms of the protocol. Data on the proportion of nutrients and other food components from each ingestive event was estimated by discrete meal categories (i.e., breakfast, lunch, dinner, and Spanish-language equivalents) and snacks (i.e., snacks, beverage only, and extended consumption events (events where foods or beverages were consumed over a long period of time). Also of interest was the proportion of food components consumed between 8 p.m. and midnight among adolescents and adults.

Because data analysis and systematic review are different approaches to review the evidence, the presentation of the summary of evidence is organized differently below. In each case, however, the conclusion statements are informed by the evidence reviewed, as outlined in the protocol. The Committee took the strengths and limitations of data analyses into account in formulating conclusion statements. The grading process used for questions answered by the NESR systematic review methodology does not apply to questions using data analysis; therefore, data analysis conclusions were not graded.

## **Systematic Review Methodology**

Questions 2 through 5 in this Chapter were answered by conducting systematic reviews with support from USDA's Nutrition Evidence Systematic Review (NESR) team.

NESR's systematic review methodology provided a rigorous, consistent, and transparent process for the Committee to search for, evaluate, analyze, and synthesize evidence. The Committee developed a systematic review protocol for each question, which described how the Committee would apply NESR's methodology to answer the question. Each protocol included an analytic framework and inclusion and exclusion criteria that were used to guide identification of the most relevant body of evidence to use in answering each systematic review question.

Next, a literature search was conducted to identify all potentially relevant articles, and those articles were screened by 2 NESR analysts independently based on the criteria selected by the Committee. For each included article, data were extracted and risk of bias assessed. The

Committee qualitatively synthesized the body of evidence to inform development of a conclusion statement(s), and graded the strength of evidence using pre-established criteria for risk of bias, consistency, directness, precision, and generalizability. Finally, recommendations for future research were identified.

A detailed description of NESR’s systematic review methodology is provided in **Part C. Methodology**, including standard inclusion and exclusion criteria applied in many of the Committee’s systematic reviews. Complete documentation of each systematic review, including the protocol, is available on the following website: [nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews](https://nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews). Below is a summary of the unique elements of the protocols developed to answer the questions on frequency of eating.

For the questions on frequency of eating and all-cause mortality, cardiovascular disease, and type 2 diabetes, the population of interest was children and adolescents (ages 2 to 18 years); adults (ages 19 to 64 years); women during pregnancy or lactation; older adults (ages 65 years and older). For the question on frequency of eating and growth, size, body composition, and risk of overweight and obesity, “women during pregnancy or lactation” were removed from the population of interest. Women during pregnancy and women during lactation were the populations of interest in 2 additional questions examining the relationship between frequency of eating and gestational weight gain (see **Part D. Chapter 2: Food, Beverage, and Nutrient Consumption During Pregnancy** for these results) or post-partum weight loss (See **Part D. Chapter 3: Food, Beverages, and Nutrient Consumption During Lactation** for these results), respectively.

In all reviews, the intervention or exposure of interest was frequency of eating, with the comparator of interest being a different number of daily eating occasions. Frequency of eating was defined as “the number of daily eating occasions,” and daily eating occasions were defined as “any ingestive event (solid food or beverage, including water) that is either energy yielding or non-energy yielding.”

The outcomes of interest in each review are as follows:

- All-cause mortality: the total number of deaths from all causes during a specific time period
- Cardiovascular disease: total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) (including TC:HDL cholesterol and LDL:HDL cholesterol ratios), triglycerides, blood pressure (systolic and diastolic), cardiovascular disease (myocardial infarction, coronary heart disease (CHD), coronary

artery disease, congestive heart failure, peripheral artery disease), stroke, venous thrombosis, and cardiovascular disease-related mortality

- Type 2 diabetes: glucose, insulin, hemoglobin A1c, prediabetes, and type 2 diabetes
- Growth, size, body composition, and risk of overweight and obesity: weight, weight-for-age, height, length/stature-for-age, body mass index (BMI), BMI z-score, weight-for-length, body circumferences (head, arm, waist, thigh, neck), body composition and distribution (e.g., percent fat mass, fat-free mass, lean mass), and incidence and prevalence of underweight, failure to thrive, stunting, wasting, healthy weight, overweight, or obesity

When establishing inclusion and exclusion criteria, the Committee used standard NESR criteria for study design, publication status, language of publication, country, study participants, and health status of study participants. Studies were included if they were published from January 2000 to June 2019. In addition, the Committee applied unique inclusion and exclusion criteria for eating frequency data collection and size of study groups, as follows:

- Data collection for eating frequency, in both intervention and observational studies, had to encompass a minimum of 3, 24-hour periods or a questionnaire that covered at least 3 days. In addition, for intervention studies, data collection had to occur on at least 2 occasions, including baseline and during or after the intervention. These criteria were selected to ensure a reasonable measure of customary eating frequency was used in both observational and intervention studies. Eating frequency varies across days and throughout the lifespan. To capture customary or habitual eating frequency, the Committee determined it necessary to have multiple days of data collection. With respect to intervention studies, the Committee required measurement of eating frequency on 2 occasions, at baseline, and then again during or after the intervention. This requirement allowed for the measurement of baseline (usual) eating frequency pattern before the intervention, whereas the second occasion measured eating frequency as a result of the intervention. The second occasion could also be a measure of compliance or adherence to the intervention.
- For intervention studies, at least 15 participants for studies using within-subject analyses, or 30 participants for studies using between-subject analysis, or a power calculation included was required. It is important to ensure that a study is adequately powered to find an effect. Including 30 participants in studies using between-subject

analysis, or 15 participants using within-subject analysis, resulted in being able to detect a less than 1 standard deviation of the mean.

## **REVIEW OF THE SCIENCE**

### **Question 1. What is the relationship between the frequency of eating and achieving nutrient and food group recommendations?**

**Approach to Answering Question:** Data analysis

#### **Conclusion Statements**

Eating patterns vary by frequency and timing in the United States, and are shaped by age, race/ethnicity, and income. On average, the U.S. population reports 5.7 eating occasions per day, occurring most often at noon or “evening.”

Most of the U.S. population report consuming 3 meals (64 percent of the population) or 2 meals (28 percent of the population) per day.

Snacking is ubiquitous, occurring in 93 percent of the U.S. population. Snacks provide 22 percent to 23 percent of total energy consumed and 2 to 3 snacking events are reported on average per day.

Late-night eating events often include alcohol intake (in adults), and intakes of added sugars, sodium, and saturated fats in adolescents and adults.

When compared with 2 meals, Americans who consume 3 meals per day tend to have approximately 5-point higher Healthy Eating Index scores.

#### **Summary of the Evidence**

Various eating patterns exist in America, especially with regard to the frequency and timing of eating, which are largely shaped by a number of demographic characteristics such as age, race/ethnicity, and income. A recent analysis examining the frequency of eating, timing of events, and labels applied to those eating events by Americans such as breakfast, lunch, or dinner and their Spanish equivalents indicated that on average, Americans report about 5.7

eating events a day, inclusive of meals, snacks, beverages, and extended consumption. The majority of these eating events cluster around certain times of the day that align with conventional naming of meals such as lunch and dinner. However, conventional naming of meals is limited given the extensive variability in eating behaviors among American demographic subpopulations. Nevertheless, conventional naming of meals helps shape context for providing and tailoring recommendations. The times associated with conventional meals were 7 to 9 a.m. for breakfast, 12 to 1 p.m. for lunch, and 6 to 8 p.m. for dinner. Most Americans report 2 or 3 snacks per day, most often in the afternoon time between lunch and dinner. Later temporal eating events were more likely to be reported by adolescents and young adults. Eating events after 8 p.m. represented one-quarter to one-third of food components recommended to be consumed in moderation: added sugars, sodium, and saturated fats. Additionally, among adults, most alcoholic beverages are consumed within this time range.

The majority of Americans report consuming 2 (28 percent) or 3 (64 percent) meals per day, and the likelihood of reporting 3 meals per day varied in magnitude by age group among Americans. Although U.S. adults (ages 20 years and older) were the least likely to report 3 meals per day and the largest proportion of their daily energy intake was reported at dinner time, adolescents (ages 14 to 18 years) and young adults (ages 20 to 39 years) were the least likely to consume breakfast, and tended to shift eating occasions to later in the day (i.e., after 8 p.m.). Alternatively, among children (ages 2 to 19 years), total daily energy was generally distributed between breakfast (18 percent), lunch (27 percent), dinner (32 percent), as well as snacks (23 percent). Although snacking is ubiquitous in the U.S. population (93 percent) and provides nearly 23 percent of total daily energy for most Americans, snacks alone provide as much as 35 percent of total added sugars among children. Similar patterns were also observed when evaluating differences in eating behaviors by race/ethnicity. The frequency and timing of eating varied by race/ethnicity, with Hispanic and non-Hispanic Black Americans as the least likely to report 3 meals per day. Hispanic children and adults report a higher percent of their daily energy and nutrients at breakfast than other meals. This subgroup then also was less likely to consume lunch or dinner than other race/ethnic groups.

Notable differences also were observed when assessing the frequency and timing of eating by family income. Those whose family income was less than 131 percent of the Federal poverty level had the lowest percent reporting eating occasions (i.e., meals and snacks) and lower frequency of eating when compared with those who had a family income greater than 131 percent of the poverty level. As a result, individuals residing in the lowest poverty-to-income-

ratio families had a lower proportion of nutrients consumed at lunch relative to other income groups, which was especially notable among children 2 to 11 years

When evaluating the relationship between the frequency of eating and dietary quality using the Healthy Eating Index (HEI),<sup>8</sup> Americans who consumed 3 meals per day (HEI score = 61) consistently reported a diet higher in dietary quality than Americans who consumed 2 meals per day (HEI score = 55), regardless of population subgroup (see **Part D. Chapter 1: Current Intakes of Foods, Beverages, and Nutrients**, Question 3, for additional information about the HEI). These findings also were consistent with individual HEI dietary quality components. Americans reporting 3 meals per day were more likely to have higher intake of several adequacy components, including total vegetables, greens and beans, total fruit, whole fruit, whole grains, and dairy and lower intake of some moderation components, such as added sugar and sodium, than those who reported only 2 meals per day. Every eating occasion is a chance to make nutrient-dense food choices. Shifts in childhood and adulthood snacks, and adolescence eating frequency and timing could help align patterns with recommendations.

For additional details on this body of evidence, visit: <https://www.dietaryguidelines.gov/2020-advisory-committee-report/data-analysis>.

## **Question 2. What is the relationship between the frequency of eating and growth, size, body composition, and risk of overweight and obesity?**

**Approach to Answering Question:** NESR systematic review

### **Conclusion Statement and Grade**

Insufficient evidence is available to determine the relationship between the frequency of eating and growth, size, body composition, and risk of overweight and obesity. Grade: Grade Not Assignable

## Summary of the Evidence

- This systematic review was undertaken to examine the relationship between the frequency of eating and growth, size, body composition, and risk of overweight and obesity.
- This review included 6 studies<sup>9-14</sup> published between January 2000 and September 2019 that met the inclusion criteria for this systematic review: 1 randomized controlled trial (RCT) and 5 prospective cohort studies (PCSs).
- Four out of 6 included studies reported an association between frequency of eating and at least one growth, size, body composition, or overweight and obesity outcome. However, the studies were inconsistent in terms of how they defined and examined frequency of eating, the outcomes they examined, and their reported results.
- Several critical limitations were identified within the body of evidence:
  - Studies varied in intervention or exposure assessment methods.
  - Definitions of eating occasions and number of eating occasions in the comparison groups varied in every included study.
  - Outcomes varied across studies: BMI, change in BMI, body fat, fat-free mass, waist circumference, change in waist circumference, 5 kg weight gain, weight change, subcutaneous fat, preperitoneal fat, abdominal fat index.
  - Eating frequency assessment was conducted only at baseline, leading to concerns of possible changes over time.
  - Both energy yielding and non-energy yielding beverages were inconsistently accounted for within eating occasion definitions across studies.

- Water consumption was not explicitly mentioned in any included studies.
- The studies had high or unknown attrition rates.
- Study populations did not fully represent the race/ethnic or socioeconomic diversity of the American population.
- Due to the inconsistency and limitations in the body of evidence included in this systematic review, the Committee determined that the evidence was insufficient to draw conclusions about the relationships between frequency of eating and growth, size, body composition, and risk of overweight and obesity.

**For additional details on this body of evidence, visit:** [nestr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-growth-size-body-composition-obesity](https://nestr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-growth-size-body-composition-obesity)

### **Question 3. What is the relationship between the frequency of eating and all-cause mortality?**

**Approach to Answering Question:** NESR systematic review

#### **Conclusion Statement and Grade**

No evidence is available to determine the relationship between the frequency of eating and all-cause mortality. Grade: Grade Not Assignable

#### **Summary of the Evidence**

- This systematic review was undertaken to examine the relationship between the frequency of eating and all-cause mortality.
- All-cause mortality was defined as the total number of deaths from all causes during a specific time-period.
- This review identified 0 studies published between January 2000 and June 2019 that met the inclusion criteria for this systematic review.

**For additional details on this body of evidence, visit:** [nestr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-all-cause-mortality](https://nestr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-all-cause-mortality)

## **Question 4. What is the relationship between the frequency of eating and risk of cardiovascular disease?**

**Approach to Answering Question:** NESR systematic review

### **Conclusion Statement and Grade**

Insufficient evidence is available to determine the relationship between the frequency of eating and cardiovascular disease. Grade: Grade Not Assignable

### **Summary of the Evidence**

- This systematic review was undertaken to examine the relationship between the frequency of eating and cardiovascular disease.
- This review identified 2 PCSs<sup>15,16</sup> published between January 2000 and September 2019 that met the inclusion criteria for this systematic review.
- The studies were inconsistent in terms of how they defined and examined frequency of eating, the outcomes they examined, and in their reported results:
  - One included study reported that a higher eating frequency at baseline was associated with lower blood pressure after a 5-year follow-up.
  - One included study reported no association between eating frequency at baseline and risk of coronary heart disease after a 16-year follow-up.
- Critical limitations were identified within the body of evidence:
  - Weak study designs were used to explore this question.
  - Eating frequency was measured only at baseline, leading to concern that changes in exposure status may have occurred over the follow-up time periods.
  - The amount of attrition was unknown.
  - The study showed several risks of bias.
  - Inconsistent outcomes were included across studies with respect to relative risks and 95% confidence intervals for CHD, systolic blood pressure, diastolic blood pressure, and hypertension.
  - Water consumption was not explicitly mentioned in either included study.
  - Due to the small body of evidence with inconsistency in design and reported results and several limitations, the Committee determined that the evidence was insufficient to draw

conclusions about the relationship between frequency of eating and cardiovascular disease.

**For additional details on this body of evidence, visit:** [nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-cardiovascular-disease](https://www.nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-cardiovascular-disease)

## **Question 5. What is the relationship between the frequency of eating and risk of type 2 diabetes?**

**Approach to Answering Question:** NESR systematic review

### **Conclusion Statement and Grade**

Insufficient evidence is available to determine the relationship between the frequency of eating and type 2 diabetes. Grade: Grade Not Assignable

### **Summary of the Evidence**

- This systematic review was undertaken to examine the relationship between the frequency of eating and type 2 diabetes.
- This review included 2 PCSs<sup>12,17</sup> published between January 2000 and September 2019 that met inclusion criteria.
  - One included study reported that adult men who reported 1 to 2 eating occasions per day had a higher risk of type 2 diabetes compared to men who reported 3 eating occasions after 16 years of follow-up.
  - One included study did not report an association between frequency of eating in adult women and risk of type 2 diabetes after a 6-year follow-up.
- Critical limitations were identified within the body of evidence:
  - Habitual eating frequency was measured only at baseline, leading to concern that changes in exposure status may have occurred over the follow-up time periods.
  - Weak study designs were used to explore this question.
  - Beverages and water were not included in assessments of eating occasions.
  - The amount of attrition was unknown.

- Due to a small, inconsistent body of evidence with critical limitations, the Committee determined that the evidence was insufficient to draw conclusions about the relationship between frequency of eating and type 2 diabetes.

**For additional details on this body of evidence, visit:** [nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-type-2-diabetes](https://www.nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews/frequency-eating-subcommittee/frequency-eating-type-2-diabetes)

## DISCUSSION

Eating frequency is associated with a wide range of appetitive, digestive, and metabolic processes that are relevant to the health and well-being of Americans.<sup>18-24</sup> Using rigorous criteria developed by this Committee for examining 5 questions on frequency of eating (see Methods section), the NESR staff identified 9 scientific publications to include in this review. Following analysis of these scientific publications, this Committee concluded that insufficient evidence was available at present to determine the relationship between frequency of eating and growth, body size and composition, overweight and obesity, cardiovascular disease, type 2 diabetes, and all-cause mortality. Further, due to insufficient evidence, grades for the strength of the evidence reviewed were not assignable.

Based on this review, the Committee identified a need to standardize the definition of ingestive events within the scientific community; to improve the methodology for measuring frequency of eating; to include the collection and analysis of eating frequency data within all study designs; and to complete more well-designed, RCTs that directly examine whether a causal role exists between frequency of eating and health.

Although the Committee was unable to find adequate evidence to address the questions on eating frequency and health, it was able to conduct a cross-sectional analysis from the only available sources of nationally representative data to describe the state of eating frequency in the U.S. diet. This analysis revealed a wide variety of eating frequency patterns that varied by socioeconomic and demographic factors. Diet quality was higher when self-reported meal intake increased from 2 meals per day to 3, whereas late-night eating often contained food components recommended to be consumed only in moderation.

As questions specific to frequency of eating and health were a new addition for the Committee, it was charged with the task of defining an eating occasion out of necessity. Eating occasions are the unit that, when summed over a given period of time, leads to a quantitative

measure of the frequency of eating. The scientific literature is inconsistent in defining an eating occasion or ingestive event. So the Committee decided for the purposes of informing Federal dietary guidelines that an eating occasion should be considered as “any ingestive event including preload (for intervention trials), meals, or snacks comprised of foods or beverages that are energy yielding or non-energy yielding”. The Committee recommends the scientific community raise the standardization of frequency of eating terms to a high priority (see Research Recommendations in **Part E. Future Directions**).

It was important to ensure that the studies testing frequency of eating and health hypotheses were capturing habitual or usual eating frequency. Thus, the Committee decided to add inclusion criteria for the systematic review question that would require studies collect a minimum of 3 days of dietary data. In addition to this criterion, intervention studies also were required to collect these data on at least 2 occasions, including baseline and during or after the intervention. This approach allowed for the measurement of: 1) usual eating frequency to determine whether a change occurred as a result of the intervention, and 2) compliance and/or adherence to the respective eating frequency intervention. These requirements did result in the exclusion of a small number of studies from the literature review. It should be noted that 3 days of eating frequency data collection were unavailable in the nationally representative data sources.<sup>7,25</sup> Because no health hypothesis was tested in these data sources, the Committee was willing to accept a slightly lower data collection requirement to obtain an estimate of eating frequency in the current U.S. population.

Overall, the review of the literature on frequency of eating and health that did meet the Committee's inclusion and exclusion criteria uncovered multiple concerns with PCSs, including: weak study designs, variations in intervention or exposure assessment methods, inconsistent definitions of eating occasions, diverse reported outcomes, dissimilar measures of eating frequency, missing data for comparisons across studies, different criteria for inclusion of energy-yielding and non-energy-yielding beverages, failure to explicitly report water consumption, high or unknown attrition rates, inclusion of populations that were not fully representative of the race-ethnic or socioeconomic diversity of the U.S. population, and high risk of bias.

Only 1 RCT met the inclusion and exclusion criteria for the systematic review. Overall, the RCTs pertinent to frequency of eating were observed to have major limitations, including: failure to report all eating occasions over a 24-hour period, weak study designs (e.g., low power, short duration, missing key control groups/conditions, absence of baseline characterization of study group ingestive behavior), variations in intervention or exposure assessment methods, inconsistent definitions of eating occasions, diverse reported outcomes, dissimilar measures of

eating frequency, missing data for comparisons across studies, different criteria for inclusion of energy-yielding and non-energy-yielding beverages, failure to explicitly report water consumption, high or unknown attrition rates; inclusion of populations that are not fully representative of the race-ethnic or socioeconomic diversity of the U.S. population, and high risk of bias.

The Committee recommends future studies on frequency of eating include all of the necessary data in a study to assess frequency of eating and outcomes, including key confounders and adequate dietary data collection. Quantifying and including water intake as an eating occasion is also a high priority.

Additionally, intermittent fasting, time-restricted eating, breakfast skipping, and late-night eating are all topics of current public interest. The manipulation of eating frequency and timing of ingestion is at the core of each of these eating behaviors. Although timing of eating occasions is also an important consideration in the relationship between frequency of eating and health, the Committee determined that the root of the questions posed required that the number of daily eating occasions be evaluated as the primary intervention or exposure of interest. Studies that adequately addressed the number of eating occasions and also tested the timing of the eating occasions would have been included in the body of evidence. Unfortunately, the current literature on timing of eating occasions typically did not adequately report the total number of ingestive events over a 24-hour period, which would have allowed for the disentanglement of the effects of the number of eating occasions vs the timing on health. Such data must be included in future research on timing of eating to determine the degree to which compensatory behaviors (e.g., increased energy-dense eating occasions following breakfast skipping) occur and affect the health outcomes. The Committee also recommends the 2025 Dietary Guidelines Advisory Committee consider separate questions examining how the timing of ingestive events influences health, and how food insecurity and other constraints on food choice and access fit into hypotheses around frequency of eating and health. All of these issues are addressed in Research Recommendations in ***Part E. Future Directions***.

## SUMMARY

The 3 main components that characterize a person's eating behavior are the frequency, types, and amounts of foods ingested. Although the types and amounts of foods consumed are traditionally a focus of the *Dietary Guidelines for Americans* and the Dietary Guidelines Advisory Committees, the 2020 Committee is the first to directly address the question of frequency of

eating. The frequency of eating is an increasingly relevant topic that contributes to a wide range of appetitive, digestive, and metabolic processes that are relevant to the health and well-being of Americans.

The NESR review did not yield specific answers to the questions concerning the relationship between frequency of eating and health outcomes of obesity, all-cause mortality, risk of cardiovascular disease, or risk of type 2 diabetes. This was primarily due to the limited availability of high-quality data. The Committee cannot therefore make recommendations to the Departments on frequency of eating and health.

The Committee was able to address the relationship between the frequency of eating and achieving nutrient and food group recommendations. The Committee determined that, on average, Americans self-report 5.7 eating occasions throughout the day with the majority (64 percent) consuming 3 meals per day and 28 percent consuming 2 meals per day. More than 90 percent of Americans also report 2 to 3 snacking occasions per day. Reported frequency of eating and types of ingested foods varied widely across age, race-ethnicity, and income groups.

Americans who reported consuming an average of 3 meals per day had a higher diet quality compared to those consuming 2 meals per day. This was attributable to relatively larger intakes of vegetables, greens and beans, fruit, whole grains, and dairy and smaller intakes of foods with added sugars and sodium in the 3 meal per day pattern.

Nearly one-fourth (22 percent to 23 percent) of energy consumed by Americans is provided by snacks. Although these eating occasions can contribute to meeting nutrient and food group recommendations (e.g., fruits, dairy), they also can include disproportionately large amounts of high-energy, low-nutrient foods and/or beverages that do not contribute substantively to meeting dietary recommendations. For example, snacks alone provide as much as 35 percent of total added sugars among children.

The Committee affirms that healthy dietary patterns and eating frequencies can be constructed in a variety of ways to suit differing life stages and cultural practices (see **Part D. Chapter 8: Dietary Patterns**). The Committee's findings also suggest that following a dietary pattern that reduces snacking and emphasizes meals, both primarily comprised of foods and beverages that contribute to nutrient and food group recommendations, can help align eating patterns with dietary guideline recommendations.

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