

PART D. CHAPTER 12: ADDED SUGARS

INTRODUCTION

The *2015-2020 Dietary Guidelines for Americans* emphasized healthy dietary patterns across the lifespan that include nutrient-dense foods consumed at an appropriate energy level to help achieve and maintain healthy body weight as well as to support nutrient adequacy and reduce the risk of chronic disease. As such, a major recommendation was to limit energy from added sugars; specifically, to consume less than 10 percent of energy from added sugars.¹ This value (less than 10 percent of energy) was based on food pattern modeling and national data that informed an estimate of energy intake from added sugars that would be possible while meeting food group and nutrient needs within energy limits appropriate for healthy weight. Because added sugars and saturated fats were considered together, the *2015-2020 Dietary Guidelines for Americans* included a cautionary note that for most energy levels, not enough energy would be available, after meeting food group needs, to consume 10 percent of energy from added sugars and from saturated fats. Similar to the previous approach, the 2020 Dietary Guidelines Advisory Committee focused on analyses of the amount of added sugars that can be accommodated in healthy dietary patterns without exceeding energy needs.

Guidance on added sugars is of great relevance because of the high prevalence in the United States of overweight and obesity, type 2 diabetes, cardiovascular disease (CVD), and adiposity-related cancers (see **Part D. Chapter 1: Current Intakes of Foods, Beverages, and Nutrients**). The prevalence of obesity among adults in the U.S. population was 38.9 percent (95% CI: 37.0%, 40.7%) in 2013-2016, with the prevalence of severe obesity at 7.6 percent (95% CI: 6.8%, 8.6%).² Among U.S. youth ages 2 to 19 years, the prevalence of obesity and severe obesity during the same time period was 17.8 percent (95% CI: 16.1%, 19.6%), and 5.8 percent (95% CI: 4.8%, 6.9%), respectively.³ For adults, between 2007-2008 and 2015-2016, the prevalence of obesity and severe obesity increased. However, for youth, no significant trends were observed.⁴ Because obesity is a risk factor for numerous health outcomes, the Committee was asked to address a series of questions on diet and health outcomes assessing the relationship between consumption of added sugars and: 1) growth, size, body composition and risk of overweight and obesity, including gestational weight gain during pregnancy and postpartum weight loss during lactation, 2) risk of CVD, and 3) risk of type 2 diabetes. These questions were addressed as follows:

- **Added sugars in relation to growth, size, body composition and risk of overweight and obesity.** *Part D. Chapter 10: Beverages* presents evidence for the effects of sugar-sweetened beverages (SSB) on these outcomes for children and adults. Given time constraints and because SSB account for a substantial proportion of total energy from added sugars in the U.S. population ages 2 years and older (24 percent for sweetened beverages, not including coffees and teas with added sugar), the Committee relied on evidence from the SSB component of the beverage review for this question. Pregnant and lactating populations were not addressed in this review.
- **Added sugars in relation to risk of CVD.** The review of evidence and conclusions is presented in this Chapter, below, and includes evidence for outcomes including CVD risk profile, CVD clinical endpoints, and CVD mortality. This outcome was prioritized due to the “moderate” grade it received from the 2015 Committee compared to a grade of “strong” for growth, size, body composition, and risk of overweight and obesity and for type 2 diabetes.
- **Added sugars in relation to risk of type 2 diabetes.** Due to time constraints, this evidence was not reviewed, and the 2020 Committee refers to the 2015 Dietary Guidelines Advisory Committee report, in which a review of 5 systematic reviews and a meta-analysis yielded a conclusion of strong evidence that higher consumption of added sugars, especially SSB, increases risk of type 2 diabetes in adults,¹ and that this association was explained, in part, by body mass index.

In addition to these questions on diet and health outcomes, the Committee was asked to consider the relationship between added sugars consumption and achieving nutrient and food group recommendations using data analyses, and the amount of added sugars that can be accommodated in a healthy diet using food pattern modeling.

The Committee defined the term “added sugars” according to the 2016 U.S. Food and Drug Administration (FDA) guidance, which is sugars that are either added during the processing of foods, or are packaged as such (e.g., a bag of sugar). Added sugars include sugars (free, mono-, and disaccharides), sugars from syrups and honey, and sugars from concentrated fruit or vegetable juices that are in excess of what would be expected from the same volume of 100% fruit or vegetable juices of the same type.⁵ In its review, the Committee included studies on consumption of total added sugars from foods and beverages, as well as studies that focused on added sugars from a single substantial source (e.g., sucrose, SSB).

Questions

1. What is the relationship between added sugars consumption and achieving nutrient and food group recommendations?
2. What is the relationship between added sugars consumption and risk of cardiovascular disease?
3. How much added sugars can be accommodated in a healthy diet while still meeting food group and nutrient needs?

METHODOLOGY

Question 1 was answered using data analysis. Before examining any evidence, the Committee developed a protocol that described how data analyses would be used to answer the question. The protocol included an analytic framework and analytic plan. The analytic framework described the overall scope of the analyses, including the population, types of analyses, and data sources. It also included definitions of key terms.

This question relied on analyses of data from What We Eat in America (WWEIA), the dietary component of the National Health and Nutrition Examination Survey (NHANES). The WWEIA, NHANES collects dietary intake data using 24-hour dietary recalls. Data analyses outlined in the analytic plan focused on the contribution of added sugars to food group intakes as well as intakes of nutrients and other food components. Existing data tables were used when available with new analyses conducted by the Data Analysis Team (DAT) at the Committee's request to provide additional information for specific population groups, such as infants and toddlers and women who are pregnant or lactating. Life stages from children ages 2 years through older adults and including women who are pregnant or lactating were considered. For the general population ages 2 years and older, the 2015-2016 cycle of data were examined. For women who are pregnant or lactating, and analyses of estimated mean added sugars as a percent of total energy, the 2013-2016 data cycles were combined and used. Analyses examining change in dietary intake over time also relied on the 2007-2010 data cycles.

A description of the data analysis methodology is provided in **Part C. Methodology**, including information about the data sources. Complete documentation of the data analysis protocol and the referenced results are available on the following website: <https://www.dietaryguidelines.gov/2020-advisory-committee-report/data-analysis>. Below is a summary of the key elements of the protocol developed to answer Question 1.

The Question describes usual intake distribution in the U.S. population of added sugars from all sources, defined according to FDA guidance. The percent of the U.S. population with added sugars intake less than or equal to and greater than 10 percent of total energy intake based on usual intake distributions also was determined. The Committee also assessed food category contributions to total added sugars intake and determined what, if any, contribution these food categories have on intake of food groups and nutrients as a percent of energy and other dietary components (e.g., intake of whole grains). Demographic subgroup analyses were conducted to look at differences by sex and by race and ethnicity.

The Committee took into account the strengths and limitations of data quality and analyses when formulating conclusion statements, but conclusion statements based on data analyses were not graded. Because data analysis and systematic review are different approaches to reviewing the evidence, the presentation of the summary of evidence is organized differently, but in each case, the conclusion statements are informed by the evidence reviewed, as outlined in the protocol.

Question 2 in this chapter was answered using a systematic review conducted with support from USDA's Nutrition Evidence Systematic Review (NESR) team. This review covered evidence published since the existing systematic review conducted by the 2015 Committee. NESR's systematic review methodology provided a rigorous, consistent, and transparent process for the Committee to search for, evaluate, analyze, and synthesize evidence. The new evidence was synthesized separately from the existing review, and used to draw and grade conclusion statements based solely on the new evidence. **Part C. Methodology** provides a description of the process the Committee used when existing systematic reviews were available. In addition, detailed information about the 2015 Committee's review of the evidence can be found in their report, which is available at the following website: nesr.usda.gov/2015-dietary-guidelines-advisory-committee-systematic-reviews / dietaryguidelines.gov/current-dietary-guidelines/process-develop-2015-2020-dg/advisory-committee.

The Committee developed a systematic review protocol for this question that described how the Committee would apply NESR's methodology to answer the question. The protocol included an analytic framework and inclusion and exclusion criteria to guide identification of the most relevant and appropriate body of evidence to use in answering each systematic review question. Each analytic framework outlined core elements of the systematic review question (i.e., population; intervention and/or exposure and comparator [i.e., the alternative being compared to the intervention or exposure]; and outcomes), and included definitions for key terms, key

confounders, and other factors to be considered when reviewing the evidence. The inclusion and exclusion criteria were selected, up front, to operationalize the elements of the analytic framework, and specify what made a study relevant for each systematic review question.

Next, a literature search was conducted to identify all potentially relevant articles, and those articles were screened by two 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. Below is a summary of the unique elements of the protocol developed to answer the question addressed in this chapter. 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 is available on the following website: nesr.usda.gov/2020-dietary-guidelines-advisory-committee-systematic-reviews.

For the systematic review on added sugars and risk of CVD, the populations of interest were children and adolescents (ages 2 to 18 years) and adults (ages 19 years and older).¹

The intervention or exposure of interest was the consumption of added sugars, particularly added sugars from the overall diet or from a food or beverage group that represent a large portion of overall added sugars intake, such as SSB. Studies were excluded if the intervention or exposure examined was consumption of individual types of added sugars that do not represent a large proportion of overall added sugars intake, experimentally-manipulated foods or beverages, low- or no-calorie sweeteners, or sugar alcohols.

The comparator of interest was different levels of consumption of added sugars, including no consumption, or consumption of low- or no-calorie sweeteners. Studies were excluded if they did not examine a comparator.

Outcomes of interest included both intermediate and endpoint health outcomes, and their eligibility for inclusion ultimately varied based on participant age and study design. Intermediate outcomes included total cholesterol, low-density lipoprotein cholesterol (LDL-C), high-density

¹ Infants and toddlers (birth to age 2 years) were later added as a key population of interest for the intervention or exposure only, with corresponding health status criteria and confounders. Only 1 eligible study was found; therefore, all evidence for birth through age 18 years was summarized in this chapter rather than reporting findings separately for birth to age 24 months in the chapter specific to that population (**Part D. Chapter 5: Foods and Beverages Consumed During Infancy and Toddlerhood**).

lipoprotein cholesterol (HDL-C), triglycerides, and blood pressure (systolic and diastolic). The original protocol included cholesterol ratios (total cholesterol:HDL-C and LDL:HDL cholesterol), but they were later removed to enable a focus on a smaller number of intermediate outcomes. The endpoint health outcomes included CVD, myocardial infarction, coronary heart disease, coronary artery disease, congestive heart failure, peripheral artery disease, stroke (ischemic and hemorrhagic), venous thrombosis, and CVD-related mortality. To focus on the strongest available evidence, the Committee established criteria to specify which study designs were eligible for inclusion depending on the outcomes being examined. For adults (ages 18 years and older), only evidence on intermediate outcomes from controlled trials was included; for endpoint outcomes, evidence from controlled trials and certain types of observational studies was included. In children (ages 2 to 18 years), evidence on intermediate and endpoint outcomes from both controlled trials and certain types of observational studies was included.

When establishing inclusion and exclusion criteria, the Committee used standard NESR criteria for publication status, language of publication, country, study participants, and health status of study participants. Additional criteria were added for study duration and sample size, each of which varied by study design. Experimental studies fewer than 4 weeks in duration and observational studies enrolling fewer than 1,000 participants were excluded to focus on the most physiologically plausible and strongest evidence, respectively. Studies were included if they were published from September 2014 to September 2019. This publication date range was applied to this review because the 2015 Committee reviewed evidence on the relationship between added sugars and risk of CVD, which included evidence on this relationship published up to September 2014.

To answer Question 3, the Committee developed a food pattern modeling protocol. The protocol included an analytic framework that described the scope of the food pattern modeling exercises as follows: 1) estimating the energy in the USDA Food Patterns that can be used for added sugars, 2) redistributing energy from top reported sources of added sugars to foods and beverages that achieve food group and nutrient goals, and 3) estimating excess energy from added sugars when USDA Food Patterns are met with typical vs nutrient-dense choices. The analytic framework also described the population, data sources, and key terms used to answer this question.

The exercises relied on data from the U.S. Department of Agriculture Food and Nutrient Database for Dietary Studies (FNDDS) 2015-2016. The Food Patterns Equivalents Database (FPED) 2015-2016 and the National Nutrient Database for Standard Reference, Release 28

(2016 version) provided supporting data. The U.S. population ages 2 years and older, including women who are pregnant or lactating, was considered. The following are key definitions for the food pattern modeling Exercises 1-3:

- **USDA Food Pattern:** A pattern of consumption designed to articulate the evidence on the relationship between diet and health and meet the known nutrient needs of targeted age-sex groups within energy constraints. The patterns include recommended amounts to eat from 5 major food groups—Fruits, Vegetables, Grains, Protein Foods, and Dairy—with recommendations further defined for subgroups of Vegetables and Grains. The USDA Food Patterns do not account for beverages that are not constituents of food groups or subgroups such as soft drinks and coffee or tea.
- **Item Cluster:** Identified groupings of the same or similar foods within each food group and subgroup. Item clusters are used to calculate the composite nutrient profile for each food group and subgroup used to define the USDA Food Pattern.
- **Nutrient Profiles:** The anticipated nutrient content for each food group and subgroup that could be obtained by eating a variety of foods from that group/subgroup in nutrient-dense forms. The nutrient profiles are based on a weighted average of nutrient-dense forms of foods. The weighted average calculation considers a range of American food choices, but in nutrient-dense forms and results in a food pattern that can be adapted to fit an individual's preferences.
- **Nutrient-Dense Representative Food:** The food within an item cluster with the least amount of added sugars, sodium, and solid fats. For some item clusters, the nutrient-dense representative food contains some added sugars, solid fats, and/or sodium.
- **Typical Choice Representative Food:** The most frequently consumed food within an item cluster of foods, including any added sugars, solid fats, and/or sodium.

The analytic plan described the methods the Committee used to address the 3 food pattern modeling exercises. Exercise 1 used the base USDA Food Patterns (i.e., the Healthy U.S.-Style Pattern; see **Part D. Chapter 14: USDA Food Patterns for Individuals Ages 2 Years and Older**) to estimate the energy that could come from added sugars for individuals ages 2 years and older. This involved first identifying the amount of essential calories in the base USDA Food Patterns calculated using nutrient-dense representative foods, some of which contain small amounts of added sugars for palatability or as function of the available food supply. The essential calories from all food groups and oils in the base USDA Food Pattern were summed, with the remaining energy considered as the amount available for other uses. This remaining

energy was assigned exclusively to solid fats and added sugars based on the proportional, population-level intake of these nutrients (55 percent solid fats; 45 percent added sugars). The percent of energy available for added sugars consumption beyond the small amounts inherent to some nutrient-dense foods that comprise the USDA Food Patterns, also were calculated for each of the 12 energy levels.

For Exercise 2, the Committee sought to demonstrate how reducing added sugars intake from current levels of consumption could provide an opportunity to increase intake of more nutrient-dense foods that help meet components of the USDA Food Patterns and specific nutrient goals for age-sex groups. First, the energy from added sugars from the 5 top contributing sources was calculated for age-sex groups. Using current mean intakes for each of the 5 USDA Food Pattern food groups, the amount of additional Fruit, Vegetables, Grains, Protein Foods and Dairy needed to achieve current recommendations was quantified. The nutrient profiles for each food group were then used to estimate the energy needed to achieve these recommendations. Energy needed to meet food group goals were then compared to energy from the top 5 food sources of added sugars. As the final step, the Committee identified gaps in food groups and nutrient intakes that could be addressed by redistributing energy from the top 5 food category sources of added sugars for age-sex groups.

Exercise 3 estimated excess energy from added sugars and solid fats if the USDA Food Patterns were developed with typical choices rather than nutrient-dense representative foods. Typical choices were represented by the nutrient profile of the most frequently consumed food within each item cluster comprising the USDA Food Pattern. Energy and nutrient excesses and deficiencies that exist when typical vs nutrient-dense representative foods comprise the pattern were evaluated.

More information about the food pattern modeling methodology is provided in **Part C. Methodology**. Complete documentation of the food pattern modeling analyses and results is available on the following website: <https://www.dietaryguidelines.gov/2020-advisory-committee-report/food-pattern-modeling/FPM-added-sugars>.

REVIEW OF THE SCIENCE

Question 1. What is the relationship between added sugars consumption and achieving nutrient and food group recommendations?

Approach to Answering Question: Data analysis

Conclusion Statement

In the U.S. population ages 1 year and older, mean usual consumption of added sugars was 13 percent of daily energy intake in 2013-2016. Presently, mean intakes as a percent of total energy range from 10 to 15 percent across age-sex groups. The estimated proportion of the population that consumed greater than 10 percent of energy from added sugars has decreased from 70 percent in 2007-2010, to 63 percent in 2013-2016.

Intake of added sugars averaged 16.2 teaspoon equivalents on a given day for ages 2 and older in 2015-2016. Mean teaspoon equivalent intakes were similar across income and race-ethnicity groups, except that non-Hispanic Asians had lower mean teaspoon equivalent intakes of added sugars compared to other race-ethnic groups.

Nearly 70 percent of added sugars intake comes from 5 WWEIA, NHANES food categories: sweetened beverages, desserts and sweet snacks, coffee and tea (with their additions), candy and sugars, and breakfast cereals and bars. Added sugars intakes could be greatly reduced by decreasing intakes of foods and beverages in these categories and by consuming low- or no-sugar-added versions of foods and beverages that can make positive contributions to diet.

Summary of the Evidence

The following sections describe the results of data analyses conducted to answer Question 1. Additional details can be found in the added sugars data supplements, referenced below as the Food Group Intake Distribution (DIST_DS) and Food Categories Sources (Cat_DS).

Usual Intake Distribution of Added Sugars

Data from 2013 to 2016 show 37 percent of individuals ages 1 year and older consume less than or equal to 10 percent of daily energy from added sugars compared to 30 percent in 2007 to 2010 (Dist_DS). Among adults ages 19 years and older, men are more likely to consume less

than or equal to 10 percent of daily energy from added sugars than women (41 vs 38 percent for men and women, respectively). Among children, a higher percentage of older compared to younger children have mean intakes of added sugars greater than 10 percent: 48 to 50 percent of children ages 1 to 3 years consume more than 10 percent of energy from added sugars compared to 72 to 79 percent of children ages 4 to 18 years. During this time period, total energy consumption remained largely the same (2,065 kcal 2007-2010 vs 2,058 kcal 2013-2016) as the small reduction in consumption of added sugars, was largely offset by a small increase (11.1 to 11.4 percent of total energy) in saturated fat intake.^{6,7}

Mean intakes of added sugars in teaspoon equivalents (tsp eq) remain high across age, sex, race-ethnicity, and income groups. Reported intake of added sugars is 16.20 tsp eq for individuals ages 2 years and older.⁸ Mean intakes are lowest among non-Hispanic Asians (9.58 tsp eq), and similar across other race-ethnic groups, ranging from 15.61 to 17.68 tsp eq on a given day. Average consumption across income groups is 16.19 tsp eq, with less than a 2 tsp eq difference across the income groups.

The range of added sugars intake is wide. Ten percent of the population consumes approximately 100 kcal (approximately 6 tsp eq; 5 percent of a 2,000 kcal diet) or less from added sugars on a given day (Dist_DS). The remaining 90 percent consume in excess of this amount. At the 75th percentile of intake, men and women ages 19 to 70 years consume approximately 400 kcal (25 tsp eq; 20 percent of a 2,000 kcal diet) and 300 kcal (19 tsp eq; 15 percent of a 2,000 kcal diet) of added sugars, respectively. This pattern of consumption at the 75th percentile of intakes is similar among older adults (ages 71 years and older, as defined by these analyses): men consume an average of 350 kcals (22 tsp eq) or 15.7 percent of mean total energy from added sugars and women consume 275 kcal (17 tsp eq) or 15.5 percent of mean total energy.

Women who are pregnant or lactating consume slightly more added sugars, with intakes at the 75th percentile of 372 kcal (23 tsp eq) and 320 kcal (20 tsp eq), respectively, compared to females ages 19 years and older who are not pregnant or lactating who consume 306 kcal (19 tsp eq) from added sugars per day (Dist_DS).

Food Category Sources Contribution to Total Added Sugars Intake

Nearly 70 percent or more of added sugars intake across all age-sex groups comes from 5 food categories: sweetened beverages (i.e., soft drinks, fruit drinks, sports and energy drinks, including smoothies and grain drinks), desserts and sweet snacks, coffee and tea (with their

additions), candy and sugars (e.g., jams, syrups, toppings), and breakfast cereals and bars (Cat_DS). On average, these food categories are the top 5 contributors to added sugars intake for all individuals ages 2 years and older. Some differences exist within age groups. Among younger children ages 2 to 5 years and 6 to 11 years, higher fat milk and yogurt products and burgers and sandwiches, respectively, replace coffee and tea with their additions as a top 5 contributor to added sugars intake. Among adults ages 41 years and older, burgers and sandwiches contribute slightly more to added sugars intake than do breakfast cereals and bars.

Individuals who exceed recommendations for added sugars intake consume more added sugars across many food and beverage sources compared to individuals who meet recommendations.^{9,10} Based on 1 day of dietary recall data, adults who report greater than 10 percent of total energy from added sugars consume significantly more sweetened beverages, coffee, tea, sweet bakery products, candy, ready-to-eat cereals, other desserts, and flavored milks compared to adults who report less than 10 percent of total energy from added sugars. Similar trends are seen among children. This suggests the additional intake of added sugars among those who exceed recommendations does not come from 1 food category.

Across all age categories, beverages (not including milk and 100% juice) contribute 37.1 percent to total added sugars intake (Cat_DS). Among children ages 2 to 19 years, sweetened beverages alone contribute 16.4 to 32.1 percent of added sugars intake. Within this category, fruit drinks are a key contributor to added sugars intake for children ages 2 to 5 years, whereas in older children ages 6 to 19 years, soft drinks are greater contributors.

Table D12.1. Percent of energy from added sugars from the top 5 food category sources across individuals ages 2 years and older¹

	Age Group (Years) ²							
	2+	2-5	6-11	12-19	20-40	41-50	51-70	71+
Sweetened beverages	24.1	16.4	25.2	32.1	32.1	25.3	16.5	12.8
Desserts and sweet snacks	18.8	23.3	22.2	16.1	14.3	17.4	20.5	27.7
Coffee and tea (with their additions)	11.1	2.0	3.0	7.3	12.0	14.9	14.3	11.1
Candy and sugars	9.0	12.6	12.1	8.9	7.3	7.3	9.9	9.0
Breakfast cereals and bars	7.4	11.7	9.6	10.1	6.4	6.2	6.5	7.0
Total	70.4	66.0	72.1	74.5	72.1	71.1	67.7	67.6

¹Source: National Cancer Institute, Top Sources of Food Group Intakes, NHANES 2013-2016 (Cat_DS)

²On average, these 5 food categories are the top contributors to added sugars intake, although there are variations within certain age groups.

Nutrient and Food Group Contributions from Food Category Sources of Added Sugars

In addition to comprising the majority of added sugars intake, some of the top food category sources of added sugars also contribute to food group intakes (Cat_DS). The 5 food category sources that, on average, contribute the most to added sugars for individuals ages 2 years and older (Table D12.1) contribute 11.1 percent and 19.3 percent of total fruit intake in younger (ages 2 to 5 years) and older (ages 6 to 19 years) children, respectively. Although the majority (approximately 60 percent) of total fruit intake for these age groups comes from whole fruit and 100% fruit juice, consumption of sweetened beverages that contain fruit as a component contribute 7.1 to 12.9 percent. For adults ages 20 to 50 years, these 5 food categories contribute 21.7 to 24.2 percent of total daily fruit intake on a given day and slightly less (17.8 to 18.5 percent) for adults ages 51 years and older.

The 5 top food category sources of added sugars, primarily desserts and sweet snacks, and breakfast cereals and bars, account for 17.3 percent of total grain intake for individuals ages 2 years and older, with these foods making up a higher proportion of total grains intake for children ages 2 to 5 years (21.8 percent) and adults ages 71 years and older (24.8 percent) compared to other age groups (Cat_DS). Desserts and sweet snacks are typically made with refined grains, while breakfast cereals and bars often contain whole grains, which are underconsumed. Breakfast cereals and bars account for 40.3 percent of whole grains intake across the population ages 2 years and older and slightly more for children ages 2 to 5 (49.5 percent).

The 5 top food category sources of added sugars contribute to dairy intake across all age groups, but most prominently in adults ages 20 years and older, where one-fifth or more of dairy intake on a given day comes from these food sources (Cat_DS). Desserts and sweet snacks and coffee and tea with their additions contribute more to dairy intake than do the other food category sources of added sugars (3.9 to 11.4 percent from desserts and sweet snacks for ages 2 years and older, and 2.6 to 8.0 percent from coffee and tea with additions for ages 12 years and older).

With regard to nutrient contributions, the 5 top food category sources of added sugars contribute approximately 15 to 18 percent to total intakes of calcium, potassium, dietary fiber, and vitamin D in both children and adults (Cat_DS). The contribution of the 5 top food category sources of added sugars to these nutrients is slightly higher for the older adult population (ages 71 years and older). Of these 5 categories, coffee and tea contribute the most to intake of any single nutrient, as plain coffee, before additions, contributes 118 mg potassium per 8 oz and

plain black tea contributes 89 mg potassium per 8 oz. Otherwise, coffee and tea in their plain form contribute only small amounts of other dietary components.

To access the data analyses referenced above, visit:

<https://www.dietaryguidelines.gov/2020-advisory-committee-report/data-analysis>

Question 2. What is the relationship between added sugars consumption and risk of cardiovascular disease?

Approach to Answering Questions: NESR systematic review

Conclusion Statements and Grades

Limited evidence from prospective cohort studies that were based primarily on sugar-sweetened beverages suggests that higher consumption of added sugars in adulthood is associated with increased risk of cardiovascular disease mortality. Grade: Limited

Insufficient evidence is available to determine the relationship between added sugars consumption and risk of cardiovascular disease in children. Grade: Grade Not Assignable

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and cardiovascular disease risk profile. Grade: Grade Not Assignable

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and risk of stroke. Grade: Grade Not Assignable

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and incident ischemic cardiovascular disease events. Grade: Grade Not Assignable

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and risk of peripheral artery disease. Grade: Grade Not Assignable

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and risk of heart failure. Grade: Grade Not Assignable

Summary of the Evidence

- 23 studies examined the relationship between added sugars consumption and the risk of CVD¹¹⁻³³:
 - Children: 3 studies, including 1 randomized controlled trial (RCT) and 2 prospective cohort studies (PCSs).
 - Adults: 20 studies, including 4 RCTs, 2 cross-over studies, and 14 PCSs.
- The added sugars intervention/exposure included:
 - Total added sugars intake from foods and beverages.
 - Added sugars from a single substantial source of overall added sugars intake (e.g., SSB, total sucrose intake).
- CVD outcomes considered:
 - Intermediate outcomes: Total cholesterol, LDL-C, HDL-C, triglycerides, and blood pressure (systolic and diastolic).
 - Children: included intermediate outcome data from RCTs and observational studies.
 - Adults: included intermediate outcome data from RCTs and cross-over studies only.
 - Endpoint outcomes: CVD (including myocardial infarction, coronary heart disease, and coronary artery disease; congestive heart failure; and peripheral artery disease), stroke (separating ischemic and hemorrhagic when possible), venous thrombosis, and CVD-related mortality.
 - Children and adults: included endpoint outcome data from RCTs, cross-over, and observational studies.
- Evidence in children:
 - Three studies reported on intermediate CVD outcomes in children; no studies looking at endpoint outcomes in children met the inclusion criteria.
 - Findings from the 1 RCT and 1 cohort study found greater added sugars intake related to worse lipid profiles in children, namely detrimental change in total cholesterol and HDL-C over time.
 - The third study did not find a significant relationship between added sugars consumption

and CVD outcomes.

- The body of evidence was limited substantially by the small number of studies, the variability in age of the participants, and inconsistency in outcomes measured.
- Evidence in adults:
 - Intermediate outcomes:
 - Three RCTs reported in 4 articles and 2 cross-over studies examined intermediate CVD outcomes; 4 of these studies found no significant effect of added sugars consumption.
 - One RCT found that reducing added sugars consumption led to improved triglyceride levels, and the second paper from a larger sample of participants from the same RCT found that continued high levels of SSB consumption led to detrimental changes in total cholesterol and triglyceride levels.
 - RCT evidence was limited by small sample sizes and inconsistency in exposures and outcomes measured.
 - Endpoint outcomes:
 - CVD-related mortality was assessed by 8 PCSs; 6 of the 8 found no significant effect; 1 found an effect before adjustment for adiposity, and the other reported repeat exposure assessment in 2 independent cohorts and found a significant, positive association
 - A small number of studies examined ischemic CVD events, peripheral artery disease, stroke, and heart failure, which limited the ability to draw conclusions.
 - Most studies adjusted for adiposity, though four studies presented data both with and without adjustment, and all but one found the relationship did not change
 - Observational evidence was limited by inadequate adjustment for confounders, inconsistency in exposures and outcomes measured, and measures of exposure taken at baseline only.

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

Question 3. How much added sugars can be accommodated in a healthy diet while still meeting food group and nutrient needs?

Approach to Answering Questions: Food Pattern Modeling

Conclusion Statement

Estimating Remaining Energy for Added Sugars in the USDA Food Patterns

The amount of energy required to meet food group and nutrient needs using nutrient-dense representative foods comprises 85 percent or more of total energy available across most energy levels. Assuming the remaining energy is distributed exclusively to solid fats and added sugars according to population-level proportional intakes, this leaves 6 percent or less of additional energy available for the consumption of added sugars for most energy levels. In the highest energy levels analyzed of 3,000 kcal/day and 3,200 kcal/day, 7 and 8 percent or fewer additional energy would be available, respectively. Even these modest percentages of energy available for added sugars represent relatively rare scenarios where individuals consume only recommended amounts of nutrient-dense foods and beverages and no energy from alcohol. These scenarios assume a constant amount of energy consumed with no change in body weight.

Redistributing Energy from Top Reported Sources of Added Sugars

Five food categories contribute the majority of added sugars intake in the U.S. population and these foods are often energy-dense with low amounts of key dietary nutrients. The redistribution of energy from food categories with added sugars to underconsumed food groups and nutrients could have a significant positive impact on overall diet quality and nutrient status (for example, by allowing age-sex groups to better meet food group recommendations for Fruits, Vegetables, and Dairy) and also could increase consumption of key nutrients contained in these food groups.

Estimating Excess Energy from Added Sugars with Typical vs Nutrient-Dense Choices

When the USDA Food Patterns are constructed with the most frequently consumed typical food choices rather than nutrient-dense representative foods, the contribution of added sugars to total energy increases. If consumers choose to eat the recommended quantities from each food group or subgroup, but do not choose nutrient-dense foods lower in added sugars, total energy will exceed daily needs due to a relatively higher contribution of added sugars as well as solid fats.

Summary of the Evidence

Estimating Remaining Energy for Added Sugars in the USDA Food Patterns

In Exercise 1, the Committee estimated the energy available for added sugars in the base USDA Food Pattern under the assumption that individuals consume nutrient-dense representative foods that are lean or no-fat with low or no added sugars and generally without added salt (i.e., the base pattern, the Healthy U.S.-Style Pattern [see **Part D. Chapter 14: USDA Food Patterns for Individuals Ages 2 Years and Older**]). The results demonstrate that across most energy levels, assuming population-level proportional intakes of solid fats and added sugars, no consumption of alcoholic beverages, and that nutrient-dense foods and beverages are not consumed in excess of recommended amounts, 6 percent or fewer calories are available for the consumption of added sugars across all but the 2 highest energy levels analyzed.

The number of essential calories (i.e., the energy associated with the foods and beverages ingested to meet nutritional goals through choices that align with the USDA Food Patterns in forms with the least amounts of saturated fat, added sugars and sodium) was less than the amount of total energy for all energy levels. Essential calories comprise greater than 85 percent of total energy across most levels of the base USDA Food Pattern, the Healthy U.S.-Style Pattern (see **Part D. Chapter 14**). The remaining energy is available for consumption of solid fats or added sugars, alcohol, or additional consumption of nutrient-dense foods beyond food group needs. Table D12.2 assigns the remaining energy exclusively to solids fats and added sugars, with 55 percent of energy from solid fats and 45 percent from added sugars, according to population-level proportional intakes.

The energy remaining and assigned to solid fats and added sugars are low across calorie levels below 2,000, and lowest in patterns between 1,200 to 1,600 kcal/day. The higher energy

limit for solid fats and added sugars at the 1,000 kcal/day pattern is attributed to a lower amount of dairy compared to the 1,200, 1,400 and 1,600 kcal/day patterns that are designed for older children and adult women with a higher Recommended Dietary Allowance (RDA) for calcium. Assuming population-level proportional intakes of solid fats and added sugars, no alcohol consumption, and no consumption of nutrient-dense foods beyond recommended amounts, the percent of energy available for added sugars is 6 percent or less at nearly all energy levels analyzed, with 3 to 5 percent of energy available for added sugars among the majority of the population, with the exception of the 3000 kcal/day and 3,200 kcal/day levels of intake (7 and 8 percent, respectively). The added sugars inherent to the nutrient-dense foods in the Healthy U.S.-Style Pattern is small, ranging from 17 to 50 total kcal from added sugars across energy levels, or 1.5 to 1.9 percent of total energy.

Table D12.2. Essential calories and limit on solid fats and added sugars across energy levels in the Healthy U.S.-Style Food Patterns for ages 2 years and older

	Essential Calories ¹	Percent Essential Calories ¹	Energy Limit for Solid Fats and Added Sugars ²	Energy Assigned to Solid Fats ³	Energy Assigned to Added Sugars ³	Grams of Solid Fats ⁴	Grams of Added Sugars ⁴	Percent Energy Added Sugars
Level	kcal	% kcal	kcal	kcal	kcal	g	g	%
1,000	868	87	132	72	59	9	15	6
1,200	1120	93	80	44	36	5	9	3
1,400	1310	94	90	49	40	6	10	3
1,600	1496	94	104	57	47	7	12	3
1,800	1657	92	143	79	65	9	16	4
2,000	1759	88	241	133	109	16	27	5
2,200	1947	88	253	139	114	17	29	5
2,400	2079	87	321	176	144	21	36	6
2,600	2251	87	349	192	157	23	39	6
2,800	2431	87	369	203	166	24	41	6
3,000	2559	85	441	243	199	29	50	7
3,200	2620	82	580	319	261	38	65	8

¹ The energy associated with the foods and beverages ingested to meet nutritional goals through choices that align with the USDA Food Patterns in forms with the least amounts of saturated fat, added sugars and sodium.

² Calculated from pattern calorie level minus essential calories.

³ Calculated as 55 percent of energy from solid fats and 45 percent from added sugars, based on mean population intakes (NCI Usual Intakes data for NHANES 2013-2016).

⁴ Calculated using caloric values of 8.4 kcal per 1 gram of solid fats and 4 kcal per 1 gram of added sugars.

Importantly, the added sugars focus of this analysis assumes a specified solid fat intake and no alcohol consumption. If intake of solid fat is increased or alcohol is consumed, the energy from added sugars would have to be decreased markedly to meet energy goals. For example,

at the 2,000 kcal/day level, if an individual consumes 2.4 tablespoons of butter (241 kcal) in addition to the nutrient-dense foods that comprise the Healthy U.S.-Style Pattern, no energy remains for the consumption of foods and beverages with added sugars. Conversely, lower intake of fat would permit a more liberal inclusion of added sugars in a diet otherwise comprised of nutrient-dense foods. For instance, if saturated fat intake is reduced by 5 grams (about 45 kcal) then added sugars intake could be increased by about 11g (about 44 kcal) while remaining within energy balance. Table D12.3 provides hypothetical ratios of added sugars:solid fat intake at the 2,000 calorie per day level and sample foods to represent each amount of intake. Note the first row of this table is taken from Table 12.2 in which the proportion of added sugars:solid fat ratio is that of the population age 2 years and older.

Table D12.3. Example distributions of solid fats and added sugars with sample food amounts in the 2,000 kcal level in the Healthy U.S.-Style Food Pattern

	Energy Limit for Solid Fats and Added Sugars ^{1,2}	Energy Assigned to Solid Fats ³	Energy Assigned to Added Sugars ³	Grams of Solid Fats ⁴	Sample food equivalent (Butter)	Grams of Added Sugars ⁴	Sample food equivalent (Regular soda)	Percent Energy Added Sugars
Level	kcal	kcal (%)	kcal (%)	g	Tbsp	g	~Oz.	%
2,000	241	0 (0)	241 (100)	0	N/A	60	Soda: 20	12
2,000	241	60 (25)	181 (75)	7	Butter: 0.5	45	Soda: 16	9
2,000	241	109 (45)	133 (55)	12	Butter: 1.1	33	Soda: 12	6
2,000⁵	241	133 (55)	109 (45)	16	Butter: 1.2	27	Soda: 9	5
2,000	241	181 (75)	60 (25)	20	Butter: 1.7	15	Soda: 5	3
2,000	241	241 (100)	0 (0)	27	Butter: 2.4	0	N/A	0

¹ Calculated from pattern energy level minus essential calories

² The energy limit for solid fats and added sugars assumes consumption of nutrient-dense foods that meet nutritional goals through choices that align with the USDA Food Patterns in forms with the least amounts of saturated fat, added sugars and sodium.

³ Based on mean population intakes (NCI Usual Intakes data for NHANES 2013-2016)

⁴ Calculated using caloric values of 8.4 kcal per 1 gram of solid fats and 4 kcal per 1 gram of added sugars

⁵ As shown in table D 12.2, the remaining energy for added sugars and solid fats is assigned in a 55:45 ratio based on mean population-level intakes

Redistributing Energy from Top Reported Sources of Added Sugars

In Exercise 2, the Committee demonstrated how reducing added sugars intake from the top contributing sources and reassigning energy to underconsumed food groups can help better achieve food group and nutrient goals across age-sex groups.

As described earlier in this chapter for Question 1, 5 food categories (sweetened beverages, desserts and sweet snacks, coffee and tea (with their additions), candy and sugars, and

breakfast cereals and bars) make up approximately 70 percent of total added sugars intake. For many age-sex groups, these 5 food categories contribute 200 or more kcal daily to total energy intake.

The analysis of current mean intakes shows that most age-sex groups fall short of meeting food group and nutrient recommendations (<https://www.dietaryguidelines.gov/2020-advisory-committee-report/data-analysis>). More specifically, with the exception of males and females ages 2 to 3 years, age-sex groups underconsume fruits, vegetables, and dairy. Although grains are generally not underconsumed, all age-sex groups meet this food group recommendation through the consumption of refined grains rather than nutrient-dense whole grains. Protein is underconsumed by certain age-sex groups, specifically males ages 4 to 8 years, and females ages 9 to 13 years and 14 to 18 years.

Considering nutrient shortfalls across age-sex groups, as described in **Chapter 1: Current Intakes of Foods, Beverages, and Nutrients**, reassigning the energy available from the top contributors of added sugars intake (e.g., desserts and sweet snacks) to underconsumed food groups across age-sex groups could be beneficial. For example, for males ages 4 to 8 years, the redistribution of energy from the top food sources of added sugars to the Vegetables food group; particularly Dark Green, Red and Orange, and Starchy subgroups; as well as the Protein Foods group, particularly seafood and eggs, would contribute substantially to food group and nutrient goals for this age-sex group. For women of childbearing age, redistributing the energy from added sugars to the Dairy and Vegetables food groups and consuming foods rich in calcium (e.g., milk, cheese, yogurt) and folate (e.g., dark green vegetables and legumes) could help reduce these nutrient shortfalls across this population.

The redistribution of energy from refined to whole grains sources to better meet nutrient recommendations must be considered with caution, however. Specifically, certain food categories, such as breakfast cereals and bars, are both a source of whole grains and a top contributor to added sugars intakes. In these instances, shifting to a lower sugar or no-sugar added version of the breakfast cereal or bar would be preferable rather than shifting energy to other food sources.

Estimating Excess Energy from Added Sugars with Typical vs Nutrient-Dense Choices

Exercise 3 on typical choices demonstrates that although the USDA Food Patterns allow for some additional energy for added sugars when nutrient-dense representative foods are used

(Exercise 1), when typical choices are assumed, excess energy is consumed, added sugars consumption is increased, and no dietary energy remains for other uses.

The USDA Food Patterns are constructed to provide adequate levels of nutrients within calorie limits. The base USDA Food Pattern, the Healthy U.S.-Style Pattern, achieves this by including representative foods in their most nutrient-dense forms (rather than the most commonly consumed representative foods) in which solid fats and added sugars are generally limited to very small amounts. When typical rather than nutrient-dense representative food choices are included, total energy exceeds that specified in most USDA Food Patterns. For example, when typical foods are used to meet nutrient goals at the 1,600-calorie level, the food pattern includes an additional 355 kcal above the total energy target; the 2,000 kcal pattern has 264 excess energy within the foods pattern.

When typical vs nutrient-dense foods are consumed, the contribution of added sugars to total energy intake also increases. Based on a 2,000-calorie pattern, added sugars contribute more energy to the Dairy, Grains, and Fruit food groups in the USDA Food Pattern when typical rather than nutrient-dense representative foods are assumed. Within the Dairy group, the typical choices of milk shakes, flavored milks, and regular ice cream are the primary contributors to this increase. For Grains, the inclusion of desserts and sweetened cereals contribute to an increase in added sugars in this analysis. With Fruit, the typical choices analysis includes fruits packed in syrup and cooked fruit with sugar rather than fruit in its whole form, leading to higher consumption of added sugars.

It is important to note that the analysis of typical choices does not account for beverages, including alcohol, soft drinks, or coffee and tea, which are not constituents of food groups or subgroups. Therefore, the contribution of these beverages to energy intake and added sugars is not addressed or captured in the Exercise 3. Given that many beverages contribute to energy intake, but do not contribute to food group intakes and therefore are not included in these analyses, the estimate of excess energy from added sugars with typical vs nutrient-dense choices is conservative.

For additional details on the Food Pattern Modeling described above, visit:
<https://www.dietaryguidelines.gov/2020-advisory-committee-report/food-pattern-modeling>

DISCUSSION

The totality of evidence across systematic reviews conducted either as part of the Committee's report or as part of the *2015-2020 Dietary Guidelines for Americans* effort generally support conclusions that favor limiting the consumption of added sugars to, at most, very low amounts. This evidence is particularly important in light of the high proportion of total energy accounted for by added sugars among children and adults in the United States. In addition to the various specific concerns described above, the available evidence related to health effects of added sugars has a number of limitations that are important to highlight here:

- **Challenges in Exposure Assessment:** In addition to the usual limitations of dietary assessment in free-living children and adults, a question exists as to the extent to which SSB (the source of much of the research about added sugars) can inform the question of exposure to added sugars. On the one hand, these products contribute a substantial proportion of total intake of added sugars and, thus, can be used as a marker of exposure. However, on the other hand, it is possible that the health impacts of SSB may differ from those of sugars added to solid food. In either case, SSB themselves represent a specific exposure to a source of added sugars that is relevant to the U.S. population due to how commonly these beverages are consumed. An additional limitation in the available literature is that exposures were quantified in different ways across studies, with no standard approach to create categories of intake and, for continuous variable approaches, infrequent consideration of a potential non-linear dose response curve.
- **Challenges in PCSs:** Regardless of the specific approach to exposure assessment at any one time, with rare exception, PCSs considered intake of added sugars at baseline only and did not incorporate change in intake over time into the statistical analysis. This is a major limitation because changes in intake over time that are not accounted for would impose potential for serious misclassification bias.
- **Challenges in RCTs:** Very few recent RCTs were available for review. Limitations included interventions that were not effective in substantially reducing intake over time, or in which the impact of change in consumption of added sugars could not be separated from other behaviors that could affect health outcomes.

Recently published systematic reviews and meta-analyses provide additional perspective. In one such article, a systematic review and dose-response meta-analysis of PCSs addressed

added sugars in relation to CVD.³⁴ Although evidence supported a threshold for harm from intake of added sugars for CVD mortality, many methodological issues were noted and the authors considered certainty in their estimates as “weak,” and called for more research on dose responsiveness, particularly with regard to potential differences in effect for SSB compared to sugar added to solid food. From a systematic review of the impact of SSB on blood pressure, another article reported evidence for an association of higher intake of SSB with higher blood pressure. Meta-analyses conducted separately for studies of children and adults, including both PCSs and RCTs, yielded evidence that higher intake of SSB was associated with excess body weight gain. Across these systematic reviews and meta-analyses, the limitations detailed in this report were apparent; nonetheless, the totality of evidence pointed to adverse effects of added sugars, including and particularly SSB, that is associated with unhealthy weight gain and obesity-related health outcomes.

Finally, in total, remarkably few studies addressed specific CVD risk factors (other than excess body weight) in either youth or adults. Only 1 of 2 studies in adults met inclusion criteria for each of several important outcomes, including ischemic CVD events, stroke, peripheral arterial disease, and heart failure.

SUMMARY

The addition of sugars to foods or beverages provides energy, generally without contributing additional nutrient content. Taking into account both the 2015 and 2020 Committee evidence reviews, relative to the goal of improving the health of a population in which the prevalence of overweight and obesity is high, the addition of sugar to the diet raises concerns about the potential risk of increasing unhealthy weight gain and, in turn, increasing risk of obesity-related health outcomes. Foods and beverages with added sugars comprise a part of the culture and traditions of many families and communities in the United States. Therefore, it would not be reasonable, or even desirable, to recommend no consumption of added sugars. However, reducing the amount of added sugars in the diet, through either changes in consumer behavior or in how food is produced and sold, or through food policy, is an achievable objective that could improve population health. Although intake of added sugars remains high, data reviewed by the 2020 Committee suggest the consumption of added sugars decreased slightly over the last decade suggesting a reduction is feasible. With the aim of providing a balanced perspective that retains the pleasure of eating while reducing risk of adverse health outcomes, Table D12.4

provides an update to the information provided in the 2015 Committee report on the relevant recommendations from various high profile national and international organizations on this topic.

Table D12.4. Recommendations or statements related to added sugars or SSB from international and national organizations

Organization	Recommendation
World Health Organization (WHO) ³⁷	Reduced intake of free sugars throughout the life course (strong) Reduced intake of free sugars to <10% of total energy (strong) Reduced intake of free sugars to <5% of total energy (conditional)
American Heart Association (AHA) ^{38,39}	Adults: Reduce to an upper limit of half of discretionary calorie allowance for a person to achieve or maintain healthy weight: For most American women, eat or drink no more than 100 kcal per day (about 6 teaspoons); for most American men, no more than 150 kcal per day (about 9 teaspoons) Children: Limit intake of SSB to ≤1 8-oz serving per week (Evidence Level A); <100 kcal/day (~ 6 tsp) (Evidence Level C); avoid added sugars in the diet of children <2 years old (Evidence Level C)
HealthyPeople 2020 ⁴⁰	Objective NWS-17.2: Reduce consumption of energy from added sugars (Target: 9.7 percent)
American Diabetes Association (ADA) ⁴¹	Replace SSB with water as often as possible and minimize added sugars
NHLBI Expert Panel Guidelines for Cardiovascular Health and Risk Reduction in Childhood ⁴²	Reduced intake of SSB is associated with decreased obesity measures (Grade B)

Updated analyses of dietary intake in America allow for model-based estimation of discretionary calories available after accounting for foods consumed to meet nutritional requirements, as summarized in Table D12.2. Based on those analyses, along with the scientific evidence for the potential health impacts of added sugars intake, the Committee suggests that for adults and children ages 2 years and older, a recommendation of less than 6 percent of energy from added sugars is more consistent with a dietary pattern that is nutritionally adequate while avoiding excess energy intake than is a pattern with less than 10 percent energy from added sugars. The reader is referred to **Part D. Chapter 7: USDA Food Patterns for Children Younger than Age 24 Months** in which the recommendation and rationale is provided for added sugars to be avoided during the first 2 years of life. In addition to recommendations for individuals to limit intake of added sugars, in 2019, the American Heart Association and the American Academy of Pediatrics published a joint policy statement to reduce intake of sugary drinks by children and adolescents. Although the Committee did not review these policies, they

contribute support for dietary recommendations for reduction of added sugars in the American diet, thereby enabling progress toward improved weight and health status for the United States.

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