TECHNICAL SCIENTIFIC REPORT

Healthy Beverage Consumption in School-Age Children and Adolescents

Recommendations from Key National Health and Nutrition Organizations

Healthy Eating Research

January 2025

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DEFINITIONS AND FREQUENTLY USED ACRONYMS

100% Juice: Beverage made from the extraction or pressing of the natural liquid found in fruits or vegetables; 100% juice means that everything in the container came from a fruit or vegetable with no added sugars or artificial ingredients. Beverages made from 100% juice diluted with water (no other added ingredients) are also included in this category.

Beverages with Caffeine and Other Stimulants: Drinks that contain caffeine, a legal stimulant that is mildly addictive, or other stimulants, such as taurine, often found in energy drinks. Examples include coffee, tea, energy drinks, and energy shots.

Beverages with Non-Sugar Sweeteners (NSS): Beverages that contain any of the six high-intensity sweeteners approved by the U.S. Food and Drug Administration as food additives (saccharin, aspartame, acesulfame-K, sucralose, neotame, and advantame) or three additional plant- or fruit-based high-intensity sweeteners generally recognized as safe and thus permitted for use in the food supply (steviol glycosides, monk fruit, and thaumatin). NSS may also be called diet sweeteners, non-nutritive sweeteners, no- or low-calorie sweeteners, or artificial sweeteners.

Plain Drinking Water: Potable water that is unsweetened, unflavored, and fluoridated. Not all plain water sources are naturally fluoridated, but fluoridated water should be used when available. Examples include tap water, well water, or plain, unsweetened bottled or carbonated (i.e., sparkling) water.

Beverages with Supplements or Other Additives: Beverages with supplements or other additives that are marketed as having an added nutritional benefit to the diet. Examples include beverages with prebiotics, probiotics, or added vitamins or minerals.

Discretionary Calories: The calories left over after meeting an individual's nutrient needs from healthy foods. Essential calories are the minimum calories an individual needs to meet basic food group and nutrient recommendations from the Dietary Guidelines for Americans. In contrast, discretionary calories are the leftover calories after food and nutrient needs are met; they are considered "extras" and can be used on solid fats, added sugars, or on more food from any group.

Plain Pasteurized Milk: Cow's milk and other animal-based milk that has been heated to a specified temperature and for a specified length of time to kill pathogens that may be found in raw milk, and to which caloric sweeteners, NSS, or flavorings have not been added. Common varieties include whole milk (also known as Vitamin D milk), reduced fat (2%), low-fat (1%), and skim (fat-free).

Plant-Based Milk Alternatives (PBMA): Non-dairy beverages that are derived from plant-based ingredients, such as grains (e.g., rice or oats), nuts/seeds, legumes, or blends of these ingredients, and are often fortified with nutrients found in dairy milk. Many come in both sweetened and unsweetened varieties; sweetened varieties generally contain added sugars and/or NSS.

Sugar-Sweetened Beverages (SSBs): Liquids to which any forms of sugar are added. Examples include sports drinks, soft drinks/sodas, energy drinks, fruit drinks, fruit-flavored drinks, fruitades, aguas frescas, sweetened waters, horchata, and sweetened coffee and tea drinks.

Sweetened Flavored Milk: Pasteurized cow's milk to which sweeteners and/or flavorings have been added for the main purpose of increasing palatability. Examples include chocolate or strawberry milk.

Frequently Used Acronyms	
Academy	Academy of Nutrition and Dietetics
AAPD	American Academy of Pediatric Dentistry
AAP	American Academy of Pediatrics
AHA	American Heart Association
DGA	Dietary Guidelines for Americans
FDA	U.S. Food and Drug Administration
NHANES	National Health and Nutrition Examination Survey
NSS	non-sugar sweeteners
PBMA	plant-based milk alternatives
SNMCS	School Nutrition and Meal Cost Study
SSB	sugar-sweetened beverages
YRBS	Youth Risk Behavior Survey

INTRODUCTION

Dietary patterns consist of the food and beverage choices made throughout life, which can significantly impact an individual's health. While most dietary recommendations focus primarily on the foods and nutrients necessary for a healthy dietary pattern, the scientific evidence demonstrating the important contribution of beverage choices to health and well-being has grown in volume and strength over the last several decades. Simultaneously, a proliferation of new beverages in the marketplace has created confusion over the health benefits and risks of each beverage. Many of these new beverages contain added sugars that can contribute to the risk of overweight, obesity, and diet-related chronic diseases, such as dental caries and type 2 diabetes, when consumed in excess. There has also been an increase in beverages that contain non-sugar sweeteners, caffeine, and/or other ingredients with purported health benefits. As children age, there is an increase in autonomy over the purchase and selection of foods and beverages. Paired with the evolving landscape of beverages available and marketed to children and adolescents, many are faced with choice overload at home, schools, sports, parties, and other social gatherings.

Despite the importance of consuming healthy beverages in childhood and adolescence, U.S. survey data indicate that children and adolescent's beverage intakes diverge from recommendations. While SSB consumption has declined steadily from 2003 to 2018, primarily driven by declines in soda and fruit drinks, consumption of coffee and tea-based SSBs has increased significantly.[1] Overall SSB intake remains high and disparities between children of various race and ethnic groups persist. For example, rates of decline for soda and fruit drinks were significantly lower among non-Hispanic Black children compared to their non-Hispanic white peers.[1] In addition to disparities in beverage consumption by race and ethnicity, disparities also exist between age groups and gender. For example, the percentage of high school students who drank a soda/pop or sports drink one time or more per day was significantly higher for males than female high school students.[2] Further, there is a significant difference in the prevalence of 100% juice and coffee/tea consumption by age; 6- to 11-year-olds drink significantly more 100% juice and 12- to 19-year-olds drink significantly more coffee and tea beverages.[3] Thus, addressing beverage consumption is essential for improving dietary patterns and overall nutrition, health, and well-being for children and adolescents.

In 2018, Healthy Eating Research (HER) convened an expert panel of representatives from four leading national health and nutrition organizations—the Academy of Nutrition and Dietetics (the Academy), the American Academy of Pediatric Dentistry (AAPD), the American Academy of Pediatrics (AAP), and the American Heart Association (AHA)—to develop consensus recommendations for what young children (ages 0 to 5 years) should drink as part of a healthy diet. The *consensus statement* was released in 2019, along with a *technical report* on the scientific evidence underlying the recommendations and a suite of consumer-facing materials at *HealthyDrinksHealthyKids.org*. The consensus recommendations set forth comprehensive evidence-based recommendations that are used to ensure cohesion and reduce confusion among health care providers, public health practitioners, and parents and caregivers regarding what young children should be drinking. The recommendations have been impactful in driving changes in organizational practices, policies, and healthcare guidance to reduce SSB consumption and improve young children's beverage intake.

While many authoritative bodies have issued recommendations for healthy beverage intake in school-age children and adolescents (ages 5 to 18 years), important gaps exist. Recommendations have not been comprehensive in the types of beverages discussed, and many newer and increasingly popular beverage types are not addressed. There are also inconsistencies in certain aspects of the recommendations, including the recommended amounts to consume or limit, contributing to confusion among healthcare providers, other practitioners, parents and other caregivers, and children and adolescents. Given the importance of beverage consumption throughout the lifespan, especially in childhood and adolescence, HER convened the same four national health and nutrition organizations (the Academy, AAPD, AAP, and AHA) to develop comprehensive evidence-based recommendations for beverage consumption among children and adolescents ages 5 to 18 years.

BACKGROUND

The beverage recommendations resulting from this consensus panel provide authoritative guidance on optimal beverage consumption during childhood and adolescence and support a life course approach to the development of healthy dietary patterns and prevention of chronic disease. The *consensus statement* provides an overview of beverage recommendations for children and adolescents ages 5 to 18 and is intended to aid health care providers and practitioners in communicating with parents, caregivers, and school-age children about healthy beverages. This technical report provides detailed information about the recommendations and their development process, including a full review of the evidence that supports the consensus recommendations.

This section of the report provides important context for the nutritional needs of children and adolescents as recommended by the 2020–2025 Dietary Guidelines for Americans (the most recent iteration at the time of publication), and reviews consumption data from published literature to better understand current beverage intake and trends over time among 5- to 18-year-olds.

Healthy Dietary Patterns for Children Ages 5–18 Years as Recommended by the Dietary Guidelines for Americans

The 2020–2025 Dietary Guidelines for Americans (DGA) recommend following a healthy dietary pattern at every age including choosing nutrient-dense foods and beverages and limiting foods and beverages high in added sugars, saturated fat, and sodium.[4] Specifically, the DGA recommends that all Americans consume less than 10% of calories per day from added sugars, less than 10% of calories per day from saturated fat, and less than 2,300 mg per day of sodium (lower amounts of sodium are recommended for children under 14 years).[4] The Healthy U.S.-Style Dietary Pattern, as recommended by the DGA, for children and adolescents (**Table 1**) assumes all foods and beverages consumed to meet food group recommendations are in nutrient-dense forms and leaves a limited number of calories for other uses (i.e., discretionary calories, or foods and beverages that are not nutrient-dense).[4] However, many children and adolescents in the U.S. do not meet the DGA recommendations. For example, children and adolescents

Table 1: Healthy U.S.-Style Dietary Pattern for Children Ages 5–18, With Daily Energy Recommendations and Servings from Food Groups

	5–8 years		9–13 years		14–18 years	
	Female	Male	Female	Male	Female	Male
Estimated Energy Needs	1200–1800 calories per day	1200–2000 calories per day	1400–2200 calories per day	1600–2600 calories per day	1800–2400 calories per day	2000–3200 calories per day
Vegetables	1.5–2.5 cup equivalent per day		1.5–3.5 cup equivalent per day		2.5–4 cup equivalent per day	
Fruits	1–2 cup equivalent per day		1.5–2 cup equivalent per day		1.5–2.5 cup equivalent per day	
Dairy	2.5 cup equivalent per day		3 cup equivalent per day		3 cup equivalent per day	
Grains	4–6 oz equivalent per day		5–9 oz equivalent per day		6–10 oz equivalent per day	
Protein Foods	3–5.5 oz equivalent per day		4–6.5 oz equivalent per day		5–7 oz equivalent per day	
Oils	17-24 grams per day		17–34 grams per day		24–51 grams per day	
Limit on Discretionary Calories	80–280 (7–14% per day)		50–350 (4–13% per day)		140–580 (8–18% per day)	

This table is modified from the 2020-2025 DGA.[4] The DRI Calculator for Healthcare Professionals, available at *nal.usda.gov/fnic/dri-calculator*, can be used to estimate calorie needs based on age, sex, height, weight, and activity level.

under-consume fruits and vegetables and over-consume added sugars, sodium, and saturated fats.[5] Further, the DGA states that SSBs are not a necessary component of the diet for children and adolescents. Except for milk and 100% juice, all other beverages fall into discretionary calories, or calories for other uses (the final row of the table).

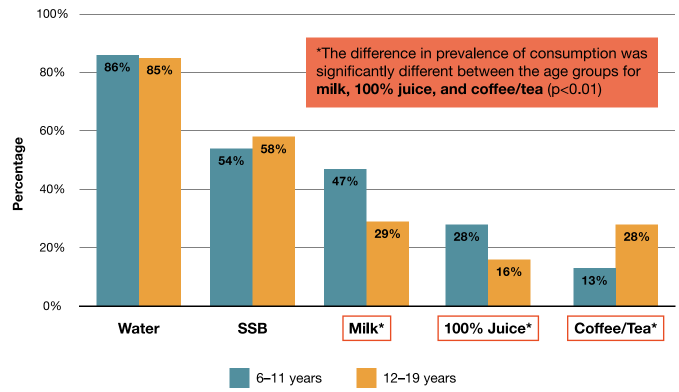
Beverage Consumption Data

The expert panel reviewed consumption data from published literature to better understand current beverage intake and trends over time among 5- to 18-year-olds in the U.S. The literature reviewed included data analyzed from national surveillance surveys including: *What We Eat in America*, *National Health and Nutrition Examination Survey (NHANES)*, *Youth Risk Behavior Surveillance (YRBS)*, and *the School Nutrition and Meal Cost Study (SNMCS)*.

Water: Based on 2017–2018 NHANES data, 86% of 6–11 year olds and 85% of 12–19 year olds reported consuming water (plain tap/bottled; flavored or carbonated; enhanced or fortified water) within the previous 24 hours (**Figure 1a**).[3] The mean daily intake of water was significantly lower for 6- to 11-year-olds (24 fluid ounces per day) compared to 12- to 19-year-olds (40 fl oz/day)(**Figure 1b**).[3] The percentage of 2- to 19-year-olds who consumed water within the previous 24 hours, by race and ethnicity, was highest among Asian children (96%) and lowest among Black children (73%)(**Figure 1c**).[3] A significantly lower percentage of Black children consumed water compared to white, Hispanic, and Asian children. Data from the 2021 YRBS indicate 44% of high school students drank less than 3 glasses per day of plain water (tap, bottled, and unflavored sparkling water) with the percentage of female students consuming less than 3 glasses per day (46%) significantly higher than the percentage of male students (42%).[2] According to the national SNMCS data in school year 2014–2015, only 28% of elementary school student respondents, 21% of middle school respondents, and 23% of high school respondents participating in the National School Lunch Program (NSLP) reported consuming water (bottled and tap) during lunch.[6]

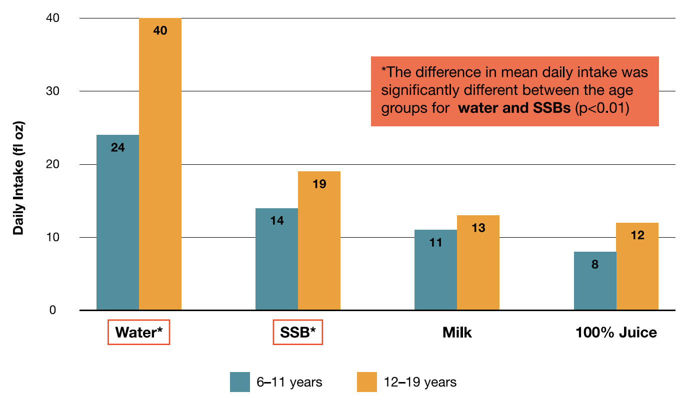
Milk: Based on 2017–2018 NHANES data, prevalence of milk consumption (includes milk (whole, reduced fat, low-fat, nonfat); flavored milk (whole, reduced fat, low-fat, nonfat); dairy drinks, and substitutes (milk shakes and other drinks, milk substitutes)) within the previous 24 hours was significantly lower for 12- to 19-year-olds (29%) than 6- to 11-year-olds (47%)(**Figure 1a**).[3] The mean daily intake of milk was 11 fl oz/day for 6- to 11-year-olds compared to 13 fl oz/day for 12- to 19-year-olds. The percentage of 2- to 19-year-olds who consumed milk within the previous 24 hours, by race and ethnicity, was highest among Hispanic (49%) and lowest among non-Hispanic Black children (31%) (**Figure 1c**).[3]

Figure 1a: Percentage of 6-11 and 12- to 19-year-olds who consumed beverages within previous 24 hours (NHANES 2017-2018)



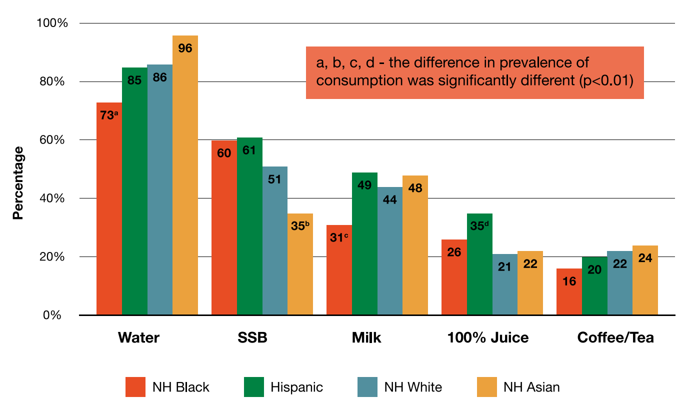
Source: Martin 2020[3]

Figure 1b: Mean daily beverage intake (fl oz) among 6-11 and 12- to 19-year-olds consuming each type (NHANES 2017-2018)



Source: Martin 2020[3]

Figure 1c: Percentage of 2- to 19-year-olds who consumed beverages within the previous 24 hours, by race and ethnicity (NHANES 2017-2018)



Source: Martin 2020[3]

100% juice: Based on 2017–2018 NHANES data, prevalence of 100% juice consumption (citrus juice, apple juice, or other fruit juice; vegetable juice) within the previous 24 hours was significantly different between 6–11 (28%) and 12- to 19-year-olds (16%)(**Figure 1a**).[3] The mean daily intake of 100% juice was 8 fl oz/day for 6- to 11-year-olds compared to 12 fl oz/day for 12–19 year olds (**Figure 1b**).[3] The percentage of 2- to 19-year-olds who consumed 100% juice within the previous 24 hours, by race and ethnicity, was highest among Hispanic (35%) and lowest among white children (21%)(**Figure 1c**).[3] A significantly higher percentage of Hispanic children consumed 100% juice compared to white, Asian, and Black children (**Figure 1c**).[3] Based on YRBS 2021 data, the prevalence of high school students (grades 9–12) who ate fruit or drank 100% fruit juices (orange juice, apple juice, or grape juice not counting punch, Kool-Aid, sports drinks, or other fruit-flavored drinks) two or more times per day has decreased from 1999–2021.[7]

Plant-based milk alternatives (PBMA): Limited data are available on the consumption of PBMA among children 5–18 years old. A marketing report from Grand View Research found key factors driving the plant-based beverage market globally are lactose intolerance and growing health concerns among consumers.[8] The global plant-based beverage market is predicted to continue expanding with a compound annual growth rate of 13% from 2023–2030.[8] Based on SNMCS data from school year 2014–2015, 6% of middle school students and less than 3% of high school students participating in NSLP reported consuming "other milk beverages" at breakfast (which included soy milk, almond milk, cocoa made with milk, milk shakes, and smoothies made with dairy).[6]

Sweetened flavored milk: Limited data are available on the consumption of sweetened flavored milk among children 5–18 years old. An analysis of NHANES 2015–2016 survey data found flavored milk among the top sources of added sugar for children 6–11 years old, providing 5% (3.5 grams) of total calories from added sugars.[9] Among children of all grades who participated in the NSLP in school year 2014–2015, 40% consumed flavored, fat-free milk at lunch compared to 12% of matched non-participants. Across all grades and NSLP participation status, flavored, fat-free milk was the type of milk most frequently consumed at lunch.[6]

Sugar-sweetened beverages (SSBs): SSB consumption has declined steadily from 2003 to 2018; however, overall intake remains high and disparities between children of various race and ethnicity groups persist. According to NHANES 2015–2016, sweetened beverages were the top sources of added sugars for children ages 2–5, 6–11, and 12–19, providing 21% (9.4 grams), 29% (19.9 grams), and 37% (28 grams) of total calories from added sugar, respectively.[9] The per capita consumption of overall calories from SSB declined significantly, primarily driven by significant declines in soda (carbonated beverage with added sugar; not identified as diet or low calorie) and fruit drinks (fruit drinks, fruit juice[i], and fruit nectars with added sugar; not identified as diet or low calorie), among all white, Black, and Hispanic children aged 6–11 and 12–19 years.[1] However, the rates of decline for consumption of soda were significantly lower for Black children 6–11 and 12–19 years old compared to their white peers. Similarly, the rates of decline for consumption of calories from fruit drinks were significantly lower for Black children 12–19 years old compared to their white peers.[1]

Based on 2017–2018 NHANES data, the prevalence of SSB consumption (defined as soft drinks, fruit drinks, sport and energy drinks that contain 40 kcal per reference amount customarily consumed, and nutritional beverages, smoothies, and grain drinks) within the previous 24 hours was similar for 6–11 (54%) and 12- to 19-year-olds (58%)(**Figure 1a**).[3] The mean daily intake of SSB was significantly lower for 6- to 11-year-olds (14 fl oz/day) compared to 12- to 19-year-olds (19 fl oz/day)(**Figure 1b**).[3] The percentage of 2- to 19-year-olds who consumed SSB within the previous 24 hours by race and ethnicity, was highest among Hispanic (61%) and lowest among Asian children (35%)(**Figure 1c**).[3] A significantly lower percentage of Asian children consumed SSB compared to white, Hispanic, and Black children (**Figure 1c**).[3] Data from the 2021 YRBS survey indicate the percentage of high school males who drank a sports drink (14%) or who drank soda/pop (17%) one or more times per day was significantly higher than high school females who drank a sports drink (8%) or who drank soda/pop (13%) one or more times per day.[2]

Beverages with non-sugar sweeteners (NSS): Limited data are available on the consumption of beverages with NSS among children 5–18 years old. Furthermore, it is difficult to quantify the amount of NSS in foods and beverages because manufacturers are not required to provide this information on labels.[10] The availability and purchasing of beverages containing NSS has increased over time as reformulation of products available in the marketplace has occurred to decrease added sugars content.[11] As a result, the percentage of children consuming beverages with these sweeteners has increased over time. For example, from 1999–2008, the prevalence of children consuming beverages with NSS doubled (6% to 13%).[12] An analysis of NHANES survey data from 2009–2012 found 25% of children ages 2–17 years consumed at least one

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i does not include 100% fruit juices

item containing NSS on at least 1 of the 2 days of reporting on intake (food, beverage, or packet).[10] The prevalence of consumption was highest for beverages (19%), however, NSS beverage consumption comprised only 1% of the total beverage intake reported in children. It was found that consumption of NSS beverages increased with age. Total NSS consumption, listed as low-calorie sweetener (LCS) and LCS packet, was highest among school-aged children ages 6 to 11 years and use was more common among white children compared to Black or Hispanic children.[10] Data from NHANES 2009–2010 found 15% of white, 8% of Hispanic, and 7% of Black children and adolescents ages 2–19 years consumed a diet drink on a given day (soft drinks, diet sport and energy drinks, other diet drinks that are low- and no- calorie-sweetened, containing 40 kcal or less per reference amount customarily consumed) and the percentage of children from higher income households (18% of 2- to 19-year-olds living in households with income at or above 350% of the poverty line) who consumed diet drinks was greater than that of children from lower income households (12% of those living between 130% and 350% of the poverty line, and 8% of those living below 130% of the poverty line).[13]

Beverages with caffeine: Limited current data are available on the consumption of beverages with caffeine among children 5–18 years old. Among children and adolescents in 2011–2012, soda and tea were the top contributors of caffeine while food provided up to 15%.[14] Based on NHANES survey data from 2003–2012, the mean total caffeine intake (from food and beverages) among 13- to 17-year-olds significantly decreased from 62 to 55 mg/day.[15] Over this time, the contribution of caffeinated sodas to mean total caffeine intake significantly decreased while the contribution of coffee and tea significantly increased. The contribution of energy drinks to mean total caffeine intake increased but remained less than 5% of total intake. In 2011–2012, the primary source of caffeine for 13–17 year olds was coffee and tea and the secondary source was caffeinated sodas.[15] Based on NHANES 2017–2018 survey data, a higher percentage of 12- to 19-year-olds (28%) consumed coffee and tea in the previous 24 hours compared to 6- to 11-year-olds (13%), however this includes both decaffeinated and regular varieties of coffee or tea.[3] The percentage of 2- to 19-year-olds who consumed coffee/tea within the previous 24 hours, by race and ethnicity, was highest among Asian children (24%) and lowest among Black children (16%) (**Figure 1c**).[3] The per capita consumption of coffee- and tea-based beverages with added sugars has significantly increased from 2003 to 2018 among Black 6- to 11-year-olds and white, Black, and Hispanic 12- to 19-year-olds.[1]

Beverages with additives/supplements: Limited data are available on the consumption of beverages with additives or supplements among children 5–18 years old. Such beverages are often labeled as "functional" as they claim to offer specific functional benefits.[16] These beverages are typically enhanced or

fortified with ingredients like bioactive compounds, vitamins, minerals, or pre- or probiotics. While the availability of "functional" beverages is growing in the retail marketplace,[16] they are either not represented in national surveillance surveys or they are grouped into broader categories of beverages during data collection (such as SSBs, milk, or water), making it difficult to ascertain the prevalence of consumption among children and adolescents. Other means of estimating prevalence of consumption could be achieved through the analysis of purchasing data, however this information was not readily available to the expert panel due to its high cost.

Limitations of National Surveillance Datasets

Consumption data for 5- to 18-year-olds is limited for beverages with NSS, PBMA, and beverages with caffeine, additives, or supplements. Data on beverage consumption by race and ethnicity and income level is also limited. Across the various national surveillance surveys, beverages are categorized and defined differently, making it difficult to compare consumption data across datasets. Additionally, beverage categories tend to be broadly defined making it difficult to identify consumption rates for specific types of beverages. For example, the NHANES milk and dairy category includes all milk fat types, flavored and unflavored milk, and other types of dairy drinks. Finally, a lack of recent data was identified; the most recent NHANES data analyses published in the literature were from the NHANES 2017–2018 cycle as the NHANES 2019–2020 data collection was suspended in March 2020 due to the COVID-19 pandemic.[17]

METHODOLOGY

This technical report (and the accompanying *consensus statement*) is the culmination of a structured, multi-component process. Additional details on each of these steps are provided below as well as in **Appendices A through E**.

❶ Convene an Expert Panel and Scientific Advisory Committee (SAC)

Healthy Eating Research (HER) invited two experts studying beverage consumption in 5- to 18-year-old children to co-chair the expert panel. Co-chairs also had expertise in clinical pediatrics, public health, and social and behavioral science. A research consultant with expertise in nutrition and public health was invited to support the expert panel's work. HER then invited the Academy, AAPD, AAP, and AHA to participate in the expert panel process due to their participation in the previous expert panel, *Healthy Beverage Consumption in Early Childhood: Recommendations from Key National Health and Nutrition Organizations*, released in 2019. Each organization designated two representatives to serve on the panel; one representative who could speak on behalf of the organization and one representative with content knowledge expertise.

HER and the co-chairs invited nine scientific experts known for their scholarship on beverage consumption in children and adolescents and/or experience in establishing dietary guidance from diverse disciplines and backgrounds to join the panel's scientific advisory committee (SAC). The goal of the SAC was to provide input throughout the consensus process on the panel methodology and protocols, including providing feedback on the background research, literature reviews, and development of the consensus recommendations. The SAC also reviewed the final consensus recommendations for scientific rigor and accuracy. A full list of expert panel and SAC members is provided in the **Acknowledgements** section at the end of this report (bios can be found in **Appendix I**).

❷ Conduct Review of Existing Recommendations and Guidance

The research consultant, in collaboration with HER staff and the co-chairs, conducted a search and qualitative analysis of existing policy statements and evidence-based recommendations and guidelines on beverage consumption for children ages 5 to 18 years. The search resulted in approximately 50 unique source documents and reports from 20 domestic and international authoritative bodies. The documents reviewed include policy and position statements and clinical practice guidelines from the Academy, AAPD, AAP, AHA, and HER; U.S. government dietary guidelines from the Dietary Guidelines for Americans (DGA), the Centers for Disease Control and Prevention (CDC), U.S. Department of Agriculture (USDA), and National Academies of Sciences, Engineering, and Medicine (NASEM); and statements from international groups such as the World Health Organization (WHO). Beverage recommendations were extracted from the sources and reviewed for consistency and completeness by beverage type and age across four criteria: 1) consumption, 2) type, 3) frequency, and 4) amount. The 'consumption' criterion indicates if guidance is provided to consume or not consume the beverage (e.g., recommended to consume, limit, avoid, etc.). The 'type' criterion indicates if guidance is provided regarding the specific type of beverage (e.g., tap or bottled water; milk fat percentage, etc.). The 'frequency' criterion indicates if guidance is provided on how often to consume the beverage (e.g., throughout the day, during meals, etc.). The 'amount' criterion indicates if guidance is provided on how much to consume (e.g., a minimum or maximum amount per day).

The review identified a high level of consistency and completeness across guidance from the organizations/authorities for only one beverage type: SSBs. A lower level of consistency and completeness across the four criteria was identified for plain drinking water, 100% juice, plain pasteurized milk, and PBMA. The lowest level of consistency and completeness was identified for flavored milk, beverages with NSS, and beverages with caffeine. No existing recommendations were found for beverages with supplements or additives. A summary of the consistency and completeness of existing evidence-based beverage recommendations is included in **Figure 2**. Detailed findings from this review are described in **Appendix E** and specifics for each beverage type are discussed further in the **Recommendations** section.

Figure 2: Consistency and Completeness in Evidence-Based Beverage Recommendations

Consistency and completeness	Beverage	Middle childhood (5–10 years)	Early adolescence (11–13 years)	Middle adolescence (14–17 years)
Higher consistency and completeness	Sugar-Sweetened Beverages	Generally well-established recommendation with broad agreement on **consumption, type, frequency, and amount**		
	Plain Drinking Water	Limited evidence or lack of agreement on either **consumption, type, frequency, or amount**		
	100% Juice			
	Plain Pasteurized Milk			
	Plant-Based Milk Alternatives			
	Sweetened Flavored Milk	Inconsistency/conflict in guidance for **two or more criteria** (e.g., consumption, type, frequency, or amount)		
	Beverages with Non-Sugar Sweeteners			
Lower consistency and completeness	Beverages with Caffeine			

❸ Convene Working Groups and Conduct Literature Reviews

Data from step two, along with the beverage consumption data, were presented to the expert panel and SAC members to identify gaps in existing recommendations and to guide recommendation development for this project. Four working groups were created based on inconsistencies or gaps identified in existing recommendations for specific beverage types including: 1) water (plain drinking water, unsweetened carbonated water, unsweetened flavored water), 2) milk (plain pasteurized milk, flavored milk, PBMA), 3) sweet beverages (100% juice, SSBs, and beverages with NSS), and 4) other beverages (beverages with caffeine and other stimulants, beverages with supplements or other additives). Each working group was staffed by an HER team member, the research consultant, or one of the panel co-chairs and included four individuals from the SAC or expert panel (self-assigned by areas of interest or expertise). The four working groups were tasked with 1) identifying a set of research questions for each beverage category to inform the literature review, 2) reviewing the literature examining the dietary and health implications of 5- to 18-year-old children consuming beverages, and 3) proposing preliminary recommendations based on the existing evidence.

Literature reviews were conducted for beverages where there was a lack of existing recommendations or where recommendations were incomplete or inconsistent. The literature reviews were conducted to further explore the health impacts of consuming certain beverages, as well as examine research gaps or questions deemed necessary by the SAC or expert panel members to develop clear and consistent recommendations. The methodology for the literature reviews and data extraction was developed based on the methodology of the 2020 Dietary Guidelines for Americans Committee *Scientific Report*, prior HER-led expert panels, and input from HER staff, panel co-chairs, the SAC, expert panel members, and an expert in library science from Duke University. HER staff and the research consultant worked with the Duke librarian to develop the search strings; the librarian conducted the searches. A scoping review was conducted from 2019 to present for each of the following beverage types:

1. Carbonated Water
2. Flavored Water
3. Plant-Based Milk Alternatives
4. Flavored Milk
5. Plain Milk/Fat Content
6. 100% Juice
7. NSS
8. Caffeine + Stimulants
9. Additives + Supplements

Additional details on the literature review processes, including the research questions and outcomes explored, inclusion/exclusion criteria, and search strategy are provided in **Appendix A**. **Appendix B** includes the Prisma flow charts for each of the scoping reviews conducted, and a list of included studies with their respective funding sources is provided in **Appendix C**.

For a selection of beverage types and specific outcomes with rigorous study designs, including experimental and observational prospective cohort studies, research evidence was evaluated using criteria adapted from the *What Works For Health* and *USDA's DGA* evidence rating systems and rated in categories from "evidence-based" (highest confidence) to "insufficient evidence" (lowest confidence). Beverage types and specific outcomes with rigorous study designs identified for evidence grading are:

- Milk fat and cardiovascular disease (CVD) outcomes;
- 100% juice and (1) cardiovascular disease outcomes and (2) oral health;
- Sweetened flavored milk and diet quality; and
- Caffeinated beverages and (1) cardiovascular disease outcomes and (2) cognitive, sleep, and behavioral outcomes.

Since this process was conducted at the conclusion of the panel's discussions to validate recommendations, results are reported separately. **Appendix D** includes further details regarding the evidence grading methodology and findings.

4 Expert Panel Discussion and Deliberation

The SAC began meeting virtually in November 2023 to provide input on the panel methodology and protocols. The expert panel members met virtually over approximately 5 months during the consensus statement development process beginning in January 2024. Over this 5-month period, the expert panel convened twice as a full group and twice as part of working groups. In addition, the expert panel and SAC convened three times as a full group when reviewing the evidence and finalizing recommendations. Throughout the process, expert panel members were asked to respond to surveys to provide feedback and expertise in between meetings. The SAC was consulted throughout the project and participated in working groups based on their area(s) of expertise.

5 Development of Final Consensus Recommendations

At the conclusion of the working group activities, HER staff and a research consultant presented the results of the literature reviews and preliminary recommendations to the full expert panel and SAC during 3 days of virtual meetings. In these meetings, the expert panel and SAC discussed the literature review results and established draft consensus recommendations. Expert panel members completed a survey between virtual meetings to provide further feedback and vote on the level of agreement with the draft consensus recommendations. The levels of consensus were: I can say an unqualified yes; I can accept (or live with) the decision; I do not fully agree with the decision, however, I will not block it; and I do not support this recommendation. In addition, expert panel and SAC members also provided comments in the survey on ancillary aspects of beverage consumption that were identified within the working groups. The final draft consensus recommendations and their supporting rationale were reviewed by all members of the expert panel and the scientific advisory committee, with refinements made as needed. The recommendations and draft technical report were then circulated to the Academy, AAPD, AAP, and AHA for final review and approval. These products were finalized after consensus was achieved among the partner organizations, HER, and RWJF.

EXPERT RECOMMENDATIONS

The expert panel's recommendations for children and adolescents are presented in three categories: 1) **Beverages recommended as part of a healthy diet** (plain drinking water and plain pasteurized milk); 2) **Beverages to limit** (100% juice, PBMA, and sweetened flavored milk); and 3) **Beverages not recommended as part of a healthy diet** (SSB, beverages with NSS, and beverages with caffeine and other stimulants). **Table 2** provides an overview of the recommendations which are broken into age subgroups to support a life-course approach to nutrition. Recognizing that children and adolescents have diverse hydration, calorie, and nutrient needs based on age and patterns of growth, physical development, and physical activity that rapidly evolve during this life stage, the expert panel used *AAP's Periodicity Table* from the Recommendations for Preventive Pediatric Health Care[18] which is based on a child's or adolescent's developmental stage, rather than age, as well as the calorie and nutrient needs established by the DGA when developing age subgroups.[4]

Table 2. Recommendations for Healthy Beverage Consumption, Ages 5–18 Years

	5–8 years	9–13 years	14–18 years
Total Hydration Needs*	40 fl oz of total beverages per day (~5 cups)	54–61 fl oz of total beverages per day (~6.75–7.6 cups)	61–88 fl oz of total beverages per day (~7.6–11 cups)
Plain Drinking Water**	16–40 fl oz per day (2–5 cups)	22–61 fl oz per day (2.75–7.6 cups)	29–88 fl oz per day (3.6–11 cups)
Plain Pasteurized Milk	up to 20 fl oz per day (2.5 cup eq/day)	up to 24 fl oz per day (3 cup eq/day)	up to 24 fl oz per day (3 cup eq/day)
100% Juice	<4–6 fl oz per day (½ to ¾ cup/day)	<6–8 fl oz per day (¾ to 1 cup/day)	<8 fl oz per day (1 cup/day)
Plant-Based Milk Alternatives	Only recommended when medically indicated (e.g., milk protein allergy) or to meet specific dietary patterns (e.g., vegan). Choose alternatives that are nutritionally similar to milk, such as unsweetened, fortified soy milk. Avoid plant-based milk alternatives containing added sugar or non-sugar sweeteners.		
Sweetened Flavored Milk	Avoid or limit consumption due to the high amount of added sugars per serving.		
Sugar-Sweetened Beverages	Not recommended		
Beverages with Non-Sugar Sweeteners	Not recommended		
Beverages with Caffeine and Other Stimulants	Not recommended		

*Total Hydration Needs represent the total volume of fluids per day consumed as beverages; amounts are based on median intake to avoid dehydration and should not be considered maximums or minimums. Total hydration needs vary for each individual based on sex, age, and weight, and will vary day-to-day based on factors such as climate and physical activity. Plain drinking water is the primary recommended beverage for meeting hydration needs.

**Plain drinking water ranges are determined using the quantities in total hydration needs minus the maximum recommended quantities of milk and 100% juice. Individual needs vary day-to-day; see the section below on plain drinking water for more information.

Note about unit conversions: 1 cup = 8 fluid ounces = 237 milliliters

While the recommendations are intended to address beverage consumption in children and adolescents, the expert panel recognizes that some beverages, such as milk and 100% juice, are an option for meeting food group recommendations in a healthy dietary pattern and the context of the whole diet should be considered in these cases. Beverages such as water, milk, and 100% juice often provide beneficial nutrients, such as vitamins, minerals, and fluoride. In contrast, many beverages in the marketplace fall into the discretionary category and may not add any nutritional benefit to the diet. These beverages often contain added sugars, which contribute excess calories to the diet, and/or NSS or stimulants, which may be harmful if consumed in large quantities.

Added sugars—sugars that are added during the processing or preparation of foods and beverages—are especially concerning in U.S. diets as they are abundant in the food supply and strong evidence links overconsumption to negative health outcomes, including increased risk of dental caries, overweight and obesity, and diet-related chronic diseases.[19] According to the DGA, approximately 85% of the calories a person consumes each day are needed to meet food group and nutrient recommendations; this leaves only a small proportion of total calories (15%) for discretionary foods and beverages, including added sugars.[4] The DGA recommends that children and adolescents limit added sugars to less than 10% of calories per day (which is equivalent to 200 calories, or 50 grams of added sugars, in a 2,000 calorie per day diet). The AHA recommends even lower limits of no more than 6 teaspoons of added sugar per day (equivalent to 25 grams of added sugars or 100 calories), and no more than 8 ounces of sugary beverages a week for children and adolescents due to the link between excess added sugar consumption and negative impacts on cardiovascular health.[20] The expert panel considered all these principles, as well as current evidence-based recommendations, and the latest research when developing the recommendations.

In the following report sections, the recommendations for each beverage category are presented along with background information, including a summary of existing recommendations, and findings from the literature reviews on the health impacts associated with consumption. Additional considerations are also presented for some beverages.

Literature review findings for each beverage are categorized by study type, including systematic reviews, meta-analyses, umbrella reviews, scoping reviews, and narrative reviews, as well as randomized control trials (RCT), quasi-experimental studies, observational studies, prospective cohort studies, and cross-sectional studies. Although prospective cohort and cross-sectional studies are both types of observational designs, the expert panel and SAC chose to specifically identify prospective cohort studies as they are of greater rigor compared to other observational designs, while cross-sectional studies were identified because they are considered the least rigorous observational study design. Therefore, observational study findings noted in the evidence section for each beverage reflect other study designs such as case-control and retrospective cohort studies. Outcomes for which evidence grading was conducted are noted in the summary statements below, and additional details are available in **Appendix D**.

BEVERAGES RECOMMENDED AS PART OF A HEALTHY DIET IN CHILDHOOD AND ADOLESCENCE

Plain Drinking Water

The expert panel defined plain drinking water as potable water that is unsweetened, unflavored, and fluoridated. Plain drinking water is commonly referred to as tap water, though other forms are also common, including well water, bottled water, and carbonated water. When reviewing existing recommendations and guidance on plain drinking water, there was broad agreement to consume water daily; however, there was a lack of agreement across organizations and authoritative bodies on the type of water, amount of water to consume daily, and frequency of consumption. Despite the lack of agreement on these specifics, there is a well-established evidence base on the importance of water for human health due to its necessity in metabolic reactions and transport of nutrients. Adequate hydration is also required for many bodily processes, including regulation of heart rate, blood pressure, metabolism, and body temperatures, as well as proper renal, gastrointestinal, and cognitive function.[21]

Plain Drinking Water

The review identified limited evidence or lack of agreement across the organizations/authorities on type, amount, and frequency of water for children and adolescents.

- **Consumption:** Broad agreement to consume water.
- **Type:** Variation in guidance on type of water, such as: fluoridated, plain, unsweetened, tap, bottled, carbonated, or sparkling.
- **Amount:** Most of the organizations/authorities did not provide quantitative guidance on water consumption. Three organizations did provide quantitative guidance which were in alignment with the NASEM Dietary Reference Intakes for Water.[22]
- **Frequency:** Variation in guidance on frequency of consumption or when to serve, such as: serve as requested by child, serve during meals, serve with snacks, and serve throughout the day.

As noted in the background section of this report, water is under-consumed among children and adolescents, with only about 85% reporting consuming water in the past 24 hours via NHANES[3] and much lower percentages of students participating in the national school lunch program reporting water consumption in the past 24 hours (via SNMCS).[6] Patel et al. has also shown that plain water deficits relative to the Dietary Reference Intakes (DRI) for water are largest for U.S. children 4–18 years old and adults over 70 years old.[21]

Health Impact Literature Review for Plain Drinking Water

A health impact literature review was not conducted for plain drinking water due to the well-established evidence base on the importance of water consumption and hydration, as well as agreement across the four consensus organizations that plain drinking water is recommended as part of a healthy diet in childhood and adolescence. The DGA Healthy U.S.-Style Dietary Pattern for children and adolescents leaves a limited number of discretionary calories for food and beverages that are not nutrient-dense, thus they recommend that primary beverages for children ages 5–18 years be calorie-free and contain no added sugars. Plain drinking water meets these criteria, yet quantitative guidance is not provided by the DGA.

In 2005, the Dietary Reference Intakes (DRIs) for water were established and are comprised of the Adequate Intake (AI) reference values (**Table 3**).[22] AI is the recommended average daily intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate; it is used when a Recommended Dietary Allowance (RDA) cannot be established. The AI for total water includes drinking water and the water content of beverages and food containing water, and is set based on the median total water intake from the U.S. National Health and Nutrition Examination Survey III data (1988–1994) and rounding to the nearest 0.1 liter. The AI reference values for water provide both a total daily water amount, as well as the proportion that is assumed to come from only fluids/beverages (i.e., not counting the water content of foods). For children and adolescents, the percentage of total daily fluids consumed from foods decreases slightly as they age; approximately 29% for 4- to 8-year-olds, 24% for 9- to 13-year-olds, and 20% for 14- to 18-year-olds. This leaves approximately 71–80% of total daily fluid needs

Table 3: Adequate Intakes for Total Water from Food and Beverages

	5–8 years	9–13 years		14–18 years	
		Female	Male	Female	Male
AI for total water per day (includes beverages and foods containing water)	**57 fl oz** (7 cups or 1.7 L)	**71 fl oz** (9 cups or 2.1 L)	**81 fl oz** (10 cups or 2.4 L)	**78 fl oz** (10 cups or 2.3 L)	**112 fl oz** (14 cups or 3.3 L)
		Female	Male	Female	Male
Amount of AI per day as total beverages (includes drinking water)	**40 fl oz per day** (5 cups or 1.2 L)	**54 fl oz** (6.75 cups or 51.6 L)	**61 fl oz** (7.6 cups or 1.8 L)	**61 fl oz** (7.6 cups or 1.8 L)	**88 fl oz** (11 cups or 2.6 L)

Source: Institute of Medicine. 2005. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. Washington, DC: The National Academies Press.

Note about unit conversions: 1 liter = 4.227 cups; 1 cup = 8 fluid ounces

coming from beverages (including drinking water). The AI for total water is set to prevent deleterious (primarily acute) effects of dehydration; it is expected that individual water needs will vary based on factors such as gender, age, weight, climate, and levels of physical activity. The resulting AI reference values for total water for children and adolescents are presented in **Table 3**.

Due to a lack of other quantitative guidance for drinking water, as well as a lack of evidence indicating specific requirements for children and adolescents, the expert panel used the AI for total beverages to establish a guide for meeting total hydration needs.

Health Impact Literature Review for Carbonated Water

The expert panel reviewed relevant literature to explore the impact of consuming carbonated water during childhood and adolescence on health. Plain carbonated water was defined as water with carbonation that is not sweetened nor contains other additives such as flavorings or NSS (e.g., seltzer or sparkling water). The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, and C** for additional details). A total of 763 articles were returned for abstract screening. Of those, 7 articles moved to full text review, and only one article met the criteria for data extraction. The primary reason articles were excluded were wrong setting, intervention, or study design.

Summary of Literature Review Key Findings for Carbonated Water

The expert panel identified one randomized control trial (RCT) examining the relationship between carbonated water intake and oral health among children and adolescents (Barajas Torres, 2022).[23] This study among children 2–18 years old in Mexico found no statistically significant differences observed with changes in oral pH or bacterial proliferation after consuming carbonated water compared to plain water. The expert panel did not identify any studies on the relationship between carbonated water intake and other health outcomes of interest (diet quality, body weight, diabetes, cardiovascular disease, bone density, taste preferences, cognitive function) among children 5–18 years of age.

The panel concluded that there is insufficient rigorous evidence to make a conclusion or recommendation on the relationship between consuming plain carbonated water and health impacts among children and adolescents.

Health Impact Literature Review for Flavored Water

The expert panel reviewed relevant literature to explore the impact of consuming flavored water during childhood and adolescence on health. Flavored water was defined as water with flavoring (natural or artificial), additives, and/or juice; waters sweetened NSS were not included as a separate NSS scoping review was conducted. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review. A total of 161 articles were returned for abstract screening. Of those, one article moved to full text review, but was then excluded as it did not provide a test beverage of interest. The PRISMA flow chart and additional literature review methodology can be found in **Appendix A and B**, and the list of included articles by beverage type can be found in **Appendix C**.

Summary of Literature Review Key Findings for Flavored Water

The expert panel did not identify any studies within scope on the relationship between flavored water intake and health outcomes of interest (diet quality, body weight, diabetes, cardiovascular disease, bone density, oral health, taste preferences, cognitive function) among children 5–18 years of age.

Expert Panel Recommendations

Plain drinking water is recommended as part of a healthy diet for children and adolescents ages 5 to 18 years. It should be the primary beverage for meeting hydration needs. The specific amount required by each individual will vary day-to-day based on climate and level of physical activity, as well as the volume of fluids consumed via other foods and beverages.

When considering total beverage intake necessary to meet hydration needs, data suggest that the following total fluid volumes (which include all beverages—water, milk, juice) will meet daily hydration needs for most children and adolescents. The expert panel used these estimates for total hydration needs to determine ranges for plain drinking water. The following plain drinking water ranges are determined using the quantities in total hydration needs minus the maximum recommended quantities of milk and maximum allowances for 100% juice.

Fluoridated water is the recommended form of plain water given its substantial oral health benefits; however, not all plain water sources are naturally fluoridated. For families who do not have access to fluoridated plain water in their communities, healthcare providers should discuss alternative sources of fluoride with patients and families, as most bottled beverages (e.g., bottled water) do not contain fluoride.

	5–8 years	9–13 years		14–18 years	
		Female	Male	Female	Male
Total Hydration Needs	**40 fl oz per day** (5 cups or 1,183 mL) No difference by sex.	**54 fl oz** (6.75 cups or 1,597 mL)	**61 fl oz** (7.6 cups or 1,804 mL)	**61 fl oz** (7.6 cups or 1,804 mL)	**88 fl oz** (11 cups or 2,602 mL)
		Female	Male	Female	Male
Plain Drinking Water	**16–40 fl oz per day** (2–5 cups or 473–1,183 mL) No difference by sex.	**22–54 fl oz** (2.75–6.75 cups or 651–1,597 mL)	**29–61 fl oz** (3.6–7.6 cups or 858–1,804 mL)	**29–61 fl oz** (3.6–7.6 cups or 858–1,804 mL)	**56–88 fl oz** (7–11 cups or 1,656–2,602 mL)

Rationale

Water is essential for life, yet establishing a daily requirement for individuals is challenging. Individual fluid needs vary on a day-to-day basis because of differences in physical activity, climate, and intake of other foods and beverages containing water. A healthy human body can compensate for some degree of over- and under-hydration in the short term, allowing normal hydration to be maintained over a range of water intakes. One day of low intake may not lead to dehydration; however, a continuous pattern of under-consuming fluids will compromise health. Body water deficits help drive the sensation of thirst, allowing for maintenance of hydration status on a day-to-day basis.[22] Thirst may help to guide water intake; however, data indicate that most children and adolescents are chronically under-hydrated,[24] thus thirst alone may not be an adequate indicator of hydration status.[25, 26]

Clinicians are often asked by families for guidance on water consumption and hydration needs for children and adolescents. When considering total beverage intake necessary to meet hydration needs, the expert panel uses the AI for total water set by the Dietary Reference Intakes Committee and the Panel on Dietary Reference Intakes for Electrolytes and Water convened by the National Academies of Sciences, Engineering, and Medicine to guide the development of this recommendation.[22] The recommended amounts of total fluid intake for adequate hydration provided by the expert panel, include only the proportion of fluids that come from daily beverage consumption, including water. However, these recommended amounts should not be interpreted as a maximum or minimum; rather they are an estimate of daily fluid needs from beverages to avoid dehydration for most children and adolescents.

Plain, fluoridated water should be the primary beverage consumed to meet daily hydration needs and should be consumed throughout the day and during mealtimes. However, the specific amount of water consumed by an individual may be adjusted based on the total amount of other beverages (e.g., milk, 100% juice) consumed in each day, as well as other factors that result in water losses (e.g., climate and physical activity).

An example scenario for how water intake may be adjusted based on age and milk consumption is included in the call out box (additional example scenarios are provided in **Appendix F**).

When considering types of water, the expert panel recommends consuming potable water that is unsweetened, unflavored, and fluoridated. Examples of plain drinking water include tap water, well water, or plain, unsweetened bottled or carbonated (i.e., sparkling) water. Tap water is the preferred water source as it is usually readily available, convenient, affordable, and environmentally friendly; in many places it is also fluoridated. Bottled water does not typically share these characteristics and should only be purchased when tap water is unsafe for drinking.

Given the evidence demonstrating the role of fluoride in dental caries prevention and supporting optimal oral health, all water consumed by children and adolescents should be fluoridated. The U.S. Public Health Service recommends an optimal fluoride concentration of 0.07 milligrams/liter in community water systems to protect from dental caries while limiting risk of dental fluorosis.[27] Individuals can learn about the fluoride content of their water by checking the Centers for Disease Control and Prevention website, *My Water's Fluoride*, or by directly contacting their community's water provider. It is important to note, however, that fluoride content is not required to be disclosed on nutrition labels. Including this information on product labels would assist providers in knowing when to prescribe supplementation as some foods and beverages do contain fluoride.

While the majority of the U.S. population receives fluoridated water through a community water system (~73% as of 2020), many individuals still do not have access to fluoridated water.[28] Because fluoridation is often determined at the municipal or county level, there are communities in the U.S. where the tap water is not fluoridated; well water is also not fluoridated. Others may live in communities or dwellings where the municipal water is not safe for consumption (e.g., buildings with outdated plumbing systems or old pipes that may be leaching harmful chemicals into the water). In these cases, the expert panel still recommends consumption of plain water (from other sources) and encourages families to speak with their dentist or pediatrician regarding alternate sources of fluoride to support optimal oral health, particularly for children under 16 years of age. It is important to note that most bottled water is not fluoridated. More information about environmental considerations of bottled water and recommendations for when the municipal water is not safe for consumption can be found in the **Other Considerations** section.

Example Scenario for Plain Drinking Water Intake in Children ages 5 through 8 years

For children ages 5 to 8 years, approximately 5 cups (40 fluid ounces) of beverages are included in total water intakes, based on the range indicated by the DRIs. The recommended intake of dairy foods at these ages is up to 2.5 cup equivalents (of which milk could technically contribute any proportion). Therefore, if children 5 to 8 years consumed the maximum of 2.5 cups of milk per day, the remaining fluid needed to be fulfilled by plain drinking water would be approximately 2.5 cups. If less milk is consumed, the remaining fluid needs to be fulfilled by plain drinking water would increase, and could be as high as 5 cups (if no milk is consumed).

- Expert panel recommendation for total hydration needs: **40 fluid ounces (or 5 cups)**
- Recommended amount of plain, pasteurized milk per day: **up to 20 fluid ounces** (or 2.5 cup equivalents per day of dairy)

Scenario 1: Approximate amount of beverages to be met by water if no milk is consumed = 40 fluid ounces (or 5 cups)

Scenario 2: Approximate amount of beverages to be met by plain drinking water if maximum amount of plain, pasteurized milk is consumed, per day = 20 fluid ounces (or 2.5 cups)

While there was a lack of evidence identified via the panel's scoping reviews on carbonated and flavored water consumption in children and adolescents, previous research in adults indicates that frequent consumption of beverages with a lower pH than water (pH of 7) can have negative impacts on oral health. Specifically, beverages with a pH of less than 4.0 can be potentially damaging to dentition, leading to erosion of enamel on the tooth's surface.[29] Dental erosion is irreversible and is of increasing concern among children due to the frequent consumption of acidic beverages with a low pH.[29] Unflavored, carbonated waters have been found to have a pH above 4.0, thus occasional consumption is of lower concern in adults. However, most flavored waters (including flavored carbonated water) have a pH in the 3.0–3.8 range due to the addition of acids (e.g., citric acid, malic acid, phosphoric acid) and other natural or artificial flavorings.[29] Thus, the expert panel does not recommend that children consume flavored waters with or without carbonation, and suggests frequency of consumption of unflavored, carbonated water be limited due to the paucity of evidence on health impacts in this population. The frequency of consumption is important to consider as consuming mostly low pH beverages will have negative impacts on oral health.

Plain Pasteurized Milk

The expert panel defined plain pasteurized milk as cow's milk and other animal-based milk that has been heated to a specified temperature and for a specified length of time to kill pathogens that may be found in raw milk, and to which caloric sweeteners, NSS, or flavorings have not been added. Common varieties include whole milk (also known as Vitamin D milk), reduced fat (2%), low-fat (1%), and skim (fat-free). When reviewing existing recommendations and guidance on plain milk, there was broad agreement to consume milk daily and general agreement that children and adolescents, ages 5–18 years, should consume low-fat or fat-free milk. There was variation, however, in the quantitative guidance provided on the amount of milk to consume per day, as well as when to consume milk (e.g., with meals).

Summary of Existing Recommendations on Plain Pasteurized Milk

The review identified limited evidence or lack of agreement across the organizations/authorities on type, amount, and frequency of milk for children and adolescents.

- **Consumption:** Broad agreement that milk can be consumed up to a maximum amount.
- **Type:** General agreement in guidance on fat type (low-fat or fat-free); one organization specifically recommended pasteurized milk.
- **Amount:** Variation in quantitative guidance, or the maximum amount to consume.
- **Frequency:** Variation in guidance on frequency of consumption or when to serve, such as: serve per day vs. serve per meal.

Health Impact Literature Review

Most dietary guidelines recommend consumption of low-fat or fat-free dairy products, however in recent years, research has indicated that dairy fat intake may not be accompanied with a higher risk of weight gain, cardiovascular disease (CVD), or type 2 diabetes in healthy individuals.[30] Thus, the expert panel prioritized reviewing literature to explore the health impacts of the milk fat content of plain cow's milk consumed during childhood and adolescence (ages 5–18 years). The literature search was specifically centered around the research question: "How does the fat content of plain, pasteurized milk impact health?" Specific outcomes of interest included: diet quality, body weight, CVD, diabetes, taste preferences, oral health, bone density, and cognitive function. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 1,457 articles were returned for abstract screening. Of those, 52 articles moved to full text review and 25 articles met the criteria for data extraction; the primary reason articles were excluded during full text review was wrong intervention.

Summary of Literature Review Key Findings for Plain Cow's Milk—Fat Content

A substantial number of articles were found on the relationship between fat content of plain pasteurized milk consumption in children and adolescents (ages 5–18 years) and diet quality, body weight, diabetes, cardiovascular disease, oral health, bone density, taste preferences, and cognitive function. However, the existing evidence on the health impacts of varying fat contents in milk is inconsistent, and limited by a lack of strong study designs, including no RCTs, and inconsistent exposures and measures.

Diet Quality

Four studies examined the relationship between plain milk fat content and diet quality among children and adolescents. Two of these studies are narrative reviews and two are cross-sectional.

- Although all studies assessed milk fat content, only one study reported findings by fat content. One cross-sectional study (Laamanen, 2024) found that the consumption of low-fat (<1%) milk was directly associated with higher serum phenylalanine.[31] Phenylalanine is an essential amino acid that aids in the production of important molecules such as dopamine, and serum concentrations have been associated with cardiovascular outcomes in adults and insulin resistance in children. Laamanen also reported that higher consumption of high-fat milk (defined as greater than 1% milkfat) was associated with a lower ratio of serum monounsaturated fatty acids to saturated fatty acids (MUFA/SFA) and higher ratio of SFA to total fatty acids. MUFA are considered good for health, unlike SFA or trans fats, thus these findings may be concerning as they reflect undesirable serum lipid profiles.
- Three included studies did not report findings by fat content. Evidence from these articles is still presented as they describe effects of overall milk consumption.
  - One narrative review (Sipple, 2020) highlighted a connection between milk avoidance and inadequate calcium intake among children.[32] While current evidence

is inconsistent, the review also discussed the potential role of milk components, such as calcium and whey protein, in weight control.

- Most studies in the second narrative review (Gutierrez, 2022) lacked a clear distinction between milk type and fat content; however, a positive relationship was found between total milk consumption and protein intake.[33]

- An NHANES (2011–2016) analysis (Maillot, 2019) found that the top quartiles of diet quality (as defined by Healthy Eating Index, 2015) were associated with more milk, 100% juice, and water, and less SSB consumption.[34]

In summary, there is insufficient rigorous evidence to make a conclusion regarding the relationship between milk fat content and diet quality; however, existing evidence suggests that increased milk consumption (regardless of fat content) is associated with intake of key nutrients.

Body Weight

Fifteen studies examined the relationship between plain milk fat content and body weight among children and adolescents. Seven of these studies are reviews—three systematic reviews, one scoping review, and three narrative reviews. Three studies are prospective cohort and five are cross-sectional.

- One systematic review (O'Sullivan, 2020) examined the associations between whole-fat dairy consumption and measures of adiposity and cardiometabolic risk factors in children aged 2–18 years.[35] A comparison with reduced-fat dairy was made when available. Consistently, studies included in the review reported that increased weight gain or adiposity was not associated with whole-fat dairy consumption.[35] Another systematic review (Vanderhout, 2020) examined the relationship between cow's milk fat consumption and adiposity in healthy children aged 1–18.[36] Within the review, 18 studies reported that higher cow's milk fat was associated with lower child adiposity, while 10 studies reported no association between cow's milk fat and child adiposity.[36] The remaining systematic review (Babio 2022) did not disaggregate findings by milk fat content. Findings from these studies can be found in the final bullet.[37]

- One narrative review (Li, 2023) examined the relationship between obesity and dairy product consumption. Results indicate that moderate intake of dairy products may reduce the likelihood of obesity, although the health benefits of low-fat compared to high-fat were unclear.[38] The two additional narrative reviews (Gutierrez, 2022 and Sipple, 2020) did not present findings by milk fat content; findings from these studies can be found in the final bullet.

- Three prospective cohort studies were identified.
  - The first (Sakaki, 2021) found that low-fat (defined as skim and 1% milk) and high-fat milk (defined as whole and 2%) were not associated with changes in BMI.[39] While the authors conclude that high-fat milk should be consumed in moderation due to a higher calorie and saturated fat content, they noted that high-fat milk may serve as an alternative to low-fat milk when calcium, vitamin D, and potassium intake are otherwise inadequate.[39]
  - The second (Vanderhout, 2021) examined healthy children ages 9 months to 8 years and found that higher cow's milk fat consumption was linked with lower odds of overweight and obesity, and lower zBMI (BMI measurement adjusted for age and sex).[40] Compared to children who drank reduced-fat milk, children who consumed whole milk had a 0.1 lower zBMI.[40]
  - A U.S.-based prospective cohort study (McGovern, 2022) found that, compared with low-fat (1%) or skim milk, early childhood consumption of whole or reduced-fat (2%) milk was associated with decreased odds of overweight or obesity in early adolescence.[41]

- Four cross-sectional studies, which took place in the U.S., Canada, Spain, and the United Kingdom, examined the relationship between milk fat and body weight. Results were mixed with multiple studies yielding results suggesting that consuming lower-fat milk does not reduce obesity risk.

- One study (White, 2020) found that whole milk consumers were less likely to have obesity.[42]
- Another study (Lahoz-Garcia, 2019) found that high-fat (defined as whole milk) and fat-free plus low-fat milk consumption varies according to adiposity and lipid profile in school children aged 8–11 years.[43]
- A third study (Swindell, 2021) conducted among children 9–11 years old found that consuming full-fat milk was inversely associated with body fat, while no association was found between consuming low-fat milk varieties.[44]
- Finally, one study (Damanhoury, 2022) focused on Canadian children with obesity aged 2–17 years (n=945) found that metabolically healthy obesity (MHO) status was positively associated with skim milk intake.[45]

- One systematic review, a scoping review, two narrative reviews, and a cross-sectional study examined cow's milk consumption, but findings were not disaggregated by milk fat content.
  - One systematic review (Babio, 2022) aimed to assess the associations between dairy consumption and the prevalence and incidence of overweight and obesity in children and adolescents globally. The review found an inverse association between total dairy consumption and obesity in pooled cross-sectional studies, while the analysis of prospective studies shows mixed results with no conclusive evidence to suggest an inverse relationship.[37]
  - The scoping review (Dougkas, 2019) examined the link between consumption of milk and dairy products and obesity, as well as adiposity indicators in children ages 2–19, globally.[46] Milk and other dairy products were not consistently associated with obesity and adiposity indicators in this population. While limited longitudinal studies examined these outcomes in relation to reduced-fat versus full-fat milk or dairy products, results did not suggest significant differences between milk fat types or total dairy products and body weight or adiposity.
  - One narrative review (Gutierrez, 2022) found that adolescents with higher milk intake were less likely to have abdominal obesity, compared to those with low milk intake. No significant association was found between BMI and intake of milk and milk-based beverages.[33]
  - Another narrative review (Sipple, 2020) highlighted the potential role of key milk components (calcium and whey protein) in weight control; however, for children and adolescents, findings are inconsistent regarding dairy consumption and weight.[32]
  - The cross-sectional study (Maillot, 2019) analyzed NHANES data from 2011–2016 and found no relationship between milk consumption and body weight status.[34] It is important to note that the study found that children from households with higher socio-economic status (SES) groups drank more fat-free (skim) and reduced-fat (2%) milk and more water; while children from households with lower SES drank more SSB and more whole milk.

In summary, the literature reviewed on milk fat content and body weight had mixed results among children and adolescents, with much of the evidence finding no relationship or that whole milk intake is associated with lower obesity or BMI z-score.

Diabetes

One narrative review and one prospective cohort study examined the relationship between plain milk fat content and diabetes among children and adolescents. However, the narrative review did not disaggregate findings by milk fat content and is described in the final bullet.

- The prospective cohort study (Kummer, 2019) examined the associations of full- and low-fat dairy food and beverage intake (milk, cheese, and cheese spread) with incident diabetes.[47] Full-fat dairy included whole milk, cheese, and cheese spreads; low-fat dairy included non-fat milk, low-fat (1%) milk, and low-fat or reduced-fat cheese alternatives (with less than 20% fat). This prospective cohort study population (n=1,623) included American Indians, a population with high levels of diabetes, aged 14–86 years old at baseline with low reported dairy food intake. During a mean follow-up of 11 years, 277 participants developed diabetes. Compared to participants who reported the lowest intake of full-fat dairy foods, participants who reported the highest intake of full-fat dairy foods had a decreased risk of developing diabetes. Although this study included adolescents, results were not disaggregated by age.
- The narrative review (Sipple, 2020) examined the regulations that influence the type of milk served in U.S. school lunch programs, milk consumption data, and health outcomes for fluid milk consumption by children participating in the school lunch program.[32] Although findings were not provided by fat content, the review concluded that milk consumption has been associated with lower risk of type 2 diabetes.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between milk fat content and diabetes among children and adolescents.

Cardiovascular Disease

Eight studies assessed the relationship between plain milk fat content and cardiovascular disease among children and adolescents. Of these studies, one was a systematic review, two were narrative reviews, one was a prospective cohort study, and four were cross-sectional.

- The evidence presented in the systematic review (O'Sullivan, 2020) suggests that there is not an association between the consumption of whole-fat dairy and increased cardiometabolic risk.[35] In one included study, shifting from whole-fat to reduced-fat dairy improved outcomes for some risk factors.[35]
- The two narrative reviews (Li, 2023; Sipple, 2020) were consistent in their findings, which indicate that milk consumption may help prevent cardiovascular-related diseases.
  - Results from the cohort studies and RCTs included in the first narrative review (Li, 2023) suggest that whole milk consumption has a neutral or potentially positive effect on the prevention of metabolic diseases.[38]
  - The second narrative review (Sipple, 2020) did not differentiate findings by fat content; rather, the authors highlighted the associations between milk consumption and decreased risk of cardiovascular disease and hypertension, in general.[32]
- A Canadian prospective cohort study (Wong, 2019)—TARGet Kids!—analyzing children ages 2–8 years (n=2,890) found that each percent increase in cow's milk fat content was linked with a small increase in non-HDL cholesterol, but not greater odds of high non-HDL cholesterol as the relationship was mediated by volume consumed.[48]
- Four cross-sectional studies were identified.
  - One cross-sectional study (McGovern, 2022) found that consumption of higher-fat milk (compared with lower-fat milk) in early childhood was not associated with adverse cardiometabolic outcomes.[41] In addition, the frequency of cow's milk consumption in early childhood was not associated with adiposity or cardiometabolic risk in early adolescence.
  - Another cross-sectional study (Damanhoury, 2022) among Canadian children ages 2–17 with obesity (n=945), found that metabolically healthy obesity (MHO) status—which includes markers for cholesterol, triglycerides, blood pressure, and fasting glucose—was positively associated with skim milk intake.[45]
  - The third cross-sectional study (Laamanen, 2024) highlighted that, throughout the lifespan, improved diet quality may support cardiometabolic health by influencing amino acid metabolism.[31] Higher phenylalanine was directly associated with consumption of low-fat (<1%) milk, and a higher consumption of high-fat (≥1%) milk was associated with lower serum ratio of monounsaturated fatty acids to saturated fatty acids (MUFA/SFA) and higher serum ratio of SFA to total fatty acids.[31]
  - The final cross-sectional study (Lahoz-Garcia, 2019) found an association between cholesterol and consumption of whole milk during childhood.[43] Children with normal levels of HDL (high density lipoproteins) cholesterol and triglycerides were more likely to consume more whole milk and less reduced-fat milk compared to children with dyslipidemic or abnormal lipid levels.[43]

In summary, the literature reviewed on milk fat content and cardiovascular outcomes had mixed results among children and adolescents. See **Appendix D** for details on the separate evidence grading process and findings for cardiovascular outcomes.

Oral Health

One cross-sectional study (Wang, 2021) examined the relationship between plain milk fat content and oral health, specifically dental caries, among children and adolescents.[49] The study (n=6,885) aimed to assess the associations between whole milk, low-fat milk, skim milk, yogurt, milk desserts, cheese, creams, and total fluid milk consumption and the risk of dental caries in U.S. children aged 2–17 years compared to no-dairy consumers. Low skim milk intake, high yogurt intake, and low total fluid milk intake were associated with decreased risk of dental caries among children aged 12–17.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between milk fat content and oral health among children and adolescents.

Bone Density

Two narrative reviews examined the relationship between plain milk fat content and bone density among children and adolescents. Both reviews confirmed a positive association between milk intake and bone health, although neither included findings disaggregated by milk fat content. The first review (Gutierrez, 2022) confirmed the relationship between bone strength and milk consumption;[33] and the second (Sipple, 2020) highlighted that children who avoided milk consumption were more likely to have inadequate calcium intake and poor bone health.[32]

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between milk fat content and bone density among children and adolescents.

Taste Preferences

One narrative review (Sipple, 2020) assessed the relationship between plain milk fat content and taste preference among children and adolescents.[32] This narrative review, partially funded by the U.S. National Dairy Council, explored factors affecting children's perception and consumption of milk. Published literature described in Sipple's review suggests that although children prefer high fat foods in general, children accept whole milk and low-fat milk equally. Children's selection of and liking for milks served in school are also influenced by sensory properties, such as the packaging.[32]

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between milk fat content and taste preferences among children and adolescents.

Cognitive Functioning

One quasi-experimental study (Naveed, 2023) examined the relationship between plain milk fat content and cognitive function among Finnish children ages 6–9 years at baseline.[50] Increased consumption of low-fat milk was longitudinally associated with improved cognition among children.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between milk fat content and cognitive functioning among children and adolescents.

Expert Recommendations

Plain pasteurized milk is recommended as part of a healthy diet for children and adolescents ages 5 through 18 years.

	5–8 years	9–13 years	14–18 years
Plain Pasteurized Milk	**up to 20 fl oz per day** (2.5 cup eq/day)	**up to 24 fl oz per day** (3 cup eq/day)	**up to 24 fl oz per day** (3 cup eq/day)

These recommendations are in alignment with recommendations from the DGA for daily servings of dairy; thus, these recommendations do not need to be met by milk alone. The dairy group includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products and nutritionally equivalent PBMA such as fortified soy beverages (soy milk).[ii] Both refrigerated and shelf-stable versions of these products are included in the dairy group, as well as buttermilk, yogurt, kefir, and cheeses.[iii] One cup-equivalent from the dairy group equals one cup (or 8 fluid ounces) of milk.

ii The expert panel recommendations address PBMA, including fortified soy beverages, separately; please reference that section of the technical report for more details.

iii Note: cream, sour cream, and cream cheese are not included in the recommendation for the dairy group due to their low calcium content. In addition, condensed milk is not included as it contains added sugars.

Rationale

The dairy group is an important source of several essential nutrients in the diets of children and adolescents, including calcium, phosphorus, vitamins A, K, and D, B vitamins, and protein.[4,51] The DGA recommends that children ages 5 through 8 years consume 2.5 cup equivalents of dairy per day to meet nutrient needs, whereas children ages 9 through 18 years should consume 3 cup equivalents per day. While these recommendations do not need to be met via milk alone, milk is a familiar beverage in U.S. diets and its availability, affordability, and nutrient density make it a good choice for healthy, growing children and adolescents. Milk provides three nutrients of public health concern given low intakes—potassium, calcium, and Vitamin D—as well as protein, phosphorous, vitamin A, vitamin B12, riboflavin, and niacin, making it an important beverage in the diet of children and adolescents. Yet, as children age, national surveillance data show dairy consumption, especially milk, decreases leading to inadequate intake of these key nutrients.[52] Thus, the expert panel recommends that milk should continue to be part of a healthy dietary pattern for most children and adolescents. When making dietary choices, individuals should consider the most nutrient-dense options in the dairy group, such as unsweetened, plain pasteurized fat-free (skim) and low-fat (1%) milk, yogurt, and cheese, given the limited number of discretionary calories available in childhood and adolescence.

Traditionally, dietary guidelines have recommended non-fat or low-fat dairy due to evidence from prospective cohort studies, systematic reviews, and meta-analyses concluding that dietary patterns including low-fat dairy are associated with a lower risk of all-cause mortality, CVD, overweight, and obesity.[53] However, the expert panel recognizes the role of dairy fat in healthy dietary patterns has been controversial in recent years due to evidence suggesting that saturated fat from dairy may not be associated with adverse health outcomes (e.g., heart disease) as previously thought.[54] In the literature reviews for this project, the expert panel did not uncover conclusive evidence to justify a departure from existing recommendations. Thus, they recommend fat-free (skim) or low-fat (1%) milk given their nutrient density and lower calorie and saturated fat content, as diets lower in saturated fat have been shown to be better for health outcomes.[55] Consumption of dairy products high in saturated fat may contribute to excess calories in the diet, which continues to be a concern due to the high prevalence of children and adolescents with overweight and/or obesity in the U.S. However, there may be situations when a higher fat content of milk (2% or whole) is appropriate, such as when a child is refusing lower-fat varieties or is having difficulty gaining weight. When counseling children and adolescents and their families, healthcare providers should recommend the milk type best suited to an individual's nutrient needs.

There are many individuals in the U.S. who are unable, or choose not, to consume dairy products, including milk. According to a 2018 study by Northwestern University, 1.9% of children in the U.S. have a milk protein allergy;[56] however, more recent data suggests this number may be rising.[57] In the case of a dairy allergy, plain, unsweetened, fortified PBMA meeting minimal nutrition standards should be considered to meet dairy needs (see the **Plant-Based Milk Alternatives** section). In the U.S. about 36% of people have lactose malabsorption (the inability to digest lactose—the sugar found in milk and milk products), which can cause lactose intolerance (digestive symptoms experienced after consuming lactose).[58] Lactose intolerance often runs in families and is more common among African Americans, American Indians, Asian Americans, and Hispanics/Latinos. In the case of lactose intolerance, choose unsweetened low-lactose and lactose-free dairy products as these products have nutritional profiles nearly identical to cow's milk. If a child simply does not like milk, other foods from the dairy group (e.g., plain, pasteurized unsweetened yogurt or cheese) can meet daily nutrient needs. If selecting foods rather than beverages to meet dairy recommendations, water consumption should be increased to meet daily hydration needs.

The expert panel also provides the following notes related to the recommendations:

Importance of Milk Pasteurization

Milk pasteurization is the heating of milk to a specified temperature for a specific length of time to kill pathogens.[59] Microorganisms play a major role in the transmission of disease, making it important to eliminate their presence in foods and beverages. The pasteurization process was developed by Louis Pasteur in 1864 during the industrial revolution and was first used to protect beer and wine from spoilage.[59] The process was adapted for milk a few years later by a scientist from Denmark; however, it took decades of research demonstrating that contaminated milk was a major vehicle for disease transmission in infants and children before it was required in major U.S. cities in the early 1900s.[59] Today, milk pasteurization is one of the greatest public health developments of the early 20th century. Yet, there is a growing movement in the U.S. to consume raw milk, or milk from a cow, sheep, goat, or other animal that has not been pasteurized.

Raw milk is not safe to drink because it can carry harmful bacteria, including Campylobacter, Salmonella, E. Coli, Listeria, Tuberculosis, and Brucella.[60] There are many ways milk can become contaminated, including: from animal feces or from bacteria living on an animal's skin; in the barn on milking equipment or in the milk processing plant; when an animal has an infected udder or a disease known as bovine tuberculosis; germs from insects, rodents, or other small animals; and through dairy workers passing bacteria through dirty clothing or boots.[60] Unpasteurized milk may carry microorganisms and pathogens that can infect consumers. Children under 5 years, elderly individuals over the age of 65, and anyone with a compromised immune system are at increased risk of becoming ill from consuming unpasteurized milk or milk products. While the sale of raw milk is permitted in 40 states, interstate sale is not permitted, and the quality of raw milk products varies considerably due to a lack of oversight.[60] The FDA, CDC, and AAP strongly recommend against drinking and eating raw milk products.[60] Pasteurization does not impact the nutritional value of milk. Thus, it is the conclusion of this panel that there is a high risk of infectious disease from consuming raw milk, yet no potential nutritional benefit, and thus, all milk consumed by children and adolescents should be pasteurized.

Navigating the different types of Milk in the Marketplace

In recent decades, fluid milk consumption has been declining in the U.S.[61] Yet, the dairy market has continued to expand offering more types of fluid milk, and unfortunately this has enhanced consumer confusion. **Appendix G** provides more information, including nutrition profile comparisons on the different types of milk available in the U.S. marketplace and descriptions of organic milk, goat milk, buffalo milk, lactose-free milk, A2 milk, ultra-filtered milk, shelf stable milk, and kefir.

Strategies for Individuals with Lactose Intolerance

Lactose intolerance occurs when an individual does not produce enough of the digestive enzyme lactase. Lactase breaks down lactose—the sugar found in milk and milk products—so that the body can absorb it. Anyone can have lactose intolerance, and while it typically runs in families, individuals can also develop the problem as they age due to a decrease in the body's production of the lactase enzyme over time. There is no cure for lactose intolerance; the primary treatment is to avoid dairy products. However, there are additional strategies that may work for some individuals, such as:[62]

- Choose lactose-free and lactose-reduced milk and milk products. These products are the same as plain cow's milk, but the lactase enzyme has been added to break down lactose making them easier to digest.
- Eat dairy products with naturally lower levels of lactose, such as hard cheeses and yogurt.
- Consume small amounts of milk with meals, which may assist with digestion.

More information is also provided in **Appendix G** on other dairy equivalents that could be consumed to meet daily dairy group recommendations.

BEVERAGES TO LIMIT AS PART OF A HEALTHY DIET

100% Juice

The expert panel defined 100% juice as beverages made from the extraction or pressing of the natural liquid found in fruits or vegetables. 100% juice means that everything in the container comes from a fruit or vegetable with no added sugars, NSS, or artificial ingredients. Beverages made from 100% juice diluted with water (no other added ingredients) are also included in this category. Review of existing recommendations and guidance on 100% juice reveals broad agreement that juice can be consumed as part of a healthy dietary pattern, if total daily consumption is limited. However, there was quite a bit of variation in how juice was defined (i.e., the type of juice), frequency of consumption, and the maximum amount to consume at each age. As noted in the consumption data section of this report, the percent of children who consume 100% juice does decline as children age, however, children and adolescents are consuming on average more than the amounts recommended by this expert panel.[3] Also of note, significantly more Hispanic children reported drinking 100% juice than non-Hispanic white or Black children.[3]

100% Juice

The review identified limited evidence or lack of agreement across the organizations/authorities on either type, amount, and frequency of water for children and adolescents.

- **Consumption:** Broad agreement that 100% juice can be consumed up to a maximum amount.
- **Type:** Variation in guidance on type of 100% juice such as: pasteurization, reconstitution, dilution, carbonation, and no added sweeteners.
- **Amount:** Variation in quantitative guidance, or the maximum amount to consume.
- **Frequency:** Variation in guidance on frequency of consumption or when to serve, such as: serve per day vs. serve per meal.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming 100% juice during childhood and adolescence on health. Specific outcomes of interest included: diet quality, body weight, CVD, diabetes, taste preferences, oral health, and cognitive function. For this scoping review, included articles must examine the impact of consuming 100% juice on one of these outcomes of interest; articles examining only juice drinks (or beverages containing less than 100% juice which also contain added sugars or other added ingredients) were not included. The panel also searched for literature with a focus on the role of diluting 100% juice with water. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 1,089 articles were returned for abstract screening. Of those, 76 articles moved to full text review and 40 articles met the criteria for data extraction. The primary reason articles were excluded during full text review was due to wrong intervention (e.g., fruit drinks were examined rather than 100% fruit juice).

Summary of Literature Review Key Findings for 100% Juice

A substantial number of articles were found on the relationship between 100% juice consumption in children and adolescents (ages 5–18 years) and diet quality, body weight, diabetes, CVD, oral health, and cognitive functioning. The expert panel did not identify any data on the relationship between childhood consumption of 100% juice and taste preferences. More research is needed to better characterize any relationships between 100% fruit juice intake and taste preferences in children and adolescents. In addition, the expert panel did not identify sufficient evidence to justify a recommendation to favor consumption of one or more specific varieties of juice (e.g., apple juice versus orange juice).

Diet Quality

Fourteen studies examined the relationship between consuming 100% juice and diet quality among children and adolescents. Four of these articles are reviews (one scoping review and three narrative reviews); the remaining studies are prospective cohort studies (n=4) and cross-sectional (n=6).

- One scoping review (Walton, 2024) conducted between December 2022–August 2023 found that 100% fruit juice minimally contributed to total energy intake and folate and potassium needs among European children.[63] 100% fruit juice provided up to one-quarter of vitamin C intakes and was a significant source of total sugars and free sugars across all age groups, which authors warn should be considered carefully to achieve a healthy, balanced diet.
- Three narrative reviews (Benton, 2019; Murray, 2020; and Gutierrez, 2022) found that consumption of 100% fruit juice among children is associated with intake of key vitamins and minerals.

- Benton and colleagues concluded that juice intake significantly contributes to total vitamin C intake among children, with beverages providing about 32–39% of their vitamin C.[64]

- The second narrative review (Murray, 2020), funded by the Juice Products Association, summarized that children who consume fruit juice have higher diet quality scores compared to children who do not drink juice, and they also consume more vitamin C, magnesium, potassium, fiber-containing foods, and whole fruit, while consuming less added sugar compared to non-consumers.[65]

- The third narrative review (Gutierrez, 2022), which examined 12 prospective cohort studies, found that 100% juice consumption among children was associated with higher intake of carbohydrates, vitamin C, vitamin B6, copper, iron, and vitamin E, as well as total energy, fruit intake, whole fruit intake, and water intake.[33] The findings from the studies included in this review were mixed on the association between 100% juice consumption and total sugar intake, discretionary fat, and fiber, magnesium, folate, potassium, vitamin A, and sodium intake.

- Four observational studies, all of which were prospective cohort studies conducted in the U.S., generally found that fruit juice intake in childhood leads to improved whole fruit intake later in adolescence or early adulthood (Sakaki, 2022; Sakaki, 2019; Moore, 2023; Wan, 2020).[66–69]

  - Multiple studies included in the 100% juice scoping review conducted by Sakaki and colleagues analyzed data collected from The Growing Up Today Study, which is a longitudinal study of children of participants enrolled in the Nurses' Health Study II (Sakaki, 2021a; Sakaki, 2022; Sakaki, 2019; Sakaki, 2023; Sakaki, 2021b).[39,66,67,70,71] At baseline, participants were 9–16 years old, with the final follow-up survey conducted when participants were 27–34 years old. Two of these prospective cohort studies examined the relationship between 100% juice and diet quality (Sakaki, 2022; Sakaki, 2019).[66,67] One found 100% juice consumption to be associated with higher intakes of sweet and salty foods, meat, starch, and dairy,[66] and the other found consumption of orange juice to be associated with higher intake of total energy and fruits and non-starchy vegetables.[67]

  - The third study conducted by Moore and colleagues (Moore, 2023) examined fruit juice intake in preadolescence in relation to whole fruit intake in adolescence using the National Growth and Health Study, which is a prospective cohort study among over 2,000 girls aged 9–10 years old with approximately equal numbers of white and Black children from urban and suburban

areas.[68] The cohort began in 1987 and was followed annually for 10 years. They found that girls who consumed more than 1 cup per day of fruit juice in preadolescence consumed more whole fruit and were more likely to meet the Dietary Guidelines for whole fruit, by later adolescence compared to those with low fruit juice intake. Among females ages 9–10, girls who drank more fruit juice had lower energy-adjusted intakes of protein and fat, but higher intakes of carbohydrates.

- A prospective cohort study (Wan, 2020) conducted among children ages 3–6 years old in the U.S. assessed fruit juice consumption in preschool with diet quality and whole fruit intake in adolescence.[69] Consumption of one or more cups per day of 100% fruit juice was associated with an increase in whole fruit intake and diet quality scores during early childhood and into adolescence. HEI scores during adolescence were almost 6 points higher among preschoolers with the highest juice intakes, compared to those with the lowest fruit juice intakes. Adolescents were also 3.8 times more likely to meet DGA recommendations for whole fruit intake if they consumed ¾ cups per day or more of fruit juice during preschool (vs. less).

- Six cross-sectional studies across the U.S., UK, Canada, and Brazil examined the relationship between 100% juice and diet quality.
  - Two similar cross-sectional studies using NHANES data (Maillot, 2019; Maillot, 2020) found that consumption of 100% juice, specifically orange juice, was significantly associated with better diet quality in children, represented by higher HEI scores.[34,72]
  - Another cross-sectional study of NHANES data (Melough, 2023) shows a relationship between 100% juice and an increased intake of free sugars, which includes both added sugars and sugars naturally present in foods, in the diets of children.[73]
  - A fourth cross-sectional study (Nicklas, 2020) of NHANES data analyzing data from 2003–2016 found that among children ages 2–18, consumption of 100% fruit juice was associated with a decrease in consumption of sweetened beverages and coffee/tea.[74] Additionally, with every 120 g (4 fl oz) of orange juice consumed, the percent of the population with inadequate intake of vitamin D, calcium, iron, and phosphorus decreased.
  - Among a sample of Canadian children assessed through the Canadian Health Survey (Murphy, 2020), more frequent consumption of 100% juice was associated with higher energy intake, except for children ages 9–13 years.[75] In addition, more frequent consumption of 100% juice was associated with total sugar intakes, except for children 4–8 years and girls 14–18 years. Finally, higher frequency of fruit juice consumption was associated with higher daily vitamin C intake across all populations. Because 100% juice serves as an additional source of total sugars and calories, it was concluded by Murphy et al. that consumers should avoid excess consumption.
  - Another study by Mitchell and colleagues analyzed 2013–2014 NHANES data, 2012–2014 UK National Diet and Nutrition Survey, and Brazil's 2008–2009 Consumer Expenditure Survey (POF).[76] Overall, they found that higher consumption of 100% fruit juice was associated with greater intakes of vitamins, minerals, and sugars. On average, 100% fruit juice contributed 15% of total sugar intake in the U.S., 12% in the UK, and 31% in Brazil.

In summary, 100% fruit juice may be an important contributor to achieving adequate fruit intake in children and adolescents, particularly in certain populations for whom access to, and affordability of whole fruit is limited. However, several studies also found that increased fruit juice intake was associated with increased intake of total sugars and energy. Thus, striking a balance in consumption is important.

Body Weight

Nineteen studies examined the relationship between consuming 100% juice and body weight among children and adolescents. Nine of these studies are reviews (one umbrella review, one meta-analysis, two systematic reviews, and five narrative reviews); the remaining studies include five prospective cohort studies and five cross-sectional studies.

- A 2024 umbrella review (Beckett, 2024) including 15 systematic literature reviews did not find associations between BMI z-score and 100% juice consumption.[77]
- A meta-analysis (Nguyen, 2024) conducted in 2024 of 17 prospective cohort studies found that pooled estimates and z-score analyses showed a significant relationship between consuming an additional serving of 100% juice per day and higher BMI.[78] Pooled estimates showed a 0.03 higher BMI for every 8-oz increase of juice consumed per day, and a 0.01 higher BMI-z-score.
- Two included systematic reviews examined the relationship between 100% juice and body weight among children and adolescents.
  - A systematic review (Mayer-Davis, 2020) conducted in 2020 among children 2–14 years old at baseline included an RCT which found no significant differences in body weight, fat mass, or fat-free mass between children

consuming juice versus water daily.[79] Among the included prospective cohort studies, two found no statistically significant relationship between 100% juice consumption and BMI; four found a statistically significant relationship, but findings were inconsistent, and significance was commonly only observed in sub-groups. Among the observational studies examining 100% juice intake and BMI, findings were inconsistent, mixed, and most were non-significant.

- The second systematic review (Rousham, 2022) examined the association between consumption of 100% juice, among other beverages, and body weight among children 10 years old or younger.[80] The synthesis reported that nine out of 10 studies found no association between 100% juice and BMI outcomes, and one noted mixed results. However, many of the studies examining BMI and overweight/obesity were conducted among children 2 to 4 years old.

■ Five narrative reviews examined the relationship between 100% juice consumption and outcomes related to body weight.

- The first narrative review (Benton, 2019) concluded that consumption of 100% fruit juice was not associated with overweight/obesity in children under 12 years old.[64] However, the review found limited evidence suggesting a small positive association between 100% juice consumption and overweight in very young children ages 1 to 6 years old.

- A narrative review (Sakaki, 2023) examining observational studies exploring the relationship between 100% juice and obesity in children concluded that the body of evidence does not suggest an association, although limited evidence suggests a relationship between 100% juice intake and overweight/obesity among children who already have overweight/obesity and among young children less than 9 years old.[70]

- Ruxton and colleagues (2021) reviewed an RCT that found that twice-daily consumption of 240 mL of 100% juice was not shown to have clinically or statistically significant relationship to weight gain or higher BMI scores.[81] Among the prospective cohort studies reviewed by Ruxton and colleagues, no associations were found when looking at all children and adolescents, but a non-clinically significant weight gain was observed among children ages 1 to 6.

- Another narrative review concluded that overweight/obesity is not associated with 100% juice consumption among children in models adjusted for total energy intake (Murray, 2020).[65]

- The fifth review found mixed relationships between 100% fruit juice consumption and numerous anthropometric outcomes, including height, weight, BMI, overweight status, and obesity status among children 4–18 years old (Gutierrez, 2022).[33] The review did, however, conclude no significant relationship between 100% juice consumption and waist circumference, skinfold thickness, or body fat percentage.

■ Five prospective cohort studies found null or negative associations between 100% juice consumption and body weight outcomes.

- In a prospective cohort study of 100 U.S. children ages 3–6 (Wan, 2020), 100% juice intake was not found to be associated with harmful BMI scores in multivariable models.[69]

- Two prospective cohort studies used data from the Growing Up Today Study II (GUTS). One of these studies (Sakaki, 2021b) found an association between consumption of 100% orange juice in children ages 9–16 and small increases in height-for-age Z-score, but consumption of orange juice was not found to be a predictor of weight gain.[71] The other study using GUTS data (Sakaki, 2021a) suggested that consumption of orange juice was inversely associated with BMI change in preadolescent and adolescent girls but not boys.[39] Interestingly, the negative association was primarily attributed to orange juice while other juices were not significantly associated with BMI change.[39]

- Another U.S.-based study among 2,165 girls ages 9–10 found no statistically significant relationship between consumption of 100% fruit juice and percent body fat or BMI at baseline intake (Moore, 2023).[68]

- A final observational study in 720 U.S. children ages 2–17 concluded that childhood consumption of 100% juice was not associated with increases in BMI scores, even in adjusted models (Marshall, 2019).[82]

■ Five cross-sectional studies found mixed association between 100% juice intake and body weight outcomes.

- One cross-sectional study (Kim, 2021) using NHANES data from 2007–2014 found that children in the highest tertile of height-for-age Z scores, a statistical measure or standard value that allows you to determine how close the value is to the mean, consumed larger amounts of 100% fruit juice.[83]

- In a U.S. study among 26,554 participants from the Growing Up Today Study II cohort (Sakaki, 2019b) where data were collected from two different cohorts at two time periods, consumption of 100% orange juice was positively associated with height among children 9–16 years old. The study also found a decrease in prevalence of overweight and obesity in boys consuming 100% orange juice compared to non-consumers, and no significant difference among girls.[71]

- Another study among 21,995 children ages 2–18 years (Nicklas, 2020) found that children who consume 100% orange juice took in an additional 160 calories per day compared to non-consumers, although no statistically significant relationship was found between orange juice intake and body weight status.[74]
- A fourth study (Mitchell, 2020) analyzing a sample of 45,210 participants from cross-sectional nationally representative data from the U.S., UK, and Brazil found that increased consumption of 100% fruit juice was associated with a significant increase in the odds of having overweight or obesity among UK and U.S. children.[76] This relationship was not observed in Brazilian children.
- Finally, a study using NHANES data from 5,919 participants ages 2–19 years (Maillot, 2020) concluded that consuming 100% juice was not found to be associated with overweight status in children.[72]

In summary, the available evidence yields mixed results on the relationship between 100% fruit juice and weight status in children.

Diabetes

Two studies examined the relationship between consuming 100% juice and diabetes among children and adolescents. One of these studies is an RCT, while the other is a cross-sectional study.

- One RCT (Anderson, 2020) in Northeast Ohio examined the effects of consuming low-fat (1%) milk versus apple juice on blood glucose over a 120-minute period in fasted children, 8–12 years old.[84] Compared to juice, consuming milk led to higher blood glucose levels at 30-min. Consuming 100% juice was found to be associated with steeper spikes and drops in glucose levels compared to milk.
- One cross-sectional study using data from the 2019 Minnesota Student Survey (Duke, 2021) found that consuming 100% fruit juice one time or more per day in the last seven days was associated with prediabetes among 125,375 8th–11th graders in the U.S.[85] Consuming 100% juice infrequently (1–6 times in the last 7 days) was not associated with prediabetes.

In summary, there is insufficient evidence to make a conclusion on the relationship between 100% juice and diabetes among children and adolescents.

Cardiovascular Disease

Three studies examined the relationship between consuming 100% juice and cardiovascular disease among children and adolescents. One of these studies is an umbrella review; the remaining studies are observational (n=1) and cross-sectional (n=1).

- A 2024 umbrella review (Beckett, 2024) including 15 systematic literature reviews found no statistically significant associations between 100% juice consumption and markers of vascular function in three primary meta-analyses.[77] Two meta-analyses included in the umbrella review reported that 100% pomegranate juice in adolescents reduced interleukin-6 levels. The expression of interleukin-6 is associated with atherosclerosis, myocardial infarction, heart failure, and ischemic stroke. The study population included some children with risk factors for cardiometabolic disease and some common conditions such as type 2 diabetes.[77]
- One observational study (Sakaki, 2022), using data from GUTS for 9,043 children ages 9–16 in the U.S. found that fruit juice consumption was not associated with elevated risk of hypertension or hyperlipidemia.[66]
- One cross-sectional study (Iyer, 2023) among 2,816 children ages 10–17 in the U.S. concluded that high consumption of 100% fruit juice was associated with increased triglyceride levels and lower high-density lipoprotein levels.[86] After

adjusting for BMI-z scores, however, the observed relationships were non-significant, highlighting the impact of body weight on cardiometabolic risk.

In summary, there is insufficient evidence to make a conclusion on the relationship between 100% juice and cardiovascular outcomes among children and adolescents. See **Appendix D** for details on the separate evidence grading process and findings for the relationship between consuming 100% juice and cardiovascular outcomes.

Oral Health

Eight studies examined the relationship between consuming 100% juice and oral health among children and adolescents. Two of these studies are systematic reviews, one is observational, and five are cross-sectional.

- A 2019 systematic review (Liska, 2019) concluded that results from prospective studies in adolescents and children ages 4–15 indicate that 100% fruit juice consumption is not associated with incidence of dental caries and tooth erosion.[87] Another systematic review (Mahboobi, 2021) examined the relationship between 100% juice consumption and oral health in children ages 6–12.[88] One cohort study included in the systematic review on 98 African-American school-age children in Alabama found that during follow-up, for each one-time per day greater frequency of consumption of water, milk, or 100% juice, there were 55%, 43%, and 26% lower risks of having permanent tooth caries, respectively.[88] However, this finding was not significant.
- An observational study (Ghazal, 2019) among U.S. children in households with low-socioeconomic status found that additional daily servings of 100% fruit juice was associated with a 26% lower risk of having tooth caries when compared to SSB drinkers.[89] However, when compared to water or milk consumption, the risk of dental caries is higher among 100% juice consumers.
- Five cross-sectional studies were identified.
  - A cross-sectional study (Garduno-Picazo, 2020) among 411 Mexican public school children ages 6–12 did not find a significant association between consumption of fruit juices and dental erosion in children.[90]
  - The second cross-sectional study conducted among 537 Mexican children between the ages of 11–14 (Gonzalez-Aragon Pineda, 2019) concluded that consumption of fruit juice alters oral pH levels and may increase the risk of childhood tooth erosion.[91] The results were particularly prominent in older children.
  - Another study amongst 473 Turkish students ages 7–14 (Korkmaz, 2020) found that children who consumed significantly more freshly squeezed orange juice had a 2.8 times higher risk of dental erosion.[92]
  - One study utilizing NHANES data (Samman, 2020) found that among children ages 2–19, high consumption of 100% juice was slightly associated with higher risk of caries.[93]
  - The final study (Melough, 2023), also examining NHANES data, found that for those with household water fluoride levels greater than or equal to 0.7 parts per million, there was not an association with greater dental decay or caries with 100% juice consumption.[73]

In summary, evidence on the relationship between 100% juice consumption during childhood and oral health is limited and mixed. See **Appendix D** for details on the separate evidence grading process and findings for the relationship between consuming 100% juice and oral health outcomes.

Cognitive Functioning

Three studies examined the relationship between consuming 100% juice and cognitive function among children and adolescents. One of these studies is an RCT; the remaining two studies are cross-sectional.

- One RCT (Anderson, 2020) conducted in 2020 examined the effects of consuming low-fat (1%) milk versus apple juice on cognition and on-task behavior in U.S. children between the ages of 8–12 years.[84] Results suggest that children with higher fasting glucose show faster response times after consuming milk compared to 100% juice.
- Two cross-sectional studies identified both positive and null relationships between 100% juice consumption and cognitive outcomes related to sleep quality.
  - In one study (Jansen, 2021) among 528 children aged 9–18 years in Mexico City, 100% fruit juice intake was associated with healthier sleep among males only, measured by earlier bedtimes and earlier wake times in the higher consumers.[94]
  - However, another study (Vezina-Im, 2024) in 218 Canadian adolescents aged 14–17 years found no association between 100% juice consumption and poor sleep outcomes.[95]

In summary, there is insufficient evidence to make a conclusion on the relationship between 100% juice and cognitive functioning among children and adolescents.

Table 4. Daily Recommended Servings from the Fruit Food Group

5–8 years	9–13 years	14–18 years
1–2 cup equivalents per day	**1.5–2 cup equivalents per day**	**1.5–2.5 cup equivalents per day**
One cup equivalent of fruit is equivalent to 1 cup of raw fruit, 1 cup of fruit juice, or ½ cup dried fruit.		

Expert Recommendations

100% fruit and vegetable juice can be part of a healthy diet in children and adolescents, but consumption should be limited. The following recommendations are considered upper limits for daily servings of 100% juice, not minimum requirements.

	5–8 years	9–13 years	14–18 years
100% Juice	**<4–6 fl oz per day** (½ to ¾ cup/day)	**<6–8 fl oz per day** (¾ to 1 cup/day)	**<8 fl oz per day** (1 cup/day)

These limits extend to 100% vegetable juice as well as fruit and vegetable juice blends. Purchased 100% juice should always be pasteurized.

Rationale

The fruit food group, as defined by the DGA, includes both whole fruit (i.e., fresh, canned, frozen, and dried fruit with no added sugars or NSS) and 100% fruit juice. According to the 2020–2025 DGA, the amount of fruit a child or adolescent needs per day increases with age and is based on total energy needs (or total calories) (see **Table 4**). However, more than 80% of Americans do not meet daily fruit recommendations.[4]

Eating fruits and vegetables in whole forms, without added sugars or NSS, is important for promoting variety in the diet, as well as for meeting vitamin c and dietary fiber recommendations as many of these are good sources of both nutrients. Fiber is a nutrient of public health concern among children and adolescents because it is under-consumed. While 100% juice can be part of a healthy dietary pattern, it is low in fiber and research has shown that when consumed in excess, it contributes to excess energy and total sugar intake. Moreover, research has shown that consuming calories in liquid form does not contribute to satiety (the feeling of fullness) in the same way as the consumption of solid foods and may therefore be associated with excess calorie intake.[96]

Thus, the expert panel recommends that 100% juice consumption is limited each day. The upper limits were determined by allowing approximately one-third to one-half of total daily fruit recommendations in the form of 100% juice. While 100% juice is not needed in the diet, the expert panel recognizes that some families may have difficulty accessing whole fruits and/or vegetables for a variety of reasons, including cost, lack of proximity to food retailers, and seasonality. In these cases, 100% juice may help meet daily fruit and/or vegetable recommendations and achieve a healthy dietary pattern.

The expert panel also provides the following notes related to the recommendations:

Fruit Juice and Dilution

For years, pediatricians have recommended diluting 100% juice with water to reduce the amount of calories and sugar per serving, as well as to increase water intake. Traditionally, parents would buy 100% juice and add water at home, but now there are many pre-diluted beverages available in the grocery store. When purchasing these products, the expert panel recommends keeping the following points in mind:

- There is no official "standard of identity" for these products. Standards of Identity for food were developed by FDA to protect consumers and help to ensure that the characteristics, ingredients, and production processes of specific foods are consistent with what consumers expect.[97] With no standard of identity for diluted juice products, the percent of juice in the beverage will differ by brand. In addition to water, many commercial products also have other added ingredients such as natural flavors, vitamin C, and citric acid. These additional ingredients will also vary by brand, and in amounts added.

- Diluting juice with water also reduces the micronutrients—vitamins and minerals—that a child would receive from drinking full-strength 100% juice. While 8 fluid ounces (or 1 cup) of 100% fruit juice equals one cup equivalent from the fruit food group, the same volume of 100% juice diluted with water in a one-to-one ratio (i.e., the final beverage is 50% juice and 50% water) equals ½ cup equivalent from the fruit food group.

- Many parents will give their kids water with a "splash" of juice; however, this can have negative consequences for oral health. Giving a child diluted juice all day increases the frequency and amount of time a child's teeth are exposed to sugar. Every time teeth are exposed to carbohydrates, like juice, oral bacteria create acid, which can linger in the mouth for up to 20 minutes before being neutralized by saliva. This prolonged exposure of acid on teeth is what leads to enamel demineralization and dental caries. So, while serving diluted juice may be a good strategy for reducing sugar intake and the amount of juice consumed daily, the frequency of consumption should still be limited.

Beware of fruit drinks

Fruit drinks are products with less than 100% juice content that also have added sugars, NSS, or other added ingredients. Many of these products contain only 5–10% juice, and due to the addition of added sugars, these beverages are an SSB and are not recommended for consumption. Yet, in 2018, the sale of fruit drinks (and flavored waters) dominated the children's beverage market.[98] Images of fruit and nutrition-related claims on packages make it difficult for parents and consumers to distinguish between 100% fruit juice and juice drinks. The only way to truly know if a product is a juice drink and not 100% juice, is to read the nutrition facts panel and the ingredient list.

Homemade juices are not always healthier

There are many recipes for homemade juices available online, and for a brief time "juicing" was a trend that gained a lot of attention. Homemade juices with no added sugar can be a healthy way to incorporate more fruits and vegetables into the diet; however, the upper limits recommended by this expert panel still apply. It is important to be aware of recipes that add sugar to the juice, like most aguas frescas. Aguas frescas are typically made from fruit blended with water and a small amount of sweetener (e.g., table sugar, honey, maple syrup). Aguas frescas with no added sweeteners can also meet the juice recommendations; however, those with added sweeteners are considered an SSB.

Plant-Based Milk Alternatives

The expert panel defined plant-based milk alternatives (PBMA) as non-dairy beverages that are derived from plant-based ingredients, such as grains (e.g., rice, oats), nuts/seeds, legumes, or blends of these ingredients, and are often fortified with nutrients found in dairy milk. Many come in both sweetened and unsweetened varieties; sweetened varieties generally contain added sugars and/or NSS. When reviewing existing recommendations and guidance on PBMA, there was a lack of agreement across the organizations/authoritative bodies on whether to consume and the type of PBMA to consume as a cow's milk substitute. Many recommendations did not address PBMA at all, but of those that did, the recommendations for amount and frequency of consumption aligned with their respective plain milk guidance. The issue of PBMA has gained importance with growing environmental health concerns among consumers and the resulting projected increase in the global plant-based beverage market between now and 2030.[8]

Plant-Based Milk Alternatives

The review identified limited evidence or lack of agreement across the organizations/authorities on consumption, type, amount, and frequency of PBMA for children and adolescents.

- **Consumption:** Limited guidance on consumption of PBMA. When addressed, broad agreement that certain types can be consumed as a substitute for cow's milk.
- **Type:** Of the organizations/authorities that provided guidance, there was variation, such as: only fortified soy vs. specific nutrient requirements.
- **Amount:** Of the organizations/authorities that provided guidance, the quantitative amounts aligned with their plain milk guidance.
- **Frequency:** Of the organizations/authorities that provided guidance, the frequency aligned with their plain milk guidance.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming PBMA during childhood and adolescence (ages 5–18 years) on health. Specific outcomes of interest included: diet quality, body weight, CVD, diabetes, taste preferences, oral health, bone density, and cognitive function. The panel also searched for literature with a focus on bioavailability of nutrients in PBMA. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 2,129 articles were returned for abstract screening. Of those, 18 articles moved to full text review and six articles met the criteria for data extraction. The primary reason articles were excluded during the full text review were wrong study population (e.g., focus on infants and toddlers) and wrong study design (e.g., lab versus human studies).

Summary of Literature Review Key Findings for Plant-Based Milk Alternatives

Overall, the evidence on the health impact of consuming PBMA was very limited. Of the studies returned, a majority compared the nutritional value of PBMA with cow's milk (n=5) and found that the nutritional content of PBMA falls short of cow's milk. One study examined the relationship between PBMA intake and body weight among children and adolescents. The expert panel did not identify in-scope articles examining the relationship between childhood consumption of PBMA and diabetes, cardiovascular-related outcomes, oral health, bone density, taste preferences, or cognitive functioning.

Diet Quality

Five studies examined the relationship between PBMA intake and diet quality among children and adolescents. Two studies are narrative reviews and three are cross-sectional.

- Two narrative reviews were identified.
  - One included narrative review (Antunes, 2023) provided a nutritional comparison of cow's milk and PBMA.[99] The review concluded that the nutritional content of PBMA varies by beverage type, but generally, they contain lower protein (except for soy), higher sugar, and lower fat contents compared to cow's milk. The authors also recommend avoiding the total replacement of cow's milk with PBMA by children due to the lack of important nutrients.
  - The second narrative review (Scholz-Ahrens, 2020) complimented the findings of Antunes, concluding that the nutritional quality and value of PBMA falls short of cow's milk, risking deficiencies of calcium, zinc, iodine, Vitamins B2, B12, D, A, and amino acids.[100]

- Three cross-sectional studies were identified.
  - A cross-sectional study (Nicol, 2024) using data from the UK's National Diet and Nutrition Survey (2016–2019) examined iodine intake among 964 children aged 4–18 years.[101] Replacing milk with PBMA was significantly associated with a decrease in usual iodine intake. Pea-based drinks had the lowest impact on iodine intake as most of these beverages are fortified.
  - The second cross-sectional study (Dineva, 2021) also examined iodine among a UK sample, although findings were not disaggregated by age.[102] Overall, significantly lower urinary iodine concentration was observed for those who consumed milk-alternative drinks exclusively compared to cow's milk consumers.
  - Finally, a cross-sectional study (Islam, 2021) using data from Canada's Community Health Survey which analyzed change in consumption and percent contribution to daily nutrient needs of plain milk and PBMA from 2004 to 2015.[103] Vitamin D, Vitamin B12, Calcium, Folate, and Vitamin A were the top five nutrients provided by plant-based beverages. Among children, consumption of plant-based beverages did not significantly differ between 2004 and 2015.

In summary, the evidence reviewed suggests that the nutritional content of PBMA falls short of cow's milk.

Body Weight

One prospective cohort study (Soczynska, 2024) examined the relationship between PBMA intake and body weight among children and adolescents.[104] This study was conducted with over 7,000 healthy children aged 1–10 years living in Toronto, Canada participating in the TARGet Kids! longitudinal cohort study. The quantity and frequency of PBMA intake was measured through a parent survey. PBMA consumption was associated with lower BMI among participants (mean age was 3.1 years). When comparing 5-year-old children who consumed equal amounts of PBMA and dairy milk, they found that the plant-milk consumers had a lower weight of 0.5 kg and lower height of 0.8 cm. No differences between soy milk compared to other PBMA were observed.

In summary, there is insufficient evidence to make a conclusion on the relationship between PBMA and body weight among children and adolescents.

Expert Recommendations

PBMA are only recommended for children and adolescents when medically indicated (e.g., milk protein allergy, galactosemia), or to meet specific dietary patterns (e.g., vegan). In these cases, fortified soy milk or PBMA that are nutritionally similar to cow's milk are recommended in place of dairy milk. As with dairy milk, PBMA containing added sugars or NSS should be avoided.

Rationale

PBMA are not recommended for exclusive consumption in place of dairy milk for healthy children and adolescents, unless medically indicated (e.g., milk protein allergy, galactosemia) or to meet specific dietary preferences (e.g., cultural foodways, vegan or vegetarian dietary patterns, and/or for environmental considerations) as these products are not nutritionally equivalent to cow's milk. Dairy is best suited to meet the nutritional needs of children and adolescents and is preferred over plant-based products because the latter have varied and incomplete nutrition profiles.

In the U.S., about 36% of people have lactose malabsorption, which can cause lactose intolerance, or the inability to digest lactose—the sugar found in milk and milk products.[58] In the case of lactose intolerance, low-lactose or lactose-free versions of dairy products should be used as an alternative to dairy for children and adolescents rather than PBMA, as these products have nutritional profiles nearly identical to cow's milk. See the **Plain Pasteurized Milk** section for more information on lactose intolerance and recommended alternatives.

According to a 2018 study by Northwestern University, 1.9% of children in the U.S. have a milk protein allergy;[56] however, more recent data suggests this number may be rising.[57] In the case of a dairy allergy, plain, unsweetened, PBMA meeting minimal nutrition standards should be considered to meet dairy needs. At a minimum, protein, calcium, vitamin D, and potassium should be considered when selecting a PBMA. **Table 5** shows the requirements for PBMA permitted in federal child nutrition programs.[105] Choosing alternatives that meet, or come close to meeting, these nutrient levels will improve overall diet quality and ensure that PBMA are an adequate substitute for the plain milk recommendations (e.g., fortified soy milk, pea-protein milk). Any PBMA not meeting these criteria should not count towards meeting daily dairy servings. In addition, it is important to avoid PBMA with added sugars, as sweetened plant-based dairy alternatives are prevalent and do not add any nutritional benefit to the diet over unsweetened varieties.

Table 5: Nutrient Requirements for PBMA as a Cow's Milk Substitute in Federal Child Nutrition Programs

Nutrient	Per cup (8 fl oz)
Protein	**8g**
Calcium	**276 mg**
Vitamin A	500 IU
Vitamin D	**100 IU**
Magnesium	24 mg
Phosphorous	222 mg
Potassium	**349 mg**
Riboflavin	0.44 mg
Vitamin B-12	1.1 mcg

Protein, Calcium, Vitamin D, and Potassium are the most important nutrients to consider when choosing PBMA as a replacement for cow's milk.

Except for soy milk fortified with calcium and vitamins A and D, the DGA does not include PBMA as part of the dairy group because their overall nutritional content is not similar to dairy foods (see **Appendix H**). In addition to being lower in several vitamins and minerals, plant proteins are not complete, meaning that they do not contain all nine of the essential amino acids humans need but cannot produce. In contrast, animal sources of protein, including milk, do contain all 9 essential amino acids. Soy is unique among plant proteins in that it is considered a complete protein for humans. Other plant-based products sold as "milks" (e.g., rice, almond, coconut, oat, hemp) are often fortified with calcium and possibly other nutrients to attain levels more similar to cow's milk, however the current research on whether the bioavailability of these added nutrients is comparable to that of their naturally-occurring counterparts in cow's milk is limited. The published literature does support that these PBMA are largely not adequate nutritional replacements for milk.[106] Thus, the expert panel agrees with the DGA that PBMA are not generally a good substitute for meeting daily dairy recommendations.

For cultural foodways that do not typically include the recommended amount of dairy milk (or as much dairy as typical U.S. diets) or for individuals who follow a vegan dietary pattern, fortified soy milk or PBMA that are nutritionally similar to cow's milk are recommended in place of dairy milk. In all these cases, the expert panel recommends consulting with a health care provider, such as a pediatrician or registered dietitian nutritionist, to ensure that intake of nutrients commonly obtained from dairy milk can be considered in dietary planning.

The expert panel also provides the following notes related to the recommendations:

Environmental Implications of PBMA

An increasing number of consumers are choosing to follow a vegan or vegetarian dietary pattern or to avoid dairy milk for environmental reasons. More information regarding the environmental implications of various PBMA in comparison to cow's milk along with the environmental impact of packaging and microplastics, can be found in the **Other Considerations** section of this report.

Sweetened Flavored Milk

The expert panel defined sweetened flavored milk as pasteurized cow's milk to which sweeteners and/or flavorings have been added for the main purpose of increasing palatability. Common examples include chocolate or strawberry milk. When reviewing existing recommendations and guidance on sweetened flavored milks, several inconsistencies were found on whether to consume, type of flavored milk (i.e., fat content), amount, and frequency. Notably, flavored milk is permitted to be served as part of the National School Lunch and Breakfast Programs, both as part of the reimbursable school meal as well as a la carte. As noted in the **Consumption Data** section, flavored milk is among the leading contributors to children's added sugar intake[9] and across all grades and NSLP participation status, flavored, fat-free milk was the type of milk most frequently consumed at lunch.[6]

Sweetened Flavored Milk

The review identified inconsistencies or conflicts in guidance across the organizations/ authorities on consumption, type, amount, and frequency of flavored milk for children and adolescents.

- **Consumption:** Disagreement on guidance for consumption of flavored milk.
- **Type:** Of the organizations/authorities that allow flavored milk, the guidance for fat types aligned with their plain milk guidance (fat-free or low-fat).
- **Amount:** A majority of organizations/authorities provide guidance to avoid or limit consumption of flavored milk. Of those that recommend limited consumption, quantitative guidance was not provided. Of those that allow flavored milk, quantitative guidance aligned with their plain milk guidance.
- **Frequency:** Of the organizations/authorities that allow flavored milk, the guidance for frequency was in alignment with plain milk amounts.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming flavored milk during childhood and adolescence on health. Specific outcomes of interest included: diet quality, body weight, CVD, diabetes, taste preferences, oral health, bone density, and cognitive function. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 96 articles were returned for abstract screening. Of those, 30 articles moved to full text review and 14 articles met the criteria for data extraction. The primary reason articles were excluded during full text review was due to examining an outcome that was not a priority for this scoping review.

Summary of Literature Review Key Findings for Sweetened Flavored Milk

A moderate amount of evidence was identified on the relationship between flavored milk and the following health outcomes among children and adolescents: diet quality, body weight, and oral health. No included articles examined the relationship between consuming flavored milk and diabetes, cardiovascular disease, bone density, taste preferences, and cognitive functioning. Overall, the existing literature is largely based on cross-sectional study designs.

Diet Quality

Ten studies examined the relationship between consuming flavored milk and diet quality among children and adolescents, including one scoping review, two narrative reviews, one RCT, one quasi-experimental, two observational studies (non-cross-sectional), and three cross-sectional studies. Limited evidence suggests flavored milk intake may suppress appetite and food intake following consumption. Although flavored milk may provide important micronutrients, the evidence reviewed demonstrates the considerable contributions to total added sugar intake among the diets of children and adolescents.

- The scoping review (Gutierrez, 2022) examined global literature on the impact of 100% juice, milk, and water consumption on health outcomes among children ages 4–18 years.[33] The study found that flavored milk was positively associated with the intake of carbohydrates, fat, calcium, and energy intake, with mixed results for saturated fat, protein, vitamin D, dietary fiber, and potassium intake.
- Two narrative reviews (Ricklefs-Johnson, 2023; Sipple, 2020), both funded by the National Dairy Council, concluded that flavored milk was not a primary source of total energy, added sugars, and saturated fat, and that it provides essential nutrients for children and adolescents.[107,32]
- The RCT (Poirier, 2019) was conducted among 32 boys in Canada ages 9–14 years old to determine the effects of isovolumetric preloads (350 mL) of a fruit-flavored drink (154 kcal), cola (158 kcal), 1% chocolate milk (224 kcal), and water (0 kcal) on subjective appetite and food intake.[108]

A reduction in food intake (appetite) was observed after chocolate milk consumption, when compared to a water control group and a fruit drink consumer group.

- The quasi-experimental study (Kucab, 2021) examined the effects of a single high-intensity interval training (HIIT) session and consumption of 163 kcal of chocolate milk or water on appetite and cognitive performance (n=20).[109] Assessment of capillary blood glucose, salivary cortisol, cognitive performance, and subjective appetite and emotions occurred at baseline and at several time points post-treatment. The study found chocolate milk consumption likely suppressed average appetite due to increased glucose.

- The two observational studies both examined flavored milk consumption and diet quality in schools, including one sample of 619 elementary school students from two suburban schools in South Carolina (Peckham, 2021)[110] and 2,966 students in 24 different middle and high schools in California (Thompson, 2020).[111]

  - The study conducted in South Carolina found that children who chose fat-free chocolate milk consumed 52 more calories and 10 grams more total sugar compared to students who selected low-fat white milk during lunch.[110] However, compared to students who chose low-fat white milk, students who chose fat-free chocolate milk consumed significantly more protein, calcium, magnesium, and vitamin A from their school meal.[110] Observed differences were largely due to consuming larger volumes of fat-free chocolate milk compared to low-fat plain milk.[110]

  - Thompson and colleagues examined the impact of removing chocolate milk from schools on overall milk consumption and intake of key nutrients. A slight decrease (<1 fluid ounce) in student milk consumption was observed after chocolate milk was removed, however, student intake of key nutrients was not reduced (calcium, protein, and vitamin D) while students' consumption of added sugar from milk significantly declined.[111]

- Three cross-sectional studies were identified.

  - A cross-sectional study (Ricciuto, 2023) using eight consecutive cycles of NHANES data from 2003–2004 through 2017–2018, examined the relationship between added sugars from beverages and micronutrient deficiency among children and adolescents aged 2–18 years old.[112] As children (2–8 y) consumed more added sugars from flavored milk, more children met or were above the estimated average requirement for calcium compared to non-flavored milk consumers. A similar pattern of increased nutrients with increased flavored milk consumption emerged for calcium among 9- to 18-year-olds, but was also observed for magnesium, phosphorus, and vitamin A.

  - Another cross-sectional study (Riley, 2019) conducted among 12,153 Australian children and adolescents found that plain milk made the greatest contribution to total dietary energy intake (3.1%), followed by flavored milk (2.8%), fruit juice (2.6%), and soft drinks (2.1%).[113] Fruit juice made the greatest contribution to total sugar intake (9.8%), followed by soft drinks (8.7%), flavored milk (5.2%), and plain milk (5%). Finally, plain milk (9.9%) and flavored milk (7.6%) made the greatest contribution to calcium intake.

  - The third cross-sectional study (Fayet-Moore, 2019) was an analysis of the 2011–2013 Australian Health Survey and included 2,812 children aged 2–18 years.[114] The analysis examined plain milk drinkers, flavored milk drinkers, other milk drinkers, nondrinkers, and milk avoiders, and found that both plain and flavored milk drinkers had higher energy intakes, protein, and saturated fat intake than nondrinkers and milk avoiders. For sugar intake, flavored and other milk drinkers consumed more total sugars than milk avoiders, but plain milk drinkers consumed significantly less sugar than all other milk intake groups.

In summary, findings from the scoping review suggest that flavored milk intake may suppress appetite and food intake following consumption (based on limited experimental evidence), while consuming flavored milk increases added sugars intake as opposed to consuming plain milk (based on limited observational evidence). See **Appendix D** for details on the separate evidence grading process and findings for the relationship between flavored milk consumption and diet quality outcomes.

Body Weight

Five studies examined the relationship between consuming flavored milk and body weight among children and adolescents, including one systematic review, one scoping review, and three cross-sectional studies. The published evidence on flavored milk and body weight is mixed.

- One systematic review conducted by the 2020–2025 Dietary Guidelines for Americans Committee examined the relationship between milk consumption and effects on body weight among children and adolescents (Mayer-Davis, 2020).[79] Of the evidence on children, there were four RCTs and 26 longitudinal cohort studies. Seven cohort studies included in the review specifically examined types of milk (i.e. milk fat levels, flavored milk) and adiposity outcomes in children; however, the results were not consistent. Only one study (Noel, 2013), a prospective cohort study, examined flavored milk as the sole exposure.[115] Noel found that in children with overweight or obesity, flavored milk consumption at age 10 was significantly associated with lower reductions in body fat and greater weight gain at age 13, compared to non-consumers. No significant association was found between flavored milk intake at age 10 and body fat or weight at age 13 for normal-weight children, when compared to non-consumers. The review concluded that insufficient evidence is available to draw a conclusion about the relationship between the type of milk (i.e., milk fat content, flavor) and adiposity in children.[79]

- A scoping review (Gutierrez, 2022) included only one study examining the relationship between flavored milk and body weight.[33] The included cross-sectional study (Fayet, 2013) was conducted among 4,487 Australian children aged 2–16 years and did not find a significantly different relationship between consuming plain milk and BMI compared to those who did not consume milk.[116] However, when they added flavored milk to the model, both BMI and waist circumference were significantly higher among children who consumed flavored and plain milk compared to non-consumers.

- Three cross-sectional studies were conducted among adolescents in Greece. One study found that consuming chocolate milk is significantly associated with overweight and obesity among children (Magriplis, 2022).[117] Another study found that chocolate milk is a protective factor against overweight and obesity (Champilomati, 2020),[118] while the third study found mixed results (Kanellopoulou, 2022).[119] The study with mixed results found that children consuming only chocolate milk were 14.5% more likely to have overweight or obesity compared to non-chocolate milk consumers, although this finding was not significant.[119] When adherence to the mediterranean diet was taken into account, children consuming chocolate milk were significantly less likely to have overweight/obesity compared to children who do not consume milk.

In summary, the literature reviewed on flavored milk and body weight was limited and mixed. Conclusions regarding the relationship between flavored milk and body weight in children and adolescents cannot be drawn.

Oral Health

One narrative review examined the relationship between flavored milk and oral health among children and adolescents (Ricklef-Johnson, 2023).[107] Funded by the National Dairy Council, the review concluded that when consumed in moderation (~1–2 cups per day), flavored milk was not observed to increase the risk of dental caries.

In summary, there is insufficient evidence to make a conclusion on the relationship between flavored milk and oral health among children and adolescents.

Expert Recommendations

Children and adolescents should avoid or limit consumption of flavored milk with added sugars (e.g., chocolate or strawberry milk), as these beverages contribute to excess intake of added sugars.

Rationale

Sweetened milks, more commonly referred to as flavored milks (e.g., chocolate or strawberry milk), are not recommended in the diets of children and adolescents as they contribute to excess intake of added sugars. An 8-ounce glass of low-fat chocolate milk[iv], for example, can contain as much as 20 grams of added sugar,[120] which is more than a sports drink (~14 grams of added sugars per 8 fluid ounces) and comparable to the amount of added sugar found in the same volume of regular soda (~25 grams per 8 fluid ounces).[4] Sweetened milk and dairy products are also increasingly sweetened with NSS which are not recommended for children and adolescents (see **Beverages with Non-Sugar Sweeteners** section).

To meet dairy recommendations, plain pasteurized milk is recommended as part of a healthy diet. Providing children with sweetened flavored milk to meet daily dairy requirements is discouraged. If low-fat plain milk is not accepted, plain milk of higher fat content, such as 2% or whole fat, is recommended for consumption. If all plain milk is not well tolerated (e.g., lactose-intolerance), unsweetened low-lactose or lactose free dairy products should be considered. If a child or adolescent does not accept the taste of plain milk or unsweetened lactose free dairy products, other dairy sources (e.g., unsweetened yogurt, cheese) should be considered before shifting to sweetened flavored milk. These other dairy sources are recommended for consumption over sweetened flavored milk as they provide valuable nutrients such as calcium, Vitamin A, and Vitamin D without high levels of added sugars. Plain milk flavored from sources without added sugar or NSS (e.g., adding a few drops of vanilla extract to plain milk) should also be considered before resorting to sweetened flavored milks.

The argument has been made that drinking chocolate milk is better than not drinking milk at all, as it still contributes to key nutrient intake. However, drinking sweetened flavored milk in place of plain milk results in added sugar intake over the maximum daily threshold. As previously mentioned, the DGA recommends that individuals older than 2 years limit calories from added sugars to no more than 10% of total calories per day; this is equivalent to about 200 calories or 50 grams of added sugar in a 2,000 calorie per day diet. The AHA recommends even lower levels for children and adolescents—no more than 6 teaspoons of added sugar per day (equivalent to 25 grams of added sugars or 100 calories), and no more than 8 ounces of sugary beverages a week.[20] If an 8-year-old child drank 2.5 cups per day of chocolate milk in place of plain milk, they would meet the recommended daily servings of dairy, however, they would also consume up to 50 grams of added sugars through milk alone, leaving no room for added sugar intake via other foods or beverages. Thus, children and adolescents should avoid consuming sweetened flavored milk, and limit consumption when avoidance is not feasible as there are alternative options for meeting daily dairy recommendations.

The expert panel recognizes that the National School Lunch Program and School Breakfast Program allow flavored milk to be served as part of reimbursable meals. Recent updates to school meal nutrition standards limit added sugars in flavored milk to no more than 10 grams of sugar per 8 fluid ounce serving in elementary schools and no more than 15 grams per 12 fluid ounce serving in middle and high schools[v], which may serve as a helpful sugar reduction strategy. However, due to the rapid growth and development of children and adolescents, there is not much room for discretionary calories in the diet, and even with these new limits, students are at risk of exceeding daily added sugar limits through flavored milk alone if they choose it at both school breakfast and lunch. Moreover, the newly formulated milks may not be available in the retail grocery market, meaning parents may not be able to purchase sweetened flavored milks lower in added sugars and they may not realize the version served at school is different. While healthcare providers and parents can encourage selection of plain milk options, some children consume up to half of their daily calories at school where they have the option to choose between flavored and plain milk. Research shows that children select flavored milk more frequently than plain milk at school, highlighting a policy opportunity to further improve the school food environment by eliminating flavored milk.[6] It will also be important to ensure that sugar limits for school meals do not result in a further increase in the use of NSS in the food supply, and in school milk in particular, as manufacturers seek to maintain product sweetness and flavor profiles.

The expert panel also provides the following notes related to the recommendations:

Added Sugar Limits and Making Dietary Tradeoffs

The exact amount of added sugar in one-cup (or 8 fluid ounces) of sweetened flavored milk will vary based on type (e.g., chocolate or strawberry) and brand. Notably, sweetened flavored milks are among the top contributors of added sugar intake in the diets of children and adolescents.[6] Other top contributors of added sugars include soda, fruit-flavored and sports drinks, and cakes and cookies.[9] Despite beverages and foods contributing an equal amount of excess added sugar in diets, beverage choices are often not considered by children and families when making dietary tradeoffs (**Table 6**).

iv Turkey Hill 1% ready-to-drink chocolate milk contains 20 grams of added sugar per 8-fluid ounces.

v This policy goes into effect July 1, 2025.

For example, a child may start the day with a bowl of cereal with plain milk (12g of added sugars in a serving of honey sweetened oat cereal), then have flavored milk (20g) and a peanut butter and jelly sandwich for lunch (18g). By lunchtime, the child has already exceeded their added sugar limit for the day (50g total). This means that the afternoon snack of cheese and crackers and a sports drink, followed by dinner of pasta with marinara sauce and cookie for dessert would contribute to an excess of the daily added sugar limit. All sources of added sugar consumed during the day should be considered when making dietary choices. By eliminating flavored milk at lunch or reducing intake to just half a cup, the child may remain within the added sugar limits, even with a cookie for dessert. Alternatively, the child could be given a choice between a glass of chocolate milk or the cookies for dessert to reduce added sugars. Eliminating flavored milk in the diet is an important step to reducing added sugar intake among children and adolescents.

Table 6: Recommended added sugar limits and beverage contribution

	Recommended Added Sugar Limits		Current Intake (averages)	
	DGA	**AHA**	**6- to 11-year -olds**	**12- to 19-year-olds**
Calories from added sugar	Based on 2,000 calorie diet, **200 calories per day** Maximum **10%** of total calories	Based on 2,000 calorie diet, **100 calories per day** Maximum **5%** of total calories	**16.4% of total calories** SSBs alone: 7.3% of total calories	**17.2% of total calories** SSBs alone: 9.8% of total calories
Added sugars (g/day)	**50 g**	**25 g**	**78.7 g**	**93.9 g**
Added sugars (tsp/day)	**12 tsp**	**6 tsp**	**18.7 tsp**	**22.4 tsp**

Added Sugars in Different Beverages

Beverage Examples	Added Sugars in 1 cup or 8 fl oz
Chocolate Milk[a]	20g = 4 ¾ tsp added sugar
Strawberry Milk[b]	11g = ~2 tsp added sugar
Sports Drink	14g = 3 1/2 tsp added sugar
Soda	25g = 6 tsp added sugar
Fruit Punch[c]	26g = 6.2 tsp added sugar
Lemonade[d]	27g = 6.43 tsp added sugar

[a]1% Turkey Hill Chocolate Milk; Horizon Low-Fat Chocolate Milk contains 10g added sugars.

[b]Horizon Low-Fat Strawberry Milk

[c]Ardmore Farms

[d]Minute Maid Lemonade

BEVERAGES NOT RECOMMENDED AS PART OF A HEALTHY DIET

Sugar-Sweetened Beverages

The expert panel defined SSBs as liquids to which any forms of sugar are added. Examples include sports drinks, soft drinks/sodas, energy drinks, fruit drinks, fruit-flavored drinks, fruitades, aguas frescas, sweetened waters, horchata, and sweetened coffee and tea drinks. When reviewing existing beverage guidelines and recommendations on SSB, there was broad agreement that children and adolescents should not consume SSBs; however, there were slight differences in how organizations or authorities defined SSB (i.e., type) and in the terminology used to describe the amount or frequency of SSB consumption).

Sugar-Sweetened Beverages

The review identified broad agreement across the organizations/authorities on consumption, amount, and frequency of SSBs for children and adolescents.

- **Consumption:** Broad agreement not to consume SSBs.
- **Type:** Some of the organizations/authorities provided specific examples of beverages that are considered SSB; while most used the term broadly.
- **Amount/Frequency:** Slight differences in terminology were used to describe the amount or frequency of SSB consumption such as “remove,” “eliminate,” “not necessary,” “limit,” “avoid,” “decrease,” and “reduce.”

Health Impact Literature Review

A literature review on the health impact of SSB consumption among children and adolescents was not conducted due to the agreement among existing recommendations, as well as the volume of well-established evidence demonstrating a link between excess added sugar consumption and negative impacts on cardiovascular health and other diet-related health outcomes.[20] In lieu of a formal literature review, the systematic review and conclusions of the 2020–2025 Dietary Guidelines Advisory Committee informed the recommendations set forth by the four organizations.

The 2020 Dietary Guidelines Advisory Committee conducted a systematic review to understand the relationship between SSB consumption and growth, size, body composition and risk of overweight and obesity among children and adolescents. The review included articles reviewed for the 2015 Dietary Guidelines (published before 2011), in addition to articles published from January 2012 through January 2019. A total of 72 articles on SSBs were included for review, 46 of which were on children ages 2–15 years. Among the articles on children, 43 were prospective cohort studies, 2 randomized controlled trials, and 1 non-randomized controlled trial.[121]

In addition, scientific statements from the four organizations were also considered if they included a formal review of the literature on the health effects of added sugar consumption in children and adolescents.

Summary of Literature Review Key Findings for Sugar-Sweetened Beverages

A majority of studies found a significant association between consuming SSBs and adiposity in children.[121] The randomized controlled trials showed a relationship between a decrease in SSB consumption and a decrease in BMI. The prospective cohort studies showed a positive relationship between SSB intake and adiposity. The evidence is limited by inconsistencies in methods, specifically differences in definition of exposure, and inconsistencies across subgroups. An additional limitation of the evidence reviewed by the DGA is the differences in the age of children assessed, and the inability to describe the evidence as it pertains to certain age sub-groups. Overall, moderate evidence suggests that higher SSB intake is associated with greater adiposity in children.

The American Heart Association reviewed and graded the current scientific evidence for studies examining the cardiovascular health effects of added sugars in children as part of the process for developing their scientific statement, “Added Sugars and Cardiovascular Disease Risk in Children”.[20] The pubmed searches were limited to original research, studies conducted in humans, and systematic reviews through November 2015, and the available literature was divided into 5 broad categories: effects on blood pressure, lipids, insulin resistance and diabetes mellitus, nonalcoholic fatty liver disease, and obesity. NHANES data from 2009–2012 were also analyzed to assess intake levels. Strong evidence supports the association of added sugars with increased CVD risk in children through increased energy intake, increased adiposity, and dyslipidemia.[20] Associations between added sugars and increased CVD risk factors were found at levels far below current consumption, leading the committee to recommend that children older than 2 years consume a maximum of 25g (100 calories or 6 teaspoons) of added sugars per day and a maximum of one 8-ounce SSB per week.[20]

Expert Recommendations

SSB, such as soft drinks/sodas, sports drinks, energy drinks, fruit drinks, fruit-flavored drinks, fruitades, aguas frescas, sweetened waters, horchata, and sweetened coffee and tea beverages, are not recommended as part of a healthy diet for children and adolescents.

Rationale

Added sugars are prevalent in the U.S. food supply. They are added during the processing and preparation of foods and include sugars from syrups and honey, concentrated fruit or vegetable juices, and foods packaged as sweeteners.[122] SSB are the largest source of added sugars in the diets of U.S. children and adolescents, while contributing little to achieving a healthy dietary pattern.[4] Moreover, consumption of SSB is associated with negative impacts on overall dietary intake and health outcomes, such as dental caries, overweight and obesity, cardiovascular disease, and type 2 diabetes.

According to the 2020–2025 DGA, a healthy dietary pattern should limit added sugars to less than 10% of calories per day.[4] In a 2000 calorie diet, this is approximately 200 calories or 12 teaspoons of added sugar. However, in 2017–2018, the average daily intake of added sugars was 17 teaspoons for children and adolescents (ages 2–19 years).[123] Looking further into differences by age, average intake of added sugars among young children is 11% of total daily energy intake, and peaks at 15% during adolescence.[4] What We Eat in America, NHANES 2015–2016, also shows the percentage of children exceeding the added sugar limit by gender and reports how many excess calories are being consumed by added sugar (**Table 7**).

SSBs are the top source of added sugars for the U.S. population, with 24% of added sugar intake coming from SSBs. Among children, SSB make up about 15% to 25% of total added sugars intake. This proportion increases in adolescents, with SSBs contributing up to 32% of total added sugars intake. Other leading sources of added sugars in U.S. diets are desserts, and sweet snacks, but added sugars are found in many unexpected products including breads, cereals, yogurt, salad dressings, and tomato sauces.[123] SSBs are generally composed of two primary ingredients—added sugars and water, with little to no ingredients providing any health benefits. Given the strength of the evidence connecting SSB consumption to poor health outcomes, and the high volume of current intake among children and adolescents, reducing SSB consumption is a simple strategy to decrease intake of added sugars and can contribute to improvements in overall diet quality.

Table 7. Added Sugar in the Diets of Children and Adolescents, ages 9–18 years

	5–8 years	9–13 years	14–18 years
Males	**80%** are exceeding the added sugar limit average male consuming 266 kcal of added sugar	**79%** are exceeding the added sugar limit average male consuming 322 kcals of added sugar	**72%** are exceeding the added sugar limit males consuming on average 347 kcal per day from added sugar
Females	**77%** are exceeding the added sugar limit average female consuming 238 kcal of added sugar	**78%** are exceeding the added sugar limit average female consuming 264 kcal of added sugar	**72%** are exceeding the added sugar limit females consuming on average 277 kcal per day from added sugar

Table Data Source: Average Intake and HEI-2015 Scores: Analysis of What We Eat in America, NHANES 2015-2016, day 1 dietary intake data, weighted. Recommended Intake Ranges: Healthy U.S.-Style Dietary Patterns (see Appendix 3). Percent Exceeding Limits: What We Eat in America, NHANES 2013-2016, 2 days dietary intake data, weighted.

The expert panel also provides the following notes related to the recommendations:

Is there any amount of SSB consumption considered to be okay?

Important gaps do exist in our knowledge of added sugars, and the question of whether there is a threshold of added sugars below which there are no negative effects is a lingering research question that needs to be addressed. While this expert panel recommends avoidance of all SSBs, the AHA recommends limiting consumption of SSBs to one or fewer 8 ounce beverages per week, suggesting that a very low level of intake may be okay, if consumption of added sugars from foods is also reduced to a maximum of 6 teaspoons per day.[20] Currently, most children and adolescents in the U.S. are consuming multiple SSBs per day, thus shifting to once a week could stand to have a significant improvement on diet quality, while also allowing room for the occasional celebration or treat in the form of an SSB.

Homemade SSBs still have health risks

Beverages made at home are sometimes viewed as healthier alternatives to bottled beverages purchased at retail locations. However, if these beverages have any form of sugar added as an ingredient—honey, agave, maple syrup, table sugar—they are still considered an SSB. At a minimum, consumption should be limited to a maximum of one 8-ounce beverage per week as recommended by AHA.

What about SSB with added ingredients that support health?

Many new beverage products have entered the marketplace in recent years with purported health claims regarding the addition of "functional" ingredients. It is important to note that this category of "functional" beverages is an industry term, and not an official classification of beverages supported by any evidence or official health claims as regulated by FDA. A typical example of these beverages includes sodas with added pre- or probiotics (though there are many more). These beverages still contain a significant number of added sugars and should be avoided. More information on the increasing number of beverages with supplements and additives can be found in the **Other Considerations** section of this report.

Beverages with Non-Sugar Sweeteners

The expert panel defined beverages with non-sugar sweeteners (NSS) as beverages that contain any of the six high-intensity sweeteners approved by the FDA as food additives (saccharin, aspartame, acesulfame-K, sucralose, neotame, and advantame) or three additional plant- or fruit-based high-intensity sweeteners generally recognized as safe and thus permitted for use in the food supply (steviol glycosides, monk fruit, and thaumatin). NSS may also be called diet sweeteners, NSS, no- or low-calorie sweeteners, or artificial sweeteners. When reviewing existing recommendations and guidance on NSS, many inconsistencies were found. For example, there was limited and mixed guidance on whether to consume and variation in terminology used. Moreover, many guidelines did not address this topic at all.

Beverages with Non-Sugar Sweeteners

The review identified inconsistencies or conflicts in guidance across the organizations/authorities on consumption, type, amount, and frequency of beverages with NSS for children and adolescents.

- **Consumption:** Limited and mixed guidance for consumption of beverages with NSS. Many indicate additional research is needed before guidance can be provided.
- **Type:** Variation in terminology, such as: non-nutritive sweeteners, low-calorie sweeteners, NSS.
- **Amount/Frequency:** When addressed, generally recommend to limit or advise against consumption. Of those that recommended limited consumption, quantitative guidance was not provided.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming NSS during childhood and adolescence (ages 5–18 years) on health. Specific outcomes of interest included: diet quality, body weight, CVD, diabetes, taste preferences, oral health, bone density, and cognitive function. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 2,777 articles were returned for abstract screening. Of those, 66 articles moved to full text review and 21 articles met the criteria for data extraction. The primary reason why articles were excluded during full text review was due to the wrong age or study population.

Summary of Literature Review Key Findings for Non-Sugar Sweeteners

A moderate amount of evidence was identified on the relationship between consumption of beverages with NSS and the following health outcomes among children and adolescents: diet quality (n=3), body weight (n=15), diabetes (n=5), CVD (n=3), oral health (n=2), taste preferences (n=1), and cognitive functioning (n=1). No included articles examined a relationship with bone density. Findings from the included studies are outlined below.

More research is needed to better characterize any relationships between NSS intake and these outcomes in children and adolescents. Most of the included studies report on observational data, which can show associations but not determine causality.

Diet Quality

Three studies examined the relationship between consuming beverages with NSS and diet quality among children and adolescents. One of these studies was a narrative review, the remaining two studies were cross-sectional.

- The narrative review (Shum, 2021) found that children who consume beverages with NSS were more likely to have higher caloric and carbohydrate intake compared to children consuming only water.[124]
- The two cross-sectional studies identified mixed effects of NSS consumption on diet quality.
  - One study (Ratliff, 2019) of 8,868 participants between the ages of 12–18 showed that higher NSS intake (1 or more servings/day) was associated with lower consumption of carbohydrates and total and added sugars compared to those who reported lower NSS intake (less than 1 serving/day).[125] In this study, NSS consumption was not found to be associated with differences in total energy or overall dietary intakes when compared to lower NSS intake.
  - Another study (Sylvetsky, 2019) using NHANES data found that NSS consumption in children ages 2–17 years was associated with consuming 196 more total calories and 15 more grams of added sugars per day when compared to water-only consumers.[126] Researchers did not identify

significant differences in energy intake between children who consumed NSS beverages and SSB, with both groups consuming extra calories, carbohydrates, and sugar compared to water-only groups.

In summary, although there is insufficient rigorous evidence to make a conclusion, the evidence that does exist on NSS consumption and diet quality is mixed, with some studies finding that children and adolescents consuming beverages with NSS had higher daily caloric and carbohydrate intake, with others finding lower intakes or no relationship. The body of evidence is limited by the lack of experimental studies.

Body Weight

Fourteen studies examined the relationship between consuming NSS and body weight among children and adolescents. Of the included studies, 11 were reviews (one umbrella review, four systematic reviews, and five narrative reviews), one was an RCT, two were observational, and one was cross-sectional.

- An umbrella review (Andrade, 2021) included one systematic review that reported statistically significant increases in BMI z-score among those consuming NSS, but six cohort studies yielded both null and positive associations.[127] The author concluded that the literature reviewed on NSS consumption and BMI among children was inconsistent.
- Four systematic reviews were identified.
    - A 2019 systematic review (Toews, 2019) examining the existing literature on the relationship between weight gain and different sweeteners included two RCTs that found similar weight gain in children receiving sucralose and acesulfame potassium (Ace-K) or aspartame, and children receiving sucrose (i.e., sugar).[128]
    - Another systematic review (Tobiassen, 2024) conducted in 2024 included studies taking place in the U.S., Mexico, and the Netherlands.[129] Each included study found a relationship between replacement of SSBs with NSS beverages and weight loss, with weight loss reductions ranging from 0.34kg–1.9kg.
    - A third systematic review published in 2022 (Rousham, 2022) had mixed results, with one included study observing an inverse association between NSS intake and BMI z-score change and three studies reporting no association between intake of beverages with NSS and BMI.[80] Regarding overweight or obesity status, one study reported no difference in odds of overweight and obesity combined, but greater odds of obesity with high (1x/day) compared with low (<1x/week or never) NSS consumption. Another study reported a negative association and two reported no association between intake and percent body fat.
    - The fourth systematic review published in 2023 (Jakobsen, 2023) reported that replacing SSB with NSS beverages significantly reduced body fat percentage by 70% amongst children 5–18 years old.[130]
- Five narrative reviews identified mixed associations between consumption of NSS beverages and body weight outcomes.
    - The first review (Czarnecka, 2021) identified studies that suggested that consumption of NSS may encourage overconsumption of calories, which is ultimately associated with weight gain.[131] Limited evidence suggests that both sugar-sweetened and artificially sweetened drinks may increase hunger and associated energy intake, leading to weight gain.
    - Another review (Hunter, 2019) found that even in RCTs, the impact of consuming NSS on weight status is minimal.[132] However, results are mixed by study, with some suggesting minimal but positive associations between NSS intake and BMI status and others reporting no change.
    - The third review (Kakleas, 2020) concluded that consumption of sucralose was associated with an insignificant increase in BMI z-score compared to sugar.[133] Other included studies observed a null relationship between NSS consumption and BMI score among children, indicating that data are both conflicting and mixed.
    - Another review (Shum, 2021) found that amongst observational studies, a positive association was found between intake of NSS soft-drinks and weight gain and fat accumulation in children.[124] However, RCT data suggest a reduction in weight following replacement of regular soda with NSS soda alternatives.
    - The final review (Young, 2019) examined cross-sectional, prospective cohort studies, and randomized controlled trials and concluded that the evidence among children is consistent with that of adults, which is that among epidemiological studies, NSS intake, especially when compared to unsweetened beverage consumption, is associated with high body weight and weight gain over time.[134] The RCTs, however, suggest that replacing SSBs with NSS consumption may lead to weight loss.

- Secondary analyses of data collected through a RCT (Ong, 2023) conducted in the U.S. among children with obesity or overweight at baseline did not find an association between consumption of beverages with NSS and measures of adiposity (BMI, waist/hip circumference).[135]

- Two observational studies concluded that consumption of beverages sweetened with NSS is associated with an increase in body weight.

    - One Australian study (Sycamnias, 2023) identified a positive relationship between NSS consumption and increased prevalence of overweight/obesity by nearly 8% in 2,925 children under the age of 16.[136] In those with high BMI scores at baseline, the association between NSS consumption and overweight/obesity strengthened over the 2-year follow-up time. Children with lower BMI scores were still found to have increased risk of obesity following NSS consumption, but to a lesser degree.

    - Another study (Zheng, 2019) that took place in Australia among children 14 years old at baseline found that replacing SSBs with 100 grams/day of NSS beverages was associated with higher BMI (by 1.29 kg/m2) and higher waist circumference 8 years later.[137]

- One cross-sectional study found that the consumption of beverages with NSS is associated with increased caloric intake and body fat. The cross-sectional study (Swindell, 2021) was conducted in the UK among 15,977 children between the ages of 9–11 and found that consuming low-calorie sweeteners was positively associated with increased body fat percentage at a 10-year follow-up.[44] However, this observation was moderated by sex, with a negative association for girls.

In summary, the available evidence yields mixed results on the relationship NSS and weight status, with studies finding null, positive, and inverse relationships. The evidence examining the effect of replacing SSB with NSS also yielded mixed results, with one observational study finding an increase in BMI and a systematic review concluding that BMI decreased when substituting SSB with NNS. The evidence is limited by the inconsistent measurement of NSS, various NSS examined, and lack of experimental studies.

Diabetes

Five studies examined the relationship between consuming beverages with NSS and diabetes among children and adolescents. Four of these studies were reviews (one systematic review, three narrative reviews), and the last included study was cross-sectional.

- One systematic review (Toews, 2019) summarized findings from a cross-over non-randomized control trial which found a significantly higher increase in blood glucose in children of school age receiving saccharin compared with sucrose.[128] The same effect was observed in preschool children.

- Three narrative reviews identified mixed effects of NSS consumption on outcomes related to diabetes.

    - One review (Ahmad, 2020) among 22 young adults between the ages of 12–25 concluded that sucralose consumption had no significant impact on glucose, insulin, GLP-1 (a hormone that helps regulate blood sugar, appetite, and digestion), or C-peptide levels (a byproduct of insulin production).[138] However, GLP-1 peak and area under the curve, which indicates glucose tolerance, were significantly higher following diet soda consumption than carbonated water consumption.

    - Another review (Shum, 2021) including crossover trial data found higher blood glucose levels in school age children who received saccharin compared to sucrose.[124]

    - The third review (Young, 2019) included 11 RCTs and noted that NSS intake increased blood glucose levels among children 4–18 years old when compared to those who did not consume any type of sweetened beverage.[134]

- One cross-sectional study (Ratliff, 2019) found that among 8,868 adolescents free of diabetes, NSS intake was not found to be significantly associated with any increase in prediabetes risk or other glycemic risk outcomes.[125]

In summary, although there is insufficient rigorous evidence to make a conclusion, the existing evidence suggests that intake of NSS is associated with increased blood glucose levels.

Cardiovascular Disease

Three studies examined the relationship between consuming NSS and cardiovascular disease among children and adolescents. Two of these studies were reviews (one systematic and one narrative review), and the remaining study was an RCT.

- One systematic review (Toews, 2019) included two RCTs examining the relationship between NSS and CVD.[128] One RCT found a strong decrease in total cholesterol in the group consuming sucrose, but an increase in the aspartame group. Changes in triglyceride levels and blood pressure were similar between the two groups. The other RCT reported that in children who are overweight and involved in active weight loss, systolic and diastolic blood pressures were similar in those receiving beverages with NSS or a placebo.

- The narrative review (Young, 2019), which included 11 RCTs, found no relationship between NSS consumption and other metabolic biomarkers such as hemoglobin A1C, triglycerides, total cholesterol, high-density lipoprotein (HDL) cholesterol, or low-density lipoprotein (LDL) cholesterol levels.[134]

- One RCT (Ong, 2023) conducted in the U.S. among adolescents and young adults (13–22 years old) with obesity or overweight concluded that consumption of beverages with NSS was statistically associated with a 38% increase in ventricular mass index and 3.9 times greater odds of left ventricular hypertrophy (not statistically significant), both indicators of CVD risk.[135]

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consumption of beverages with NSS and cardiovascular health among children and adolescents. The evidence that does exist is mixed.

Oral Health

Two studies examined the relationship between consuming beverages with NSS and oral health among children and adolescents. One of these studies was a RCT and the other a cross-sectional study.

- An RCT (Barajas-Torres, 2022) among 18 adolescents aged 12–18 years old in Mexico found no significant differences in salivary pH after ingestion of soft drinks with aspartame/ace-K, carbonated water, and plain water.[23] Greater bacterial proliferation was observed after consumption of the soft drink with sucrose, followed by the soft drink with aspartame/ace-K, and carbonated water.

- One cross-sectional study (Samman, 2020) conducted among U.S. children 3–10 years old concluded that the evidence does not support a relationship between diet drinks and adverse effects on tooth integrity or health.[93] Though the review says that diet drinks are still not recommended.

In summary, although there is insufficient rigorous evidence to make a conclusion, the evidence that does exist suggests that intake of NSS consumption during childhood is not associated with oral health outcomes.

Taste Preferences

One RCT (Dalenberg, 2019) examined the relationship between consuming NSS and taste preferences among children and adolescents, although the strength of the study is limited by the low sample size.[139] Among 11 adolescents under the age of 17, participants were randomly assigned to consume either beverages sweetened with sucralose (NSS), beverages sweetened with sucrose (sugar), or beverages sweetened with sucralose and combined with maltodextrin. Results suggest that consumption of sucralose in the presence of a carbohydrate dysregulates gut-brain regulation of glucose metabolism but does not impact sensitivity to sweet taste.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consumption of NSS and taste preferences among children and adolescents.

Cognitive Functioning

One systematic review (Toews, 2019) examined the relationship between consuming NSS and cognitive function among children and adolescents.[128] The review included 8 studies among children. Of these, 4 were RCTs, 2 were quasi-experimental, and 2 were observational. In one non-randomized controlled trial, no difference was observed between children receiving beverages with NSS and those not receiving these beverages on self-rated mood states, behavior, and cognitive performance. One randomized controlled trial described significantly worse neurocognitive performance in tests of cognitive abilities in children receiving NSSs than in children receiving sugar. Overall, no effects on mood states were observed among NSS consumers and non-consumers.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consumption of NSS and cognitive functioning among children and adolescents.

Expert Recommendations

Beverages with NSS are not recommended for consumption as part of a healthy diet for children and adolescents.

Rationale

NSS are commonly used as sugar substitutes or sugar alternatives because they are anywhere from 100 to 20,000 times sweeter than sugar (by weight) but contribute only a few or no calories when added to foods and beverages.[140] The FDA has approved six such sweeteners as food additives: acesulfame-potassium (also referred to as Ace-K), advantame, aspartame, neotame, saccharin, and sucralose. Based on the available scientific evidence, the FDA has concluded that these sweeteners meet the FDA's safety standard of reasonable certainty of no harm under their intended conditions of use (i.e., the types of food products in which they are used and the amounts in which they are added to these products).[141] The FDA has received Generally Recognized As Safe (GRAS) notices for the use of 3 additional plant and fruit based sweeteners. These include steviol glycosides, a natural substance from the leaves of the stevia plant, extracts from monk fruit (also known as Swingle fruit or Luo Han Guo), and Thaumatin, from the West African Katemfe fruit. The FDA has not questioned the GRAS determination of these sweeteners under their intended conditions of use.[140] FDA approval to use these NSS takes into account an acceptable daily intake (ADI), which is measured in milligrams per kilogram of body weight, per day. The ADI is the amount of a substance that is considered safe to eat every day over the course of one's lifetime.[140] A 100-fold safety factor is incorporated into the ADI in that the ADI cannot exceed 1/100th of the maximum amount that has been demonstrated to be without harm in experimental animals.[142] See **Table 8** for more information on these NSS.

Table 8: Sweetness of Various NSS

	Sweetness Intensity Compared to Table Sugar	Safe Consumption Levels as Determined by the FDA (in terms of sweetener packets to reach the ADI)
Advantame	20,000 times sweeter	4,920 packets ADI is 32.8mg/kg body weight/day
Neotame (aka Newtame)	7,000-13,000 times sweeter	23 packets ADI is 0.3mg/kg body weight/day
Thaumatin (aka Talin)	2,000-3,000 times sweeter	no ADI has been set
Sachharin (aka Sweet and Low, Sweet Twin, Sweet'N Low, Necta Sweet)	200-700 times sweeter	45 packets ADI is 15mg/kg body weight/day
Sucralose (aka splenda)	600 times sweeter	23 packets ADI is 5mg/kg body weight/day
Steviol Glycosides (aka Truvia, PureVia, Enliten)	200-400 times sweeter	27 packets ADI is 4mg/kg body weight/day
Luo Han Guo (aka Nectresse, Monk Fruit in the Raw, PueLo)	100-250 times sweeter	no ADI has been set
Aspartame (aka Nutrasweet, Equal, Sugar Twin)	200 times sweeter	75 packets ADI is 50mg/kg body weight/day
Acesulfame Potassium (Ace-K) (aka Sweet One, Sunett)	200 times sweeter	23 packets ADI is 15mg/kg body weight/day

The FDA assumed 1 sweetener packet is as sweet as 2 teaspoons (~8grams) of sugar for these comparisons. Source: *https://www.fda.gov/food/food-additives-petitions/aspartame-and-other-sweeteners-food*

Sweetness Intensity Compared to Table Sugar. Source: *https://www.fda.gov/media/168345/download?attachment*

Safe Consumption Levels as Determined by the FDA: *https://www.fda.gov/media/168517/download?attachment*

The use of NSS has increased in the food supply as a result of public health and policy efforts to decrease added sugars in foods and beverages. While NSS are approved by the FDA for use in the U.S. food supply, there is emerging evidence to suggest potential undesirable effects from long-term use of NSS in adults, including higher risk of type 2 diabetes, cardiovascular disease, and mortality;[143] there is also emerging evidence of undesirable effects from shorter-term use, for example on the gut microbiome.[144] The 2020 DGA, which is the current edition as of the time of this report's publication, states that questions remain about the effectiveness of replacing added sugars with low- and no-calorie sweeteners as a long-term weight management strategy.[4] More recently, the World Health Organization (WHO) recommended against the use of NSS to control body weight in both children and adults, stating that evidence shows the use of NSS does not confer any long-term benefit in reducing body fat.[143] WHO guidance also suggests that NSS not be used to reduce the risk of noncommunicable diseases among adults.

Despite new research in adults, there is a lack of evidence on the safety and impact of NSS consumption on long-term health among children and adolescents. In 2018, the AHA released a science advisory cautioning against children's and adolescent's prolonged consumption of beverages containing NSS (which they referred to as LCS), stating "…there is a dearth of evidence on the potential adverse effects of LCS beverages relative to health benefits".[51,145] In 2019, the AAP also issued a policy statement on the use of non-nutritive sweeteners in children stating that the use of NSS in isolation is unlikely to lead to substantial weight loss and that there is a lack of research on the long-term effects of NSS use in children and adolescents, thus pediatricians are encouraged to discuss the risks and benefits of potential use with children and families.[146]

This expert panel identified little conclusive evidence regarding the short and long-term health impacts of consuming beverages with NSS, particularly among children and adolescents, and therefore, concluded that a precautionary approach is prudent. Although FDA has determined that there is reasonable certainty of no harm from consuming NSS within the ADI, this does not imply that the exposures of NSS are clinically or metabolically insignificant, and the effects of chronic consumption are unknown.[51] Given that childhood and adolescence are critical developmental periods in the life course characterized by rapid physical, neurologic, cognitive, and social growth and development, along with the lack of evidence regarding the short- and long-term health impacts of consuming beverages with NSS among children and adolescents, it is this panel's expert opinion that these beverages are not necessary and should be avoided. In addition, the amount of NSS is not required to be disclosed on nutrition labels, which makes it difficult for consumers to accurately measure intake. Moreover, given the sweetness of NSS (compared to table sugar), it is reasonable to expect that they could contribute to a preference for sweet-tasting foods and beverages.

The expert panel also provides the following related recommendations and notes:

Sugar Alcohols

Sugar alcohols are another class of sweeteners permitted for use by the FDA as sugar substitutes; however, they are not considered NSS. Examples of sugar alcohols include sorbitol, xylitol, lactitol, mannitol, erythritol, and maltitol.[140] One key difference between sugar alcohols and NSS is that they are a fraction of the sweetness of sugar (25–100%) and are lower in calories than sugar. They are primarily used to sweeten sugar-free candies, cookies, and chewing gums. When consumed in high amounts, sugar alcohols can cause gastrointestinal problems, such as abdominal pain, diarrhea, or loose stools.[147] There is emerging evidence linking some sugar alcohols to possible adverse health effects, such as cardiovascular event risk,[148] but there is also evidence showing that sugar alcohols may not pose a risk to oral health.[149] More research is needed.

Product reformulation to lower added sugars may further increase products with NSS in the food supply

There is concern that the use of NSS will continue to increase in the food supply as the pressure to reduce added sugars intensifies. This is concerning for a variety of reasons, including that while NSS are required to be listed in product ingredient lists, amounts of NSS are not required to be included on food labels, so it is nearly impossible for consumers to know how much of these NSS they are taking in each day. In addition, many of these NSS are used together in products to achieve a desired sweetness level. With varying ADIs (or upper limits of safe consumption) this makes measuring total daily intake even more complicated. Moreover, many national surveillance surveys don't measure intake of foods and beverages that contain NSS as an independent category, thus existing estimates of intake are typically derived through self-report of products that contain NSS.

Beverages with Caffeine and Other Stimulants

The expert panel defined beverages with caffeine and other stimulants as drinks that contain caffeine, a legal stimulant that is mildly addictive, or other stimulants, such as taurine, often found in energy drinks. Examples include coffee, tea, energy drinks, and energy shots. When reviewing existing recommendations and guidance on beverages with caffeine and other additives, there was limited and mixed guidance across the organizations/authoritative bodies on whether to consume and in what quantities. Many organizations do not have explicit recommendations about caffeine, but of those that do, the recommendations largely focus on energy drinks. The American Academy of Pediatrics is the only organization to have caffeine-specific recommendations, which state that children under 12 should not consume caffeine, and children ages 12–18 should not exceed 100mg of caffeine per day. Beverages with caffeine, especially energy drinks, are increasingly marketed towards adolescents making it important to understand the health impacts of consuming beverages with caffeine and other stimulants on children and adolescents.

Beverages with Caffeine and Other Stimulants

The review identified inconsistencies or conflicts in guidance across the organizations/authorities on consumption, type, amount, and frequency of caffeine for children and adolescents.

- **Consumption:** Limited and mixed guidance for consumption of beverages with caffeine.
- **Type:** Most guidance focused on energy drinks, specifically, and did not address other types of beverages with caffeine.
- **Amount/Frequency:** When addressed, generally advised not to consume. Quantitative guidance, or a maximum amount, was not provided.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming beverages with caffeine or stimulants during childhood and adolescence (ages 5–18 years) on health. In addition, the expert panel was also interested in reviewing the literature on whether consumption of decaffeinated beverages pose any health risks to children and adolescents. The panel followed the search strategy and process outlined in the **Methodology** section for this scoping review (also see **Appendices A, B, C**). A total of 3,480 articles were returned for abstract screening. Of those, 128 articles moved to full text review and 61 articles met the criteria for data extraction. The primary reasons full text articles were excluded were wrong age (e.g., many studies examined older populations, such as ages 18–22) and wrong outcomes.

Summary of Literature Review Key Findings for Beverages with Caffeine and Other Stimulants

A significant amount of evidence was returned on the relationship between beverages with caffeine and other stimulants and the following health outcomes among children and adolescents: sleep, behavioral health, and cardiovascular outcomes. A moderate amount of evidence was returned for diet quality, diabetes, oral health, and body weight. Overall, the evidence is limited by the lack of robust study designs and reliance on self-report for consumption and outcomes such as sleep and mental health. Medical case studies were excluded from the review, which means that some studies examining acute, possibly fatal cardiovascular events as a result of excess caffeine consumption may be missing from these results.

Diet Quality

Eight studies examined the relationship between consuming beverages with caffeine and/or stimulants and diet quality among children and adolescents. Three of these studies were reviews (one systematic review, one scoping review, and one narrative review), and the remaining 5 studies were cross-sectional.

- One systematic review, which included a majority of cross-sectional studies, found that energy drink consumers were more likely to consume energy dense fast foods, snack foods, other SSBs, and skip breakfast (Ajibo, 2024).[150] Two additional scoping and narrative reviews came to similar conclusions suggesting that children and adolescents who consume energy drinks also have poor dietary habits (Temple, 2019; Erdmann, 2021).[151,152]
- Three out of the five cross-sectional studies found that energy drink consumption was associated with poor diet quality and habits, such as consuming more sugary drinks, snack foods, and skipping breakfast (Nuss, 2021; Puupponen, 2023; Vogel, 2022).[153–155] One study using NHANES data to assess diet quality of tea consumers and non-consumers found no significant differences in energy or nutrient intakes (Vieux, 2019),[156] while another study using NHANES data found a significant relationship between added sugars intake from coffee and tea for children ages 9–18. The fifth cross-sectional study examining the relationship between added sugars, micronutrient adequacy and caffeine consumption found

that among children 9–18 years, consuming higher added sugars from coffee and tea was associated with higher percentages below the estimated average requirement for vitamin C (Ricciuto, 2023).[112]

In summary, although there is insufficient rigorous evidence to make a conclusion, existing evidence suggests that consuming beverages with caffeine may be associated with poor dietary behaviors, including higher added sugar consumption, among children and adolescents. The evidence is limited by a lack of rigorous study designs.

Body Weight

Seven studies examined the relationship between consuming beverages with caffeine and/or stimulants and body weight among children and adolescents. Four included articles were reviews (two systematic reviews and two narrative reviews), one was a prospective cohort study, and two were cross-sectional studies.

- Two systematic reviews (Ajibo, 2024; Silva-Maldonado, 2022) examined the relationship between energy drink intake and BMI and obesity among children and adolescents.[150,157] One systematic review (Ajibo, 2024) included 57 studies, including 5 RCTs and 1 quasi-experimental study.[150] The other systematic review (Silva-Maldonado, 2022) only included observational studies.[157] Ajibo concluded that energy drink consumption is associated with increased central obesity, while the Silva-Maldonado review had conflicting findings. Silva-Madonado included one longitudinal analysis reporting energy drink consumers had higher than average BMIs when compared to non-consumers, and another included study in the review found no association between energy drink (ED) consumption and BMI.

- Two additional narrative reviews concluded that regular consumption of energy drinks could contribute to the development of obesity due to the high sugar content (Erdmann, 2021; Mihaiescu, 2024).[152,158]

- Investigators using data from a prospective Australian cohort study that collected data on SSB and coffee and tea intake, and BMI, waist circumference, and overweight status among children at age 14 and again at age 22, found no beneficial effects on body weight when substituting SSBs with tea and coffee (Zheng, 2019).[137]

- Two cross-sectional studies, one among 714 fourth and fifth grade students in Colombia (Martinez-Ospina, 2019)[159] and the other using NHANES data among 1,447 children and adolescents ages 6–19 years in the U.S. (Yu, 2022),[160] found that school-age children who consumed high caffeine, compared to participants who consume low caffeine, were more likely to have a higher BMI-z score (Martinez-Ospina, 2019 and Yu, 2022).[159,160]

In summary, although there is insufficient rigorous evidence to make a conclusion, existing evidence suggests that among children and adolescents, intake of beverages with caffeine may contribute to obesity due to high sugar content in such beverages.

Diabetes

Four studies examined the relationship between consuming beverages with caffeine and/or stimulants and diabetes and related outcomes among children and adolescents. Three studies were reviews, including two systematic reviews and one narrative review. One randomized controlled trial was also included.

- Two systematic reviews examined the relationship between energy drink consumption and diabetes related outcomes, although both systematic reviews included majority observational studies (Ajibo, 2024; Silva-Maldonado, 2022).[150,157] Ajibo's systematic review included only one study that reported energy drink consumers had increased fasting blood sugar compared to non-consumers. Silva-Maldonado's review noted that adolescent consumption of energy drinks has been associated with diabetes but did not provide substantial supporting evidence.

- The narrative review (Erdmann, 2021) cited evidence from the included RCT described below.[152]

- One RCT (Shearer, 2020) conducted among 20 children aged 13–19 years old in Canada found significant increases in glucose concentrations 30, 45, 60, and 120 minutes after consuming a caffeinated beverage (5mg/kg) compared to a decaffeinated beverage.[161] Compared to decaf consumers, the majority of participants showed an exaggerated glucose response when caffeine was consumed. Insulin levels were not significantly different at any point. Insulin sensitivity index was significantly lower after consuming a caffeinated beverage.

In summary, although there is insufficient rigorous evidence to make a conclusion, existing evidence suggests that among children and adolescents, intake of beverages with caffeine may increase serum glucose concentrations.

Cardiovascular Disease

Thirteen studies examined the relationship between consuming beverages with caffeine and/or stimulants and cardiovascular-related outcomes among children and adolescents. Seven studies were reviews, including one umbrella review, four systematic reviews, and two narrative reviews. Five randomized controlled

trials and one quasi-experimental study were also included. A majority of the reviews only included observational studies, although one systematic review conducted by Nadeem and colleagues included 32 studies, of which 7 were RCTs and 25 were quasi-experimental (Nadeem, 2021).[162]

- The four systematic reviews and one umbrella review (Ajibo, 2024; Silva-Maldonado, 2022; Nadeem, 2021; Torres-Ugalde, 2020; Khouja, 2022)[150,157,162,163,164] reported impacts of consuming beverages with caffeine on heart rate; two reported decreased heart rate (Ajibo, 2024; Khouja, 2022);[150,164] two reported increased heart rate (Silva-Maldonado, 2022; Nadeem, 2021);[157,162] and one did not specify direction (Torres-Ugalde, 2020).[163]

- Two systematic reviews and one umbrella review also reported impacts of consuming beverages with caffeine on blood pressure; one reported significant increase (Ajibo, 2024);[150] one reported dose-dependent increase (Khouja, 2022);[164] and one reported weak evidence of change but did not specify direction (Torres-Ugalde, 2020).[163]

- One systematic review found that heart palpitations were the most frequently reported adverse cardiorespiratory event (17.5%) (Nadeem, 2021).[162]

- Two additional narrative reviews were included that both concluded that energy drink consumption has led to atrial fibrillation and tachycardia, as well as elevated blood pressure, although both reviews provided little supporting evidence and did not separate findings from studies among children versus adults (Bunch, 2023; Mihaiescu, 2024).[165,158]

- Five included RCTs (Li, 2022; Mandilaras, 2022; Oberhoffer, 2023; Oberhoffer, 2022a; Oberhoffer, 2022b)[166–170] originate from the same study, EDUCATE Study: Energy Drinks—Unexplored Cardiovascular Alterations in TEens and TwEens. In the EDUCATE study, about 20 healthy children and teenagers recruited from the greater Munich, Germany area consumed a weight-adjusted amount of an energy drink (3mg/kg of caffeine) or a placebo (1mg/kg of caffeine) on two consecutive days. Three of the five RCTs found that energy drink consumption was associated with higher systolic and diastolic blood pressure (Li, 2022; Oberhoffer, 2022b; Oberhoffer, 2023),[166,170,168] with one study finding a significant positive association (Oberhofer, 2023).[168] Oberhoffer, 2023 found that on average, systolic blood pressure, diastolic blood pressure, and mean arterial pressure at daytime were 3.3%, 4.5%, and 3.9% higher after energy drink consumption. Two of the RCTs found that heart rate tended to be lower after energy drink consumption compared to placebo 60–120 minutes after consumption, but overall, no significant relationships were observed between energy drink consumption and heart rate (Mandilaras, 2022; Oberhoffer, 2022b).[167,170]

- The quasi-experimental study measured vital signs (heart rate, respiratory rate, blood pressure) among 41 adolescents aged 16–18 years in Northern Israel who regularly consume energy drinks and non-consumers at intervals of 15–30 minutes, 1 hour, and 2 hours after drinking either 250ml of an energy drink or 250ml of water (Mansour, 2019).[171] Among regular energy drink consumers compared to the control group, systolic blood pressure was significantly higher at baseline, 15–30 minutes, 1 hour, and 2 hours after consumption. The study did not find other significant differences between the groups on heart rate, respiratory rate, and diastolic blood pressure.

In summary, results from the scoping review provide limited evidence suggesting energy drink consumption among adolescents can increase blood pressure, but findings are mixed on the impact on heart rate. Most of the more rigorous studies reviewed examine energy drinks rather than caffeine in isolation. See **Appendix D** for details on the separate evidence grading process and findings for cardiovascular related outcomes.

Oral Health

Four studies examined the relationship between consuming beverages with caffeine and/or stimulants and oral health among children and adolescents. Two studies were reviews, including one systematic review and one narrative review. Two cross-sectional studies were also included.

- One systematic review (Ajibo, 2024) examined the relationship between energy drink consumption and outcomes related to oral health.[150] The systematic review included two relevant studies, one of which found that frequency of energy drink consumption was related to the prevalence of dental caries, and the other found energy drink consumption to be associated with erosive tooth wear. Both studies found a statistically significant relationship, although both were cross-sectional.

- A narrative review (Mihaiescu, 2024) cited that enamel degradation caused by energy drink's acidity are health risks associated with chronic use, although limited information was provided.[158]

- A cross-sectional study (Korkmaz, 2020) conducted among 473 Turkish children ages 7–14 years found that children with dental erosion drank significantly more iced tea and energy drinks compared to children without erosion.[92] In addition, energy drinks were found to increase the likelihood of causing erosion by 10.1 times (compared to 2.8 times for orange juice, 3.6 times for drinks with cola, and 2.1 times for gaseous drinks).

- Another cross-sectional study (Puupponen, 2023) using data from the Finnish nationally representative international Health Behaviour in School-Aged Children Study looking at 2,428 13- to 15-year-old adolescents found that compared to non-consumers, frequent energy drink consumers were more likely to report inadequate tooth brushing.[154] Although this behavior may be associated with oral health, tooth brushing behavior is not a priority outcome for this report.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with caffeine and oral health among children and adolescents.

Bone Density

Two studies examined the relationship between consuming beverages with caffeine and/or stimulants and bone mineral density among children and adolescents. Both studies were cross-sectional utilizing NHANES data among children ages 8 to 19.

- An analysis of NHANES data (Cui, 2023) from 2007–2008 and 2009–2010 assessing count of caffeinated beverages and foods from 24-hr dietary recalls and bone mineral density measured by Dual-energy X-ray absorptiometry (DXA) examinations found no statistically significant effect of caffeine on bone mineral density.[172]

- Another secondary analysis of NHANES 2009–2014 data (Luo, 2022) using presence of caffeine metabolites in urine and bone mineral density measured by DXA examinations found associations between urinary caffeine metabolites and bone mineral density.[173] Specifically, urine theophylline was negatively associated with bone mineral density, while urine paraxanthine, caffeine, and theobromine were positively associated with bone mineral density.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with caffeine and bone density among children and adolescents.

Taste Preferences

One scoping review discussed the relationship between consuming beverages with caffeine and/or stimulants and taste preferences among children and adolescents.

- A scoping review of 100 studies conducted by Temple and colleagues (Temple, 2019) concluded that caffeine could increase the liking for flavored SSBs, including tea, soda, and coffee-type drinks among children and adolescents.[151] Temple suggests, "that caffeine can promote liking, reinforcement, and intake of a variety of beverages, even those that do not normally contain caffeine."

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with caffeine and taste preferences among children and adolescents.

Cognitive Functioning

<u>Sleep</u>

Thirty-three studies examined the relationship between consuming beverages with caffeine and/or stimulants and sleep outcomes among children and adolescents. These included one umbrella review, one meta-analysis, six systematic reviews, one scoping review, four narrative reviews, one RCT, one quasi-experimental, five observational studies, and thirteen cross-sectional studies. Nearly all included studies found a relationship between caffeine consumption and poor sleep quality.

- Khouja's umbrella review included 15 systematic reviews, totaling 74 studies (Khouja, 2022). The reviews consistently concluded that caffeine/energy drink consumption is associated with sleep problems.[164]

- The one meta-analysis (Shahdadian, 2023), which did not include any RCTs or quasi-experimental studies, found that short sleep duration as opposed to sufficient sleep duration was associated with significantly higher odds of energy drink intake among children.[174]

- Of the six included systematic reviews, only one examined experimental studies while the others included majority cross-sectional studies. All six systematic reviews concluded that caffeine intake can lead to sleep disturbances.

  - A systematic review (Nadeem, 2021) including seven RCTs and 25 quasi-experimental studies found that the most frequently reported physiological events with energy drink consumption were insomnia and sleeping-related symptoms (35.4%).[162]

  - Ward et al (Ward, 2021) found a dose-response relationship between caffeinated SSBs and sleep, that overall caffeine consumption and total hours slept were negatively correlated, and that total caffeine consumption was associated with decreased sleep quality.[175] However, only one study was examined for each of these observed relationships.

  - Silva-Maldonado's systematic review (Silva-Maldonado, 2022) similarly found a strong, positive association between consumption and probability of sleep disturbances.[157]

  - Torres-Ugalde's systematic review (Torres-Ugalde, 2020) included various studies reporting alteration in sleep cycles after caffeine consumption.[163]

  - Zhong's systematic review (Zhong, 2024) included numerous studies examining the relationship between high caffeine intake and sleep outcomes.[176] Studies found significant relationships between high caffeine intake and shorter total sleep duration (10 out of 13 studies), difficulty sleeping (2 out of 3), and daytime sleepiness (4 out of 4), among other sleep problems. Mixed evidence was found on caffeine consumption and insomnia (1 out of 2) and sleep disturbances (1 out of 2). The authors conducted a meta-analysis and found that reducing caffeine intake can improve sleep among children.

  - Finally, Ajibo's review (Ajibo, 2024) found that increased energy drink intake was consistently associated with short sleep duration and poor sleep quality across ten reviewed studies.[150]

- A scoping review conducted by Temple and colleagues (Temple, 2019) to explore the trends and safety of consuming caffeine in childhood concluded that energy drink intake is associated with shorter sleep duration, more interrupted sleep, poor sleep quality, and sleep hygiene.[151]

- An RCT conducted among 10- to 18-year-olds residing in Munich, Germany (Oberhoffer, 2023) gave study participants either a caffeinated energy drink (3mg/kg) or a placebo drink on two consecutive days in the morning.[168] The duration of sleep was significantly shorter after consuming the energy drink, which appeared related to an earlier wake time than a later going to sleep time. However, compared to the placebo group, wake time was significantly earlier in the energy drink group. Sleep time and quality was self-reported.

- One quasi-experimental study (Cusick, 2020) assessed self-reported caffeine consumption and sleep quality for 302 eighth graders aged 12–14 years from the U.S. with and without ADHD. They found a significant association between afternoon caffeine use and sleep problems for participants with and without ADHD.[177]

- Among the five observational studies, all found a significant association between total caffeine intake and shorter total sleep time among adolescents.

  - One study (Jessel, 2023) conducted among 6,112 children ages 9–10 years found that for every mg/kg/day of caffeine consumed, there was a 19% decrease in odds of children reporting more than 9 hours of sleep.[178]

  - Another study (Lunsford-Avery, 2023) among U.S. adolescents ages 11–17 similarly found that total sleep time, measured by an at-home sleep electroencephalography, decreased by 28 minutes for every evening caffeinated beverage consumed.[179]

  - A study (Jansen, 2021) conducted among 528 Mexican adolescents aged 9 to 17 found that consuming coffee and tea was associated with shorter sleep duration among females, compared to non-consumers.[94]

  - A prospective cohort study (Mathew, 2022) conducted among U.S. adolescents from February 2014 to March 2016 demonstrated that compared to low or no-caffeine consumers, adolescents who consumed caffeinated beverages frequently had greater sleep variability, and sleep was delayed on nights following daytime caffeinated beverage consumption.[180] Sleep was measured with a wrist-worn accelerometer with off-wrist detection.

  - The second prospective cohort study (Svensson, 2021), was conducted among 982 Swedish students aged 12–16 years and found that consumption of energy drinks in 2010 was associated with not getting enough sleep in 2011.[181]

- All thirteen cross-sectional studies reported that caffeine consumption, particularly when consumed before bed, was associated with lower sleep quality compared to non-consumers (Vézina-Im, 2024; Nuss, 2021; Puupponen, 2023; Kaldenbach, 2022; Potvin, 2022; Pucci, 2019; Saxvig, 2021; Şimşek, 2019; Brahmbhatt, 2022; Carman, 2021; Galland, 2020; Halldorsson, 2021; Albrech, 2022).[95,153,154,182–191]

In summary, findings from the scoping review provide moderate and consistent evidence suggesting that caffeine consumption among children and adolescents is associated with poor sleep quality, including increased sleep disturbances and shorter sleep duration. The evidence is limited by the use of sleep self-report across a majority of the included studies. See **Appendix D** for details on the separate evidence grading process and findings for beverages with caffeine and sleep outcomes.

Behavioral Health

Twenty-one studies examined the relationship between consuming beverages with caffeine and/or stimulants and behavioral health outcomes among children and adolescents. These included four systematic reviews, one umbrella review, one scoping review, six narrative reviews, two observational studies, and seven cross-sectional studies.

- Four systematic reviews (including 2 reviews that included majority experimental studies) and 1 umbrella review found that energy drink consumption is associated with anxiety, depression, and irritability/anger (Ajibo, 2024; Silva-Maldonado, 2022; Nadeem, 2021; Khouja, 2022; Marinoni, 2022).[150,157,162,164,192] The evidence also suggests that frequent energy drink consumption is associated with suicidal ideation and attempts (Ajibo, 2024; Nadeem, 2021; Khouja, 2022; Marinoni, 2022).[150,162,164,192] Nadeem's review (which included all experimental studies) described two studies reporting significantly higher rates of suicidal ideation and attempts among participants who consumed energy drinks once daily, or more than 5 times per week.[162]

- The scoping review conducted by Temple and colleagues (Temple, 2019) concluded that the existing evidence suggests caffeine consumption may be associated with long-term behavioral problems, such as anger, violence, and alcohol and drug use.[151] Several of the articles reviewed by Temple are described in the bullets below as they were also included in our review.

- The six included narrative reviews all concluded that energy drink consumption is associated with mental health concerns, including anxiety, psychological distress, and depression (Erdmann, 2021; Mihaiescu, 2024; Bunch, 2023; Moussa, 2021; Rodak, 2021; Soos, 2021).[152,158,165,193–195] One review (Bunch, 2023) found that consuming 100–400 mg/day of caffeine is associated with increased anxiety, jitters, and nervousness, while another review (Rodak, 2021) found similar associations at greater than 1,000 mg of caffeine per week. Other reviews did not specify the dosage. Many of the reviews cited similar studies, which were also included in this review (Erdmann, 2021; Mihaiescu, 2024; Moussa, 2021; Soos, 2021).[152,158,193,195]

- A longitudinal observational study (Svensson, 2021) conducted among 982 Swedish students ages 12–16 found an association between consuming energy drinks in 2010 and school related stress and deliberate self-harm in 2011 among those that did not report such outcomes in 2010.[181] Additionally, caffeine use among Icelandic 15–16 year olds was found to independently be associated with aggressive behaviors one year later, regardless of aggression at baseline (Kristjansson, 2021).[196] The study concluded that daily adolescent caffeine consumption is positively associated with aggressive behaviors over time. Both observational studies are limited by the reliance on self-report data.

- All six cross-sectional studies found an association between caffeine consumption and negative mental health outcomes, although the specific outcomes varied across studies.

  - The first cross-sectional study (Albrecht, 2022) was among Swiss adolescents aged 15–17 years old found that higher caffeine consumption was associated with more depressive symptoms.[191]

  - The second cross-sectional study (Carman, 2021) among 14–19-year-old Turkish adolescents found that compared to non-consumers, students who consumed energy drinks had higher perceived stress scores.[188]

  - Among Icelandic adolescents, researchers found that individuals who had higher intake of caffeine were more frequently lonely, angry, nervous, and anxious (Halldorsson, 2021).[190]

  - The fourth cross-sectional study (Kim, 2020) among South Korean adolescents aged 12–18 years showed that among adolescents who consumed energy drinks three or more times per week were more likely to experience depressive mood and suicide ideation compared to adolescents with low or no energy drink consumption.[197]

  - The fifth cross-sectional study (Masengo, 2020) among Canadian adolescents found that energy drink consumers were more likely to experience psychological distress.[198]

  - The final cross-sectional study (Maziarz, 2022) was among adolescents from Ohio and similarly found that energy drink consumption in the last year was associated with increased anger, delinquency, and negative mental health outcomes.[199]

In summary, results from the scoping review provide limited, yet consistent, evidence that energy drink consumption is associated with psychological adverse events, including depressive moods, anxiety and stress, self-harm, and sensation seeking. The evidence is limited by the inconsistent measurement of caffeine consumption and behavioral health outcomes. Some studies measured frequent consumption as 5 or more caffeinated beverages per week, while others looked at daily consumption. See **Appendix D** for details on the separate evidence grading process and findings for consumption of beverages with caffeine and behavioral health outcomes.

Academic and Cognitive Performance

Eleven studies examined the relationship between consuming beverages with caffeine and/or stimulants and academic or cognitive performance among children and adolescents. These included one umbrella review, three systematic reviews, one scoping review, one narrative review, one quasi-experimental, two prospective cohort studies, and two cross-sectional studies.

- One umbrella review (Khouja, 2022) found that drinking caffeine was associated with poor school attendance, with more frequent consumers being significantly more likely to have low educational well-being.[164]

- Overall, three systematic reviews (Ajibo, 2024; Silva-Maldonado, 2022; Marinoni, 2022)[150,157,192] and one umbrella review (Khouja, 2022)[164] found that regular energy drink consumption was associated with low academic performance compared to non-consumers. One of the systematic reviews (Marinoni, 2022) included a majority of RCTs and concluded that students with lower school performance are more likely to consume energy drinks.[192]

- The scoping review conducted by Temple and colleagues (Temple, 2019) examining the impact of caffeine on children and adolescents, reported two studies showed that increased caffeine consumption was associated with improved attention, manual hand dexterity text, and accuracy in a number search task, although this was only observed in children who do not regularly consume caffeine.[151] Although the reviews have consistent findings demonstrating a relationship between increased energy drink consumption and lower academic performance, these were majority cross-sectional studies.

- The narrative review (Moussa, 2021) contained one in-scope study, which was conducted among 5th to 12th grade students and found that compared to students who did not consume caffeine, children that consumed caffeine had a 65% increased risk for hyperactivity and inattention.[193]

- The quasi-experimental study (Cooper, 2021) evaluated the acute effects of caffeine during a vigilance task among 31 adolescents in the U.S.[200] Adolescents who consumed 3 mg/kg caffeine had significantly higher correct hits (clicking when two numbers were the same) compared to the placebo and 1 mg/kg of caffeine groups. The authors concluded that caffeine consumption may improve cognitive performance.

- A prospective cohort study (Svensson, 2021) conducted among Swedish adolescents aged 12–16 years old showed that energy drink consumption in 2010 was associated with school related stress one year later.[181] The second prospective cohort study (Zhang, 2020) was conducted among 11,718 youth aged 9–10 years participating in the Adolescent Brain Cognitive Development Study, which is a longitudinal cohort study started in 2017.[201] This study found that increased caffeine intake was significantly associated with decreased cognitive abilities, including vocabulary comprehension, working memory, cognitive flexibility, processing speed, and episodic memory.

- Two cross-sectional studies assessed the relationship between caffeine consumption and cognitive function. Kwon and colleagues found that daily caffeinated soda consumption was associated with high impulsivity and lower working memory (Kwon, 2024).[202] Leal and colleagues found heavy consumers of energy drinks (two or more per day) to be significantly more likely than non-consumers to experience school disengagement, low academic performance, and be unsure about graduating high school (Leal, 2022).[203]

In summary, the limited evidence available on the relationship between consuming beverages with caffeine and academic performance and other cognitive outcomes is mixed. The evidence suggests that caffeine consumption may be associated with lower academic performance, although the published literature is limited to cross-sectional study designs. See **Appendix D** for details on the separate evidence grading process and findings for consumption of beverages with caffeine and cognitive outcomes.

Expert Recommendations

Beverages with caffeine are not recommended for consumption as part of a healthy diet for children and adolescents.

Rationale

Caffeine is not necessary for adequate nutrition, thus beverages with caffeine are not recommended for consumption as part of a healthy diet for children and adolescents. Common sources of caffeine include coffee, non-herbal teas, energy drinks, sodas, chocolate and coffee flavored foods and beverages, and other beverages (e.g., some water and juices now have added caffeine). Caffeine consumption from coffee and energy drinks has increased over the past decade with the proliferation of energy drinks in the market, which contain large amounts of caffeine and added sugar.[204] Yet, caffeine content is not required to be disclosed on nutrition labels, making it difficult to accurately measure intake via foods and beverages. With increased intake, has come an increase in case reports of adolescents experiencing adverse effects, the most concerning of which include cardiovascular events and in some cases fatality. Recent research also demonstrates significant negative impacts on sleep quality and patterns, dietary intake and patterns, and mental health.

There is uncertainty about the safe level of caffeine intake in children and adolescents. AAP suggests that children under 12-years old avoid caffeine entirely, while adolescents (ages 13–18) limit intake to no more than 100 mg/day through foods and beverages.[205] However, this recommendation is hard to operationalize given caffeine content is not required to be disclosed on nutrition labels. **Table 9** includes known caffeine levels for some beverages (exact caffeine amount varies by brand), and it is easy to see how quickly a 100 mg/day limit can be exceeded, especially when considering the amounts of caffeine that may be consumed from foods in addition to beverages.[206] Thus, the expert panel recommends a precautionary approach of avoiding caffeine for all children and adolescents. All children and adolescents should avoid consuming energy drinks and many coffees and teas, which can contain large amounts of caffeine and sugar as well as additional stimulants.

Table 9: Caffeine Levels in Beverages

Caffeine in Beverages per cup (8 fl oz)	
Coffee	80–100 mg
Brewed Black or Green Tea	55 mg in 1 tea bag
Bottled Iced Tea	15–25 mg
Decaf Coffee or Tea	2–15 mg
Soda (regular cola)	35–40 mg
Energy Drinks	150–300 mg
Energy Shots*	200–250 mg

*Energy Shots serving is 1.5-2 fl oz

The expert panel also provides the following notes related to the recommendations:

Caffeine is rarely found in beverages as the sole ingredient of concern. Rather, these beverages often contain large amounts of added sugars, NSS, multiple stimulants (i.e., caffeine and taurine), as well as other additives. These ingredients are not recommended in isolation and are particularly cautioned against when in combination. Special consideration to the ingredients list and nutrition facts label should be taken if selecting a caffeinated beverage. Although the expert panel was unable to find literature on the health impacts of decaffeinated beverages specifically, these beverages are also recommended to avoid when containing sweeteners and additives.

Beverages with Additives and Supplements

The expert panel defined beverages with additives and supplements as beverages that are marketed as having an added nutritional benefit to the diet. Examples include beverages with prebiotics, probiotics, or added vitamins or minerals. Over the past two decades, consumer demand for healthier products has increased, and as a result the industry has continued to develop products marketed as "better for you." One segment of the market that has grown significantly is "functional beverages," which are nonalcoholic drinks that contain wellness-aligned ingredients and are marketed as having a beneficial effect beyond the essential nutrients the body needs.[207] It is important to note that most of the health claims on these products are not supported by evidence. Moreover, the increasing consumption and popularity of these beverages are concerning as many contain added sugars, NSS, and stimulants. When reviewing existing recommendations and guidance on beverages with additives and supplements, most guidelines did not address this topic at all.

Health Impact Literature Review

The expert panel reviewed relevant literature to explore the impact of consuming beverages with additives and supplements, such as prebiotics, probiotics, or added vitamins or minerals, during childhood and adolescents (ages 5–18 years) on health. Sports drinks were also included in this category initially as many of them contain additives and supplements marketed as having performance-enhancing benefits. A total of 1,115 articles were returned for abstract screening. Of those, 20 articles moved to full text review. A final eight articles met the criteria for data extraction. The primary reasons articles were excluded were due to examining the wrong exposure or beverage type, and not assessing an outcome of interest. The PRISMA flow chart and list of included articles by beverage type can be found in **Appendix B**. The panel followed the search strategy and process outlined in the **Methodology** section.

Summary of Literature Review Key Findings for Beverages with Additives and Supplements

Limited evidence exists on the health impacts of consuming beverages with additives and supplements in childhood. The existing evidence is limited by the lack of robust study designs. Additionally, among the studies that were reviewed, there was inconsistency across the beverage type assessed, and varying definitions of beverages with additives and supplements. There is insufficient evidence available to describe the health impacts of consuming beverages with additives and supplements among children and adolescents. No articles assessing diet quality, body weight, cardiovascular disease, bone density, and taste preferences were returned.

Diabetes

Two studies examined the relationship between consuming beverages with supplements and additives and diabetes-related outcomes among children and adolescents, including one narrative review and one RCT.

- The narrative review (Barretto, 2024) explored the perceptions and effects of supplement-use, including energy drinks with supplements, among children and adolescents.[208] Some studies reviewed indicate potential benefits of consuming Vitamin D in the prevention of type 2 diabetes and the pathophysiology of type 1 diabetes. However, they also conclude that children and adolescents excessively use supplements, and that specific supplementation is only recommended for children with deficiencies or reduced intake.

- The RCT (Mayengbam, 2019) was conducted among twenty healthy adolescents aged 13–19 years from Alberta, Canada.[209] After an overnight fast, participants consumed 1.5ml/kg of either colored water (comparison), or a vitamin fortified, sugar free beverage developed to mimic 5hr Energy Decaffeinated. After 40 minutes of rest, participants underwent a modified oral glucose tolerance test. Additional blood samples were collected at 0, 30, 45, 60, 90 and 120 minutes. The fortified beverage, compared to the colored water, led to a disproportionate increase in insulin levels, resulting in a 28% decline in the insulin sensitivity index. Disruptions in the metabolism of vitamin B and one-carbon compounds in individuals who consumed the fortified beverage were also observed, and this effect became more pronounced over time. No differences in blood glucose were observed between the treatments.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with additives or supplements and diabetes among children and adolescents.

Oral Health

Three studies examined the relationship between consuming beverages with supplements and additives and oral health outcomes among children and adolescents, including two systematic reviews and one observational study.

- A systematic review (Feldmann, 2024) of 9 RCTs evaluating the effects of probiotics-containing beverages on dental caries development found inconsistent findings.[210] Overall, a statistically significant difference in proportion of individuals with cavitated lesions was not observed. However, the consumption of probiotics-containing beverages was significantly associated with a smaller amount of both cavitated and non-cavitated lesions. Munoz-Urtubia's systematic review lacked a description of individual study designs but concluded that the consumption of sports drinks has a negative impact on oral health in children (Munoz-Urtubia, 2023).[211]

- A total of 411 children averaging 8 years of age in Mexico City were clinically examined for the presence of dental erosion and surveyed for dietary behaviors (Garduno-Picazo, 2020).[90] Dental erosion was found to be associated with frequent consumption of probiotic beverages and sports beverages.

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with additives or supplements and oral health among children and adolescents. The included articles on oral health examined different types of additives, resulting in insufficient evidence on any one additive.

Cognitive Functioning

Four studies examined the relationship between consuming beverages with supplements and additives and cognitive functioning outcomes among children and adolescents, including one narrative review, one RCT, and two cross-sectional studies.

- The narrative review (Barretto, 2024) assessed perceptions and effects of supplement use among children and adolescents.[208] This review described the prevalent use of melatonin in children with sleep disorders. Melatonin can come in many forms, including in beverages. This review did not examine the form melatonin is administered. However, there is a lack of evidence and recommendations on the indication, dose, duration of use, and long-term effects of melatonin use among children.

- A sample of 54, 7- to 10-year-olds in the UK were recruited to consume either a 200ml of wild blueberry drink containing 253 mg anthocyanins or a matched placebo (Barfoot, 2019).[212] After two hours, cognitive performance was assessed through the Continuous Performance Task, Ravens Coloured Progressive Matrices, York Assessment of Reading for Comprehension, or Single Word Reading Task. No significant differences between treatment groups were observed for any of the cognitive performance tests.

- The two cross-sectional studies examined consumption of sports drinks among high schoolers in the U.S. and Spain (Michael, 2020; Schroder, 2021).[213,214] Using 2017 Youth Risk Behavior Survey data, the U.S. study (Michael, 2020) found that students who drank one or more sports drinks per day were significantly more likely to attempt suicide compared to those who did not.[213] The survey conducted in Spain (Schroder, 2021) assessed school performance as an outcome and found that sports drink consumption was not associated with school performance.[214]

In summary, there is insufficient rigorous evidence to make a conclusion on the relationship between consuming beverages with additives or supplements and cognitive functioning. The included articles examined different types of additives, and a variety of outcomes within the cognitive functioning umbrella, resulting in insufficient evidence on any one additive and any outcome.

Expert Recommendations

Given the paucity of evidence on many of the supplements and additives being used in beverages, as well as the fact that many of the beverages with these ingredients also fall into other categories (e.g., SSB, NSS, beverages with caffeine), the expert panel determined that beverages with additives and supplements should not be a unique category for the purpose of this report. Rather, this is a cross-cutting issue that consumers should be aware of as more and more manufacturers are adding supplements and additives to beverages, yet the evidence to support their health claims is lacking. More importantly, the lack of evidence on the potential risks and/or harms of consuming these additives and supplements is also concerning. This issue is discussed further in the **Other Considerations** section of this report.

OTHER CONSIDERATIONS

The expert panel considered several other issues when reviewing the literature and developing recommendations, including:

The ever-changing, diverse beverage environment

The beverage environment is rapidly growing and changing, resulting in beverages in the marketplace that are new to consumers. Because of the speed in which new products are created and the quantity of these products, little to no research has been conducted on the healthfulness of new beverage types. High schoolers are frequently targeted by beverage companies as they begin making independent purchasing decisions, become more involved in sports, and experience more tiredness due to increased academic demands and media exposures that may disrupt sleep. Teenagers become more exposed to a variety of sports drinks, energy drinks, and other beverages with additives that are advertised to offer vitamins, minerals, and caffeine. Many of these beverages are also advertised to contain zero sugar, but they contain NSS, which are not recommended. In addition, non-alcoholic beverages (e.g., beer, cocktails, as in alternatives to their counterparts containing alcohol) and beverages with THC are becoming increasingly available. Beverages with THC are currently not allowed to be sold to individuals under 21, but there are currently no age restrictions for non-alcoholic beverages.

The quantity, variety, and ever-changing beverage environment makes it difficult for consumers to make a healthy choice with confidence. Close attention should be paid to the ingredient list of beverages to determine the actual healthfulness of the product. In general, plain water and milk should be the preferred beverage types at all ages.

Beverages with additives and deceitful marketing

The proliferation of new beverages in the marketplace requires consumers to consider their specific beverage choices more closely. Beverage companies are constantly adapting current beverages to become more appealing to consumers, largely utilizing creative marketing and advertising strategies to suggest the beverage offers a nutritional benefit over other similar products or serves a specific function. Many of these claims are made directly by beverage companies and are not regulated by the FDA nor supported by evidence.

In addition, many new beverages contain additives and supplements that are unknown to consumers and are understudied. These additives may include NSS, caffeine and other stimulants, prebiotics, probiotics, and vitamins and minerals, which may not be listed on the nutrition facts label or ingredient lists. In general, beverages that contain majority water with no added sugars, NSS, or caffeine may be safe for consumption. However, many beverages in the marketplace include multiple additives and supplements. The layering effect of additives, specifically beverages with sweeteners and caffeine, should be considered as these beverages should be avoided due to their negative health impacts. Close attention should be paid to the ingredients list to determine the healthfulness of these beverages.

Environmental implications

In addition to considering the health and nutritional implications when choosing a beverage, more consumers are weighing the environmental impact of their beverage choices. This includes the impact of the beverage packaging (both production and disposal of), production, land and water use, and the potential biodiversity consequences. The effects of micro- and nano-plastics found in plastic bottles are also of concern.

A majority of single-serve or ready-to-drink beverages in the marketplace, including juice, sodas, and other caffeinated beverages, are sold in plastic containers. Single-use plastic containers make significant contributions to carbon emissions in their creation and disposal. The production of plastic from fossil fuels is estimated to emit 1.5–12.5 million metric tons of greenhouse gases.[215] Single-use plastics do not decompose once they are disposed of in landfills. Landfills alone account for more than 15% of methane emissions.[215] The greenhouse gas emissions (GHGE) from a sugary drink manufacturer, per liter of average content, were 81 times greater than that of a liter of tap water.[216] In addition, every plastic bottle produces 11 times more GHGE and uses 27 times more water than a reusable stainless steel water bottle.[216] Due to the harmful environmental impact of single-use beverages, consumers should use a reusable bottle and drink tap water when safe for consumption. Compared to plastic, paper or cardboard containers (i.e., milk cartons) are more environmentally friendly as they decompose.

If tap water is not safe for consumption, the expert panel recommends consumers consider a home filter rather than purchasing bottled water. It's important to note that filters remove many substances from the water, including the bad (i.e., lead) and good (i.e., fluoride). The Center for Disease Control (CDC) provides information about how to choose a water filter and other water filtration sources. In summary, there are numerous types of water filters that remove various contaminants, but it is most important to ensure that the filter is NSF certified for the specific contaminants of concern. It's important to have a certified professional test your water, then choose a water filter based on the identified contaminants and what works best for your home and budget. More information about how to select a filter can be found on CDC's website, *Choosing Home Water Filters and Other Water Treatment Systems*.

Despite lacking nutritional value in comparison to cow's milk, PBMA have gained popularity with consumers striving to lessen their environmental impact. There are many different environmental impacts to consider, including greenhouse gas emissions, land use, water use, and eutrophication. PBMA uses less water (2–20x less), land (10x less) and produces less carbon dioxide (5–3x less) than cow's milk.[217] However, the evidence is less clear regarding the environmental impacts between different PBMA. Almond milk, for example, has a higher water demand than other PBMA, but also has the lowest greenhouse gas emissions.[217,218] Experts also warn that switching to PBMA may pose biodiversity consequences as certain countries rely on cows and their grazing to maintain biodiversity within pastures.[218]

The consumption of microplastics has been found to be associated with negative impacts on a variety of organs, including the intestines, blood vessels, lungs and liver, and reproductive and nervous systems. A study examining other effects of microplastics on humans found them to be related to oxidative stress, DNA damage, organ dysfunction, metabolic disorder, immune response, neurotoxicity, as well as reproductive and developmental toxicity.[219] Chronic diseases have also been shown to be related to microplastics exposure in the epidemiological evidence. A 2019 study found that individuals who consume only bottled water may be ingesting an additional 90,000 microplastics per year compared to 4,000 microplastics for tap water consumers.[220] A recent study using a novel approach to measure nanoplastics, found that on average, a liter of bottled water included about 240,000 tiny pieces of plastic, a majority of nanoplastics.[221] Polyamide, which is often used by the beverage industry to filter water, and polyethylene terephthalate (PET) were the two most common plastics detected.[221] PET is also used to make bottles for other beverage types. The health impacts of nanoplastics are still understudied, although evidence on the transient abilities of nanoplastics suggest they could have similar or more significant effects as microplastics. The presence of micro and nanoplastics in plastic bottles should be considered by consumers when making beverage choices as many sodas, juices, and caffeinated beverages are only available in plastic containers in the marketplace. Bottled water is frequently cited as the largest source of microplastics due to the plastics that are added to filter and purify the water. Tap water, when it is safe for consumption, is the preferred water source to reduce micro and/or nanoplastic exposure.

Opportunities for these recommendations to inform policy, systems, and environmental efforts to improve children's and adolescent's health

The goal of these recommendations is to provide consistency in nutrition guidance provided in the U.S. across both health providers and federal programs. Currently, children ages 5–18 obtain most of their food and beverages from school, thus the school food environment represents a prime opportunity for changes to align with these recommendations. Flavored milk, for example, is currently allowed in elementary, middle, and high schools through the National School Lunch and Breakfast Programs. The recommendations included in this report could provide the evidence necessary to shape the added sugar and flavored milk standards in school meals moving forward. Additional opportunities for policy, systems, and environmental impact of these recommendations are provided in the **Policy and Practice Implications** section of the report.

Varying cultural food ways, traditions, and customs or dietary patterns in the U.S.

Providing clear, national recommendations on beverage consumption is necessary to improve population-level child health; however, the panel recognizes that individual beverage consumption varies across cultures, traditions, and customs. For example, lactose intolerance is more prevalent among individuals from certain nationalities or ethnicities, thus these individuals often do not consume milk and may choose to instead consume PBMA as opposed to dairy sources. In these cases, families should consult with a pediatrician or dietitian to ensure adequate intake of essential nutrients.

Overall, beverage consumption varies greatly among and across families, cultures, and even individuals. It is most important to follow a healthy dietary pattern, acknowledging that this can be obtained in many ways.

Budgetary considerations

Cost is a main driver of beverage purchasing decisions for families and adolescents. Although plain tap water is both free and the recommended beverage type, not all children and adolescents enjoy drinking plain water. Products that are developed to appeal to the health-conscious consumer, like naturally-flavored carbonated waters, are not recommended for daily consumption and are also not affordable for many families. Natural, unsweetened flavorings may be added to water at home to appeal to children ages 5–18. For example, water may be flavored with frozen berries or whole milk may be flavored with a small amount of vanilla extract. Healthy beverage habits can be developed at any age and continual exposure to healthy beverages, like plain water and milk, can lead to changes in child taste preferences over time.

RESEARCH RECOMMENDATIONS

Throughout the expert panel's review of the literature, several themes emerged regarding the limitations of the evidence. First, the health impacts of consuming certain beverages among school-age children are significantly under-studied. Additional research is needed examining the health effects and consumption patterns of carbonated and flavored water, PBMA, and beverages with additives or supplements. More high-quality studies, including randomized-controlled trials, quasi-experimental studies, and prospective cohort studies are needed for all beverage types. Additionally, there is a dearth of research on beverage consumption patterns and behaviors and their associated health outcomes among racially and ethnically diverse populations in the U.S.

To better understand the effects of beverage consumption on health among children and adolescents, more research is needed.

Future studies should:

- Utilize an experimental study design, specifically randomized controlled trials or quasi-experimental designs, to examine cause-effect relationships between beverage consumption and health outcomes;
- Clearly define the beverage type as the exposure, and disaggregate data on beverage sub-types when presenting findings (when possible) to document effects of individual beverages (i.e., chocolate milk as opposed to flavored milk or plain water as opposed to flavored water);
- National nutrition surveillance data measurement tools should revisit beverage categories, and separate beverage types to align with current recommendations and new products in the marketplace. For example, plain milk and flavored milk, which are currently combined in NHANES as "milk," should be separated into two distinct categories;
- Utilize consistent measures of beverage consumption to allow for comparison across studies;
- Ensure sufficient duration of follow-up to allow for assessment of both short and long-term effects;
- Explore age-related mechanisms when differences by age are observed; and
- Examine dose-effects.

Additionally, knowledge gaps for each beverage type were identified that could be explored through future research among children ages 5–18 years.

These include conducting studies that:

- Explore the independent effects of carbonation and flavored water on dental enamel;
- Specify the amount of NSS used, and assess doses similar to real-life consumption to examine the effect of lower versus higher doses;
- Provide a better understanding of how NSS exposure in childhood impacts sweet taste preferences and future dietary choices;
- Examine effects of NSS in isolation to understand differential effects across NSS types;
- Assess the health impacts of substituting beverages to limit or avoid (such as 100% juice, NSS, SSB, or flavored milk) with water. These intervention studies should include children with healthy weights, as well as with overweight;
- Assess a variety of 100% fruit juices to understand any differential effects (e.g., apple versus orange juice);
- Examine the cardiovascular effects of caffeine and energy drinks;
- Separate effects of components of energy drinks (i.e., caffeine versus other stimulants, such as taurine, and sweeteners), and explore the synergistic effects; and
- Explore the health impacts of decaffeinated beverages.

POLICY AND PRACTICE IMPLICATIONS

The expert panel's beverage recommendations are expected to inform policy, environmental, and systems efforts to improve the health of children and adolescents. The recommendations and messaging provided in this report can be used by healthcare providers, public health practitioners, and parents and other caregivers to provide consistent and clear messaging about healthy beverage consumption during childhood and adolescence.

Examples of policy applications include:

- Nutrition standards for children's restaurant meals, such as default beverages to be offered.
- Nutrition standards for marketing beverages to children under the age of 18.
- Nutrition standards and educational materials for federal nutrition assistance programs serving children such as Supplemental Nutrition Assistance Program (SNAP), SNAP-Ed, CACFP, and WIC.
- Nutrition standards for national school meal programs—including the National School Lunch Program (NSLP), the School Breakfast Program (SBP), and Summer Meals—specifically updating standards for beverages with caffeine and flavored milk, as well as ensuring access to safe drinking water in schools.
- The 2025–2030 (and future iterations of) Dietary Guidelines for Americans.
- Beverage taxation policies.
- Front-of-pack-nutrition-labeling (FOPNL), including interpretive or warning labels applied to beverages to inform consumers about the actual and/or relative healthiness of different beverages.

Examples of practice applications include:

- Update the current, as well as create new *USDA Team Nutrition* resources about healthy beverage consumption for use in USDA child nutrition programs. This includes nutrition education materials and training resources for school foodservice staff.
- Update the current, as well as create new resources in the *SNAP-Ed Library* about healthy beverage consumption for use in SNAP-Ed education, interventions, and programming.
- Align and standardize education about healthy beverage consumption provided by local and state health departments and agencies, such as public health campaigns (e.g., Rethink Your Drink).
- Align and standardize the education and counseling provided about healthy beverage consumption in the health care setting by various provider types (e.g., Physicians, Dietitians, Nurses, Dentists, etc.).

The expert panel hopes that its simple, straightforward recommendations will spur the development of innovative advertising and marketing strategies to promote young children's consumption of recommended beverages.

CONCLUSIONS

Beverages are critical for adequate hydration and play an important role in achieving a healthy dietary pattern and in developing life-long healthy nutrition habits. Despite efforts to improve beverage intake patterns among children and adolescents, many are still not meeting recommendations, and disparities in intake by race, ethnicity, and income persist. The beverage recommendations put forward by this expert panel are based on the best available evidence, and in some cases, expert opinion.

A consistent theme that emerged throughout the expert panel's information-gathering efforts and review of the literature was that research and evidence on the health impacts of consuming most beverages during childhood and adolescence is limited. High-quality studies (defined by this effort as randomized control trials, quasi-experimental studies, and observational prospective cohort studies) are particularly scarce, as are longitudinal data to examine the long-term health impacts of beverage consumption. Additionally, there is a dearth of research on beverage consumption patterns and behaviors and their associated health outcomes among different racial and ethnic groups in the U.S. These recommendations take a conservative approach given the scarcity of evidence and may change over time as new evidence emerges.

The goal of this consensus panel is to provide consistent messages that can be used by healthcare providers, public health practitioners, and parents and other caregivers to improve the beverage intake patterns of children and adolescents. The level of collaboration and consistency among major national health and nutrition organizations represented in these recommendations has the capacity to make meaningful change and improve the health and well-being of 5- to 18-year-olds throughout the U.S.

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About Healthy Eating Research

Healthy Eating Research (HER) is a national program of the Robert Wood Johnson Foundation. Technical assistance and direction are provided by Duke University under the direction of Mary Story PhD, RD, program director, and Megan Lott, MPH, RDN, deputy director. HER supports research to identify, analyze, and evaluate environmental and policy strategies that can promote healthy eating among children and prevent childhood obesity. Special emphasis is given to research projects that benefit children and adolescents and their families, especially among lower-income and racial and ethnic minority population groups that are at highest risk for poor health and well-being and nutrition-related health disparities. For more information, visit *www.healthyeatingresearch.org* or follow HER on X at @HEResearch or Instagram at @HealthyEatingResearch.

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APPENDIX A: METHODOLOGY SUPPLEMENTAL INFORMATION

Literature reviews were conducted to examine research gaps or questions about the health impacts of beverages as deemed necessary by the SAC or expert panel members to develop clear and consistent recommendations.

The methodology for the literature reviews and data extraction was developed based on the methodology of the 2020 Dietary Guidelines Advisory Committee *Scientific Report*, prior HER-led panels, and input from HER staff, panel co-chairs, the SAC, expert panel members, and an expert in library science from Duke University.

This appendix includes additional information regarding the literature reviews conducted by the expert panel's four working groups. The methodology and findings from the evidence grading process can be found in **Appendix D**.

Expert Panel Work Group Literature Reviews

Scoping Review Research Questions and Search String Details

Water

Carbonated Water

- What are the health impacts of consuming carbonated water?

Flavored Water

- What are the health impacts of consuming flavored water?

Milk

Plain Pasteurized Milk

- How does the fat content of plain pasteurized milk impact health?

Sweetened Flavored Milk

- What are the health impacts of consuming flavored milk?

Plant-Based Milk Alternatives

- What are the health impacts of consuming plant-based milk alternatives?
- What is the bioavailability of nutrients in various plant-based milk alternatives (calcium and Vitamin D)?

Sweetened Beverages

Beverages with Non-Sugar Sweeteners

- What are the health impacts of consuming beverages with non-sugar sweeteners (NSS)?
- What are the impacts of consuming beverages with NSS on cognitive function?
- What are the health impacts of consuming SSBs vs beverages with NSS?
- What are the health impacts of consuming water vs beverages with NSS?
- What is the impact of consuming beverages with NSS on cancer?

100% Juice

- What are the health impacts of consuming 100% juice?
- What are the health effects of diluting juice with water?

Other Beverages

Beverages with Caffeine and Other Stimulants

- What are the health impacts of consuming beverages with caffeine and other stimulants?
- What are the health impacts of consuming decaffeinated beverages?

Beverages with Additives and Other Supplements

- What are the health impacts of consuming beverages with additives and supplements?

Inclusion Criteria

To be included in the review, studies had to meet the following criteria:

- evaluate beverage consumption during the 5- to 18-year-old age period (articles were included if they evaluated exposure over an age range that overlapped with 5-18 years, such as 4-6 years);
- include healthy, non-institutionalized subjects (i.e., entire sample cannot have a chronic disease such as diabetes);
- evaluate consumption of the beverage of interest as a primary exposure;
- evaluate at least one health outcome of interest (described below);
- available in the English language;
- published in a peer-reviewed journal;
- a review or original study (i.e., medical case studies and qualitative studies were excluded); and
- take place in the United States or an OECD-member country (OECD = Organization for Economic Co-operation and Development).

The OECD brings together member countries that collaborate on key global issues at national, regional, and local levels. OECD-member countries must align their domestic laws, policies, and regulations in a wide range of governance areas with the OECD policies and standards.

Studies must hold relevance to U.S. consumption patterns, outcomes of interest, and policy and practice opportunities. Reviews that consist of a majority of in-scope studies with a few that are out of scope (i.e., majority studies conducted in the U.S. and a few in developing countries), were included.

The core health outcomes of interest for this project included: Diet Quality, Body Weight, Diabetes, Cardiovascular Disease, Bone Density, Oral Health, Taste Preferences, and Cognitive Function. Specific inclusion criteria for each health outcome are listed in **Table A1**. The expert panel determined which health outcomes were of interest for each beverage type. Most outcomes were determined a priority for all beverage types, with two exceptions:

1. Bone density was not a priority outcome for 100% juice; and
2. Taste preferences was not a priority outcome for plant-based milk alternatives and 100% juice.

Table A1. Health Outcome Inclusion Criteria

Health Outcomes	Outcome Assessed
Diet Quality	diet quality score (e.g., healthy eating index score) or diet quality indices, energy/calorie intake
Body Weight	overweight, obesity, BMI, waist circumference, body composition
Diabetes	type 2 diabetes, prediabetes, blood sugar, insulin sensitivity, metabolic syndrome
Cardiovascular Disease	CVD risk, heart disease, high blood pressure, cholesterol, heart rate
Bone Density	bone mass, height, nutrients related to bone health
Oral Health	cavities, enamel/tooth erosion, tooth decay
Taste Preferences	preference for sweet foods or beverages
Cognitive Function	sleep, psychological effects, academic performance, focus/concentration

Search Strategy

For each review, the work groups used a consistent search strategy informed by the 2020 Dietary Guidelines for Americans Advisory Committee's systematic review protocol.

First, the research team conducted an umbrella review to identify systematic reviews or meta-analyses published from 2019 onwards in PubMed, Embase, Cochrane, and Web of Science databases. The starting year of 2019 was selected because the 2020 DGAC Report was used as a primary source document. The initial umbrella reviews yielded low returns, and it was determined that key articles published since 2019 were missing. The research team therefore decided it was prudent to conduct a full scoping review to ensure all relevant and high-quality studies were included. Results from the umbrella review are not reported separately as these articles are captured within the scoping review described below.

A scoping review, which is an approach to identify and summarize existing literature on a given topic, was conducted in PubMed, Embase, and Web of Science for each of the following beverage types: carbonated water, flavored water, plant-based milk alternatives, sweetened flavored milk, fat content of plain pasteurized milk, 100% juice, beverages with non-sugar sweeteners, beverages with caffeine and stimulants, and beverages with additives and supplements. For each scoping review, articles published from 2019 to present were considered. In-scope articles included systematic reviews, meta-analyses, umbrella reviews, scoping reviews, narrative reviews, randomized controlled trials, quasi-experimental studies, and observational studies (including cross-sectional and prospective cohort studies, among other study types). Pediatric search terms were added to the search strings to ensure children ages 5-18 years were included in the study population; human subject and English language filters were applied to each search.

A librarian at Duke University developed the search strings in consultation with the HER research team. The Duke Librarian ran all searches and uploaded the results into Covidence, a software used to manage and organize systematic reviews. Two members of the research team reviewed each article abstract and full text. A third reviewer resolved conflicts at both the abstract and full text review stages. Data were extracted for included studies by members of the research team. During data extraction, each article was tagged for health outcomes of interest, although search terms for health outcomes were not included in the search strings to ensure all possible in-scope articles were returned.

Search Strings for Scoping Review

The search strings and results for each beverage type are provided in **Table A2**. Only search strings conducted in PubMed are listed. The search terms were consistent across databases, although formatting was adjusted based on best practices for each database. Search strings for other databases are available upon request.

Table A2. Search Strings

Concept	Strategy	Results
Carbonated Water		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,448
#2 Carbonated Water	"Carbonated Water"[Mesh] OR ((carbonated[tiab] OR sparkling[tiab] OR seltzer[tiab] OR mineral[tiab] OR bubbly[tiab] OR bubble[tiab]) AND (water[tiab] OR waters[tiab])) OR "club soda"[tiab] OR "club sodas"[tiab] OR seltzer[tiab] OR seltzers[tiab]	21,024
#3 Combining	#1 AND #2	948
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	915
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	868
#6 Date Limiter: 2019	PubMed User Interface	171

Concept	Strategy	Results
Flavored Water		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,448
#2 Flavored Water	(("Water"[Mesh] OR "Drinking water"[Mesh] OR water[tiab] OR waters[tiab] OR “Carbonated Water”[Mesh] OR seltzer[tiab] OR mineral[tiab] OR bubbly[tiab] OR bubble[tiab] OR “club soda”[tiab] OR “club sodas”[tiab] OR seltzer[tiab] OR seltzers[tiab]) AND (flavored[tiab] OR flavoured[tiab] OR flavor[tiab]))	3,031
#3 Combining	#1 AND #2	273
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	271
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	254
#6 Date Limiter: 2019	PubMed User Interface	75
Plain Pasteurized Milk—Milk Fat		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,216,165
#2 Plain Pasteurized Milk	"Milk"[Mesh:NoExp] OR ((cow[tiab] OR cow's[tiab] OR whole[tiab] OR "reduced fat"[tiab] OR "reduced-fat"[tiab] OR "low fat"[tiab] OR "low-fat"[tiab] OR "1%"[tiab] OR "one percent"[tiab] OR "2%"[tiab] OR "two percent"[tiab] OR skim[tiab] OR "fat free"[tiab] OR "fat-free"[tiab] OR dairy[tiab]) AND (milk[tiab] OR milks[tiab])) OR milk[tiab]	163,149
#3 Fat Content	"Fats"[Mesh] OR fat[tiab] OR fats[tiab] OR fatty[tiab]	670,287
#4 Combining	#1 AND #2 AND #3	3,100
#5 Exclude Human Milk	#4 NOT ("Lactation"[Mesh] OR "Breast Feeding"[Mesh] OR "Pregnancy"[Mesh] OR "human breast milk"[tiab])	2,340
#6 Date Limiter: 2019	PubMed User Interface	528
Sweetened Flavored Milk		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,448

Concept	Strategy	Results
#2 Flavored Milk	“flavored milk”[tiab] OR “flavoured milk”[tiab] OR “flavor milk”[tiab] OR “flavour milk”[tiab] OR “flavored milks”[tiab] OR “flavoured milks”[tiab] OR “flavor milks”[tiab] OR “flavour milks”[tiab] OR “sugar sweetened milk”[tiab] OR “sugar-sweetened milk”[tiab] OR “sugar sweetened milks”[tiab] OR “sugar-sweetened milks”[tiab] OR “sugar sweetened cow milk”[tiab] OR “sugar-sweetened cow milk”[tiab] OR “sugar sweetened cow milks”[tiab] OR “sugar-sweetened cow milks”[tiab] OR “sugar sweetened cows milk”[tiab] OR “sugar-sweetened cows milk”[tiab] OR “sugar sweetened cows milks”[tiab] OR “sugar-sweetened cows milks”[tiab] OR "sweetened flavored milk*"[tiab] OR “chocolate milk”[tiab] OR “strawberry milk”[tiab] OR "sweetened plant milk*"[tiab] OR "sweetened plant-based milk*"[tiab] OR "flavored plant milk*"[tiab] OR "flavored plant-based milk*"[tiab] OR "flavoured plant milk*"[tiab] OR "flavoured plant-based milk*"[tiab] OR "sweetened dairy substitute"[tiab] OR “sweetened dairy substitutes”[tiab] OR "sweetened non-dairy"[tiab] OR "sweetened non dairy"[tiab] OR “flavored dairy substitute”[tiab] OR “flavored dairy substitutes”[tiab] OR "flavored non-dairy"[tiab] OR "flavored non dairy"[tiab] OR “flavoured dairy substitute”[tiab] OR “flavoured dairy substitutes”[tiab] OR "flavoured non-dairy"[tiab] OR "flavoured non dairy"[tiab]	520
#3 Combining	#1 AND #2	203
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	201
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	200
#6 Date Limiter: 2019	PubMed User Interface	63
Plant-Based Milk Alternatives		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,448
#2 Plant Milk	"Milk Substitutes"[MeSH] OR "plant milk"[tiab] OR "non-dairy milk"[tiab] OR "non dairy milk"[tiab] OR "plant based milk"[tiab] OR "plant-based milk"[tiab] OR "plant milks"[tiab] OR "non-dairy milks"[tiab] OR "non dairy milks"[tiab] OR "plant based milks"[tiab] OR "plant-based milks"[tiab] OR "milk substitute"[tiab] OR "milk substitutes"[tiab] OR "milk alternative"[tiab] OR "milk alternatives"[tiab] OR "plant beverage"[tiab] OR "plant beverages"[tiab] "plant-based beverage"[tiab] OR "plant-based beverages"[tiab] OR "plant based beverage"[tiab] OR "plant based beverages"[tiab] OR “plant-based dairy alternative”[tiab] OR “plant-based dairy alternatives”[tiab] OR “plant based dairy alternative”[tiab] OR “plant based dairy alternatives”[tiab] OR "dairy alternative"[tiab] OR "dairy alternatives" OR "dairy free"[tiab] OR "dairy-free"[tiab] OR "dairy substitute"[tiab] OR "dairy substitutes"[tiab] OR "almond milk"[tiab] OR "almond beverage"[tiab] OR "oat milk"[tiab] OR "oat beverage"[tiab] OR "rice milk"[tiab] OR "rice beverage"[tiab] OR "coconut milk"[tiab] OR "coconut beverage"[tiab] OR "soy milk"[tiab] OR "soy beverage"[tiab] OR "hemp milk"[tiab] OR "hemp beverage"[tiab] OR "cashew milk"[tiab] OR "cashew beverage"[tiab] OR "walnut milk"[tiab] OR "walnut beverage"[tiab] OR "flax milk"[tiab] OR "flax beverage"[tiab] OR "hazelnut milk"[tiab] OR "hazelnut beverage"[tiab] OR "pea milk"[tiab] OR "pea beverage"[tiab] OR "nut milk"[tiab] OR "nut beverage"[tiab]	1,488
#3 Combining	#1 AND #2	217
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	194
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	190
#6 Date Limiter: 2019	PubMed User Interface	68
100% Juice		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,951

Concept	Strategy	Results
#2 100% Juice	"Fruit and Vegetable Juices"[Mesh] OR ((fruit[tiab] OR "100%"[tiab] OR "one hundred percent"[tiab] OR "one-hundred percent"[tiab] OR vegetable[tiab] OR apple[tiab] OR orange[tiab] OR grape[tiab] OR grapefruit[tiab] OR cranberry[tiab] OR currant[tiab] OR blackcurrant[tiab] OR tomato[tiab]) AND (juice[tiab] OR juices[tiab])) OR (("100%"[tiab] OR "one hundred percent"[tiab] OR "one-hundred percent"[tiab]) AND ("fruit drink"[tiab] OR "fruit drinks"[tiab] OR "fruit beverage"[tiab] OR "fruit beverages"[tiab]))	18,357
#3 Combining	#1 AND #2	2,119
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	2,057
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	2,043
#6 Date Limiter: 2019	PubMed User Interface	508

Beverages with Non-Sugar Sweeteners

Concept	Strategy	Results
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,951
#2 Low Calorie Sweeteners	"Sweetening Agents"[Mesh] OR "Saccharin"[Mesh] OR "Aspartame"[Mesh] OR "Stevia"[Mesh] OR "sweetening agent"[tiab] OR "sweetening agents"[tiab] OR saccharin[tiab] OR “acesulfame potassium”[tiab] OR sucralose[tiab] OR neotame[tiab] OR advantame[tiab] OR stevia[tiab] OR “artificial sweetener”[tiab] OR "artificial sweeteners"[tiab] OR “high-intensity sweetener’”[tiab] OR “high intensity sweetener’”[tiab] OR “high-intensity sweeteners”[tiab] OR “high intensity sweeteners"[tiab] OR “non-nutritive sweetener”[tiab] OR “non-nutritive sweeteners”[tiab] OR “nonnutritive sweetener”[tiab] OR “nonnutritive sweeteners”[tiab] OR “nutritive sweetener”[tiab] OR “nutritive sweeteners”[tiab] OR "non-sugar sweetener"[tiab] OR "non sugar sweetener"[tiab] OR "monk fruit"[tiab] OR "acesulfame K"[tiab] OR "ace K"[tiab] OR cyclamate[tiab] OR thaumatin[tiab] OR brazzein[tiab] OR alitame[tiab] OR neohesperidin[tiab] OR steyiol[tiab] OR rebaudiside[tiab] OR rebiana[tiab] OR mogroside[tiab] OR "luo han guo”[tiab] OR "siraitia grosvenorii swingle fruit"[tiab] OR ((diet[tiab] OR non-caloric[tiab] OR low-calorie[tiab] OR noncalorie[tiab] OR non-calorie OR "calorie free"[tiab] OR "artificially sweetened"[tiab]) AND (beverage[tiab] OR beverages[tiab] OR drink[tiab] OR drinks[tiab] OR soda[tiab] OR sodas[tiab] OR pop[tiab] OR pops[tiab]))	29,928
#3 Combining	#1 AND #2	6,217
#4 Studies Only	#3 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	6,024
#5 Humans Only	#4 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	5,789
#6 Date Limiter: 2019	PubMed User Interface	1,509

Beverages with Caffeine

#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,951
#2 Caffeinated Beverages	"Caffeine"[Mesh] OR "Coffee"[Mesh] OR "Tea"[Mesh] OR ((caffeine[tiab] OR caffeinated[tiab]) AND (drink[tiab] OR drinks[tiab] OR beverage[tiab] OR beverages[tiab] OR tea[tiab] OR teas[tiab] OR soda[tiab] OR sodas[tiab])) OR "black tea"[tiab] OR "black teas"[tiab] OR "green tea"[tiab] OR "green teas"[tiab] coffee[tiab] OR coffees[tiab] OR espresso[tiab] OR caffeinism[tiab]	9,791

Concept	Strategy	Results
#3 Beverages with Stimulants	"Energy Drinks"[Mesh] OR ((energy[tiab] OR stimulant*[tiab] OR surge[tiab] OR sport[tiab] OR sports[tiab] OR prime[tiab] OR throttle[tiab] OR Celsius[tiab] OR "yerba mate"[tiab] OR "guarana"[tiab] OR kombucha[tiab] OR kombuchas[tiab]) AND (drink*[tiab] OR beverage[tiab] OR beverages[tiab] OR shot[tiab] OR shots[tiab]))	15,332
#4 Combining	#2 OR #3	24,628
#5 Combining	#1 AND #4	4,902
#6 Studies Only	#5 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	4,791
#7 Humans Only	#6 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	4,725
#8 Date Limiter: 2019	PubMed User Interface	1,345
Beverages with Additives and Supplements		
#1 Pediatrics (5–18 Age Range)	"Adolescent"[Mesh] OR "Child"[Mesh] OR "Child, Preschool"[Mesh] OR "Minors"[Mesh] OR "Pediatrics"[Mesh] OR "Puberty"[Mesh] OR adolescent[tiab] OR adolescents[tiab] OR adolescence[tiab] OR boy[tiab] OR boys[tiab] OR boyhood[tiab] OR child[tiab] OR childhood[tiab] OR children[tiab] OR "emerging adult"[tiab] OR "emerging adults"[tiab] OR girl[tiab] OR girls[tiab] OR girlhood[tiab] OR juvenile[tiab] OR juveniles[tiab] OR kid[tiab] OR kids[tiab] OR minors[tiab]OR preadolescent[tiab] OR preadolescents[tiab] OR preadolescence[tiab] OR puberty[tiab] OR pubescent[tiab] OR pubescence[tiab] OR prepubescent[tiab] OR prepubescence[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR Pediatrician[tiab] OR pediatricians[tiab] OR paediatrician[tiab] OR paediatricians[tiab] OR pediatric[tiab] OR pediatrics[tiab] OR paediatric[tiab] OR paediatrics[tiab] OR stepchild[tiab] OR stepchildren[tiab] OR schoolchild[tiab] OR schoolgirl[tiab] OR schoolgirls[tiab] OR schoolboy[tiab] OR schoolboys[tiab] OR "school age"[tiab] OR "school aged"[tiab] OR teen[tiab] OR teens[tiab] OR teenager[tiab] OR teenagers[tiab] OR teenaged[tiab] OR teenage[tiab] OR youth[tiab] OR youths[tiab] OR youngster[tiab] OR youngsters[tiab] OR "young person"[tiab] OR "young persons"[tiab] OR "young people"[tiab]	4,217,951
#2 Beverages with Additives & Supplements	(("Bioactive compound"[tiab] OR "bioactive compounds"[tiab] OR fiber[tiab] OR fibers[tiab] OR prebiotic[tiab] OR prebiotics[tiab] OR probiotics[tiab] OR probiotics[tiab] OR protein[tiab] OR proteins[tiab] OR peptide[tiab] OR peptides[tiab] OR "unsaturated fatty acid"[tiab] OR "unsaturated fatty acids"[tiab] OR mineral[tiab] OR minerals[tiab] OR vitamin[tiab] OR vitamins[tiab] OR hydration[tiab] OR sports[tiab] OR sport[tiab] OR "meal replacement"[tiab] OR "meal replacements"[tiab] OR smart[tiab] OR fortified[tiab] OR enhanced[tiab] OR functional[tiab] OR taurine[tiab] OR "L-carnitine"[tiab] OR stimulant[tiab]) AND (drink[tiab] OR drinks[tiab] OR beverage[tiab] OR beverages[tiab] OR shake[tiab] OR shakes[tiab]))	18,781
#3 Combining	#1 AND #2	3,112
#4 Studies Only	#5 NOT (Editorial[pt] OR Letter[pt] OR Case Reports[pt] OR Comment[pt] OR Congress[pt])	3,050
#5 Humans Only	#6 NOT (animals[MeSH Terms] NOT humans[MeSH Terms])	2,978
#6 Date Limiter: 2019	PubMed User Interface	914

Scoping Review Results and Included Studies

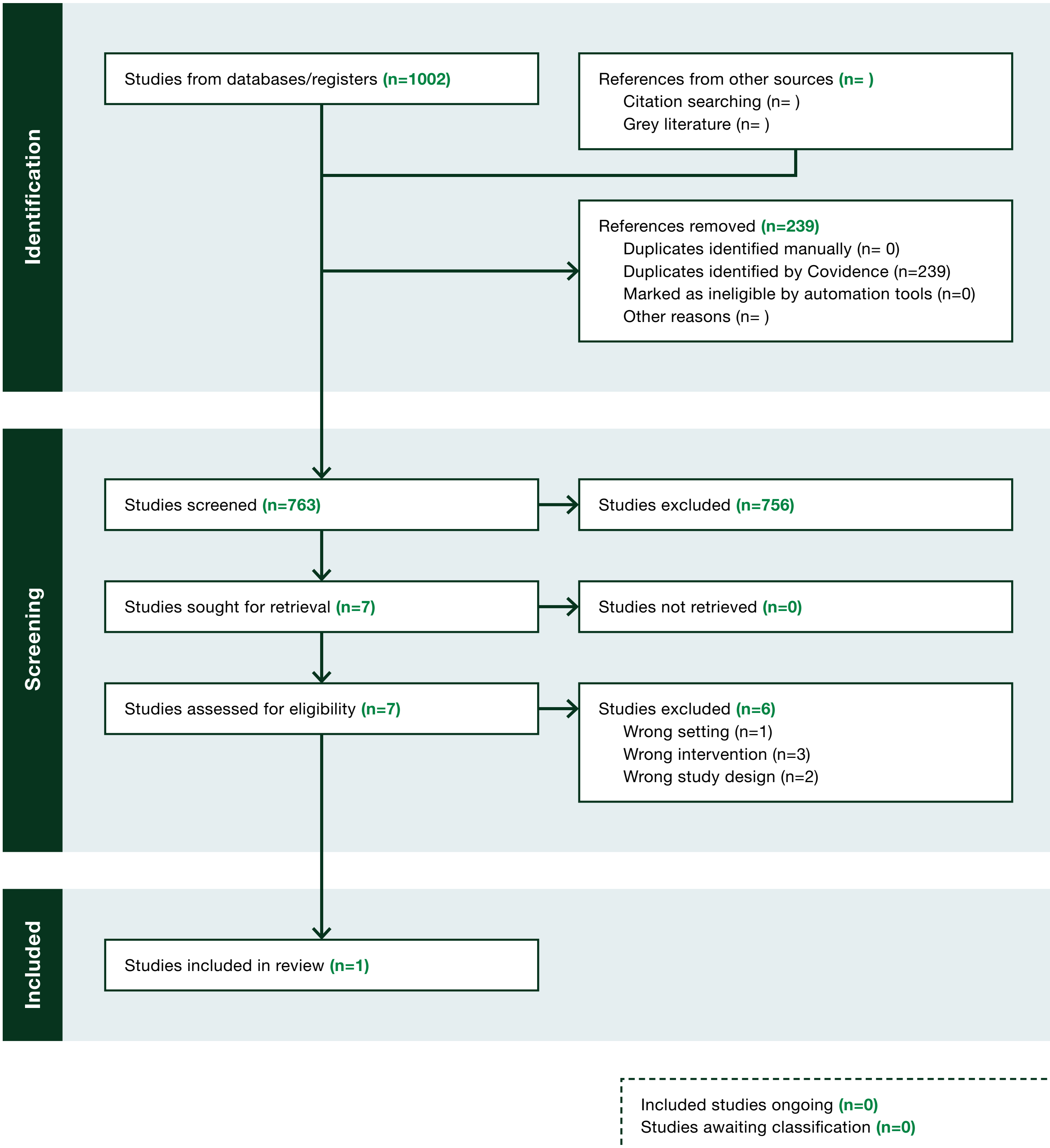
Appendix B includes PRISMA flow charts for each scoping review. **Table A3** provides a brief summary of included studies. See **Appendix C** for a full list of included studies with funding sources noted.

Table A3. Scoping Review Results

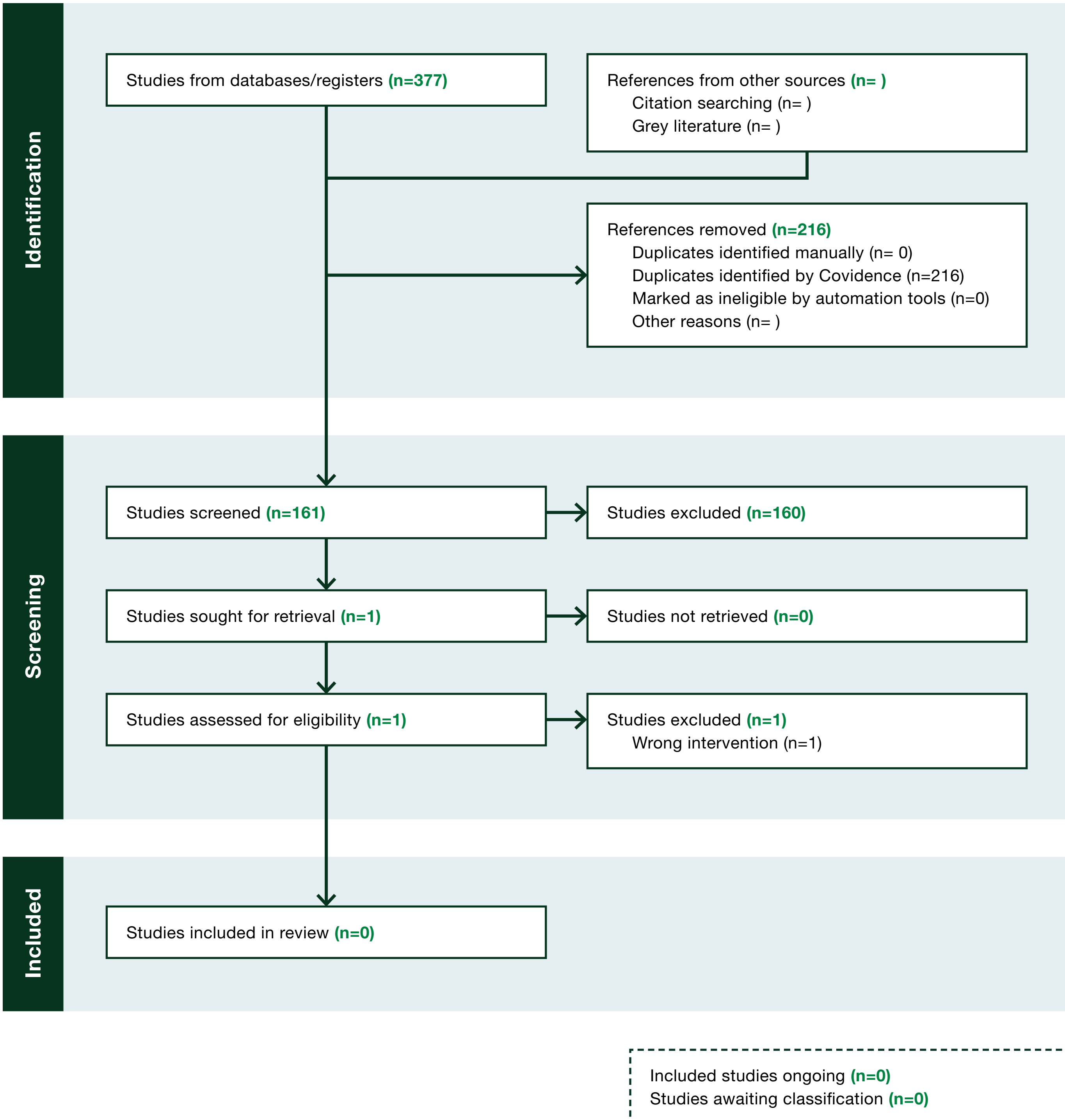
Beverage Type	Abstracts Screened	Full Text Review	Number of Included Studies
Carbonated Water	763	7	1
Flavored Water	161	1	0
Plant-Based Milk Alternatives	2129	18	6
Flavored Milk	96	30	14
Plain Milk/Fat Content	1457	52	23
100% Juice	1089	76	40
Non-Sugar Sweeteners	2777	66	21
Caffeine + Stimulants	3480	128	62
Additives + Supplements	1115	20	8

APPENDIX B. PRISMA FLOW CHARTS

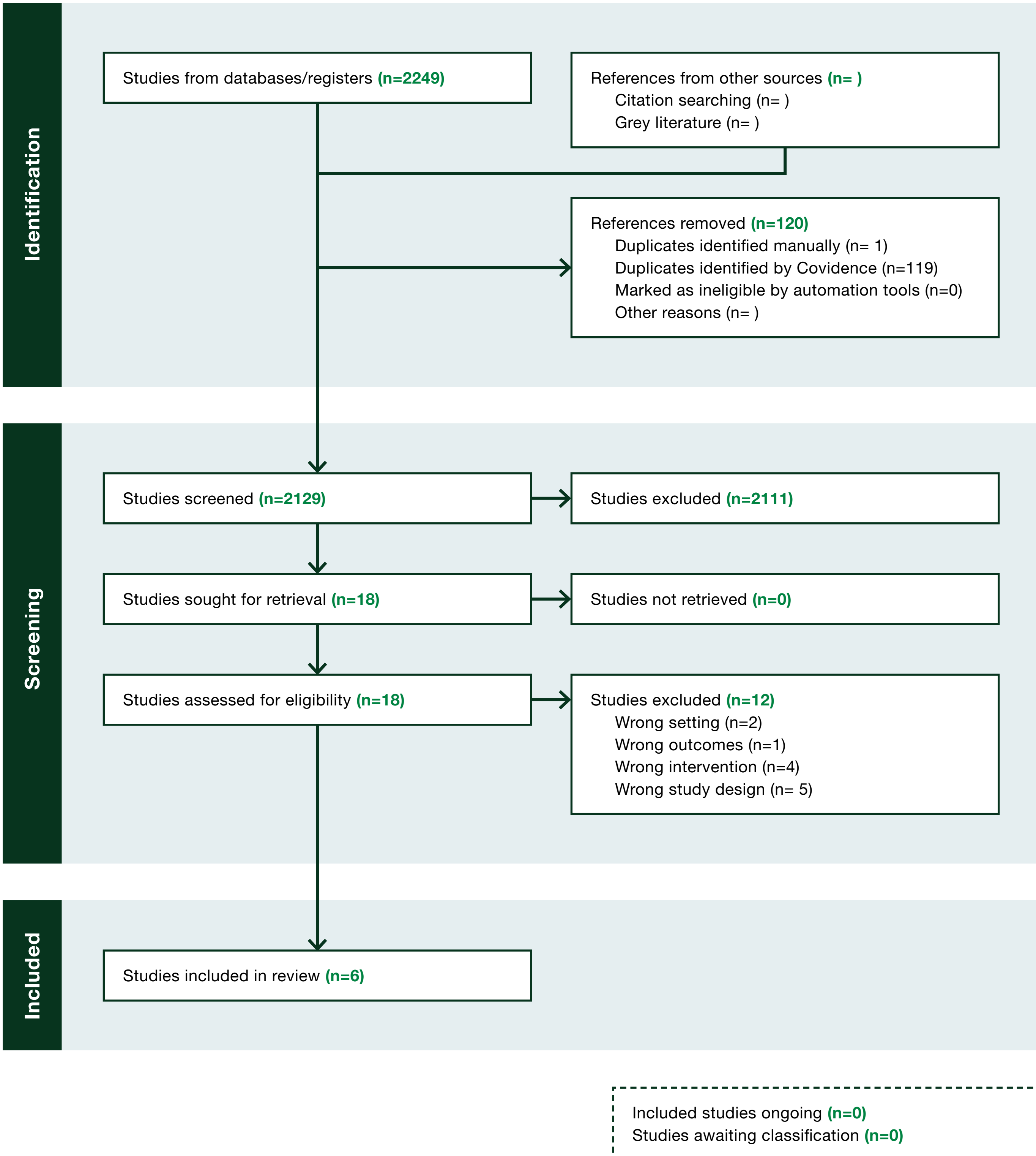
Carbonated Beverages



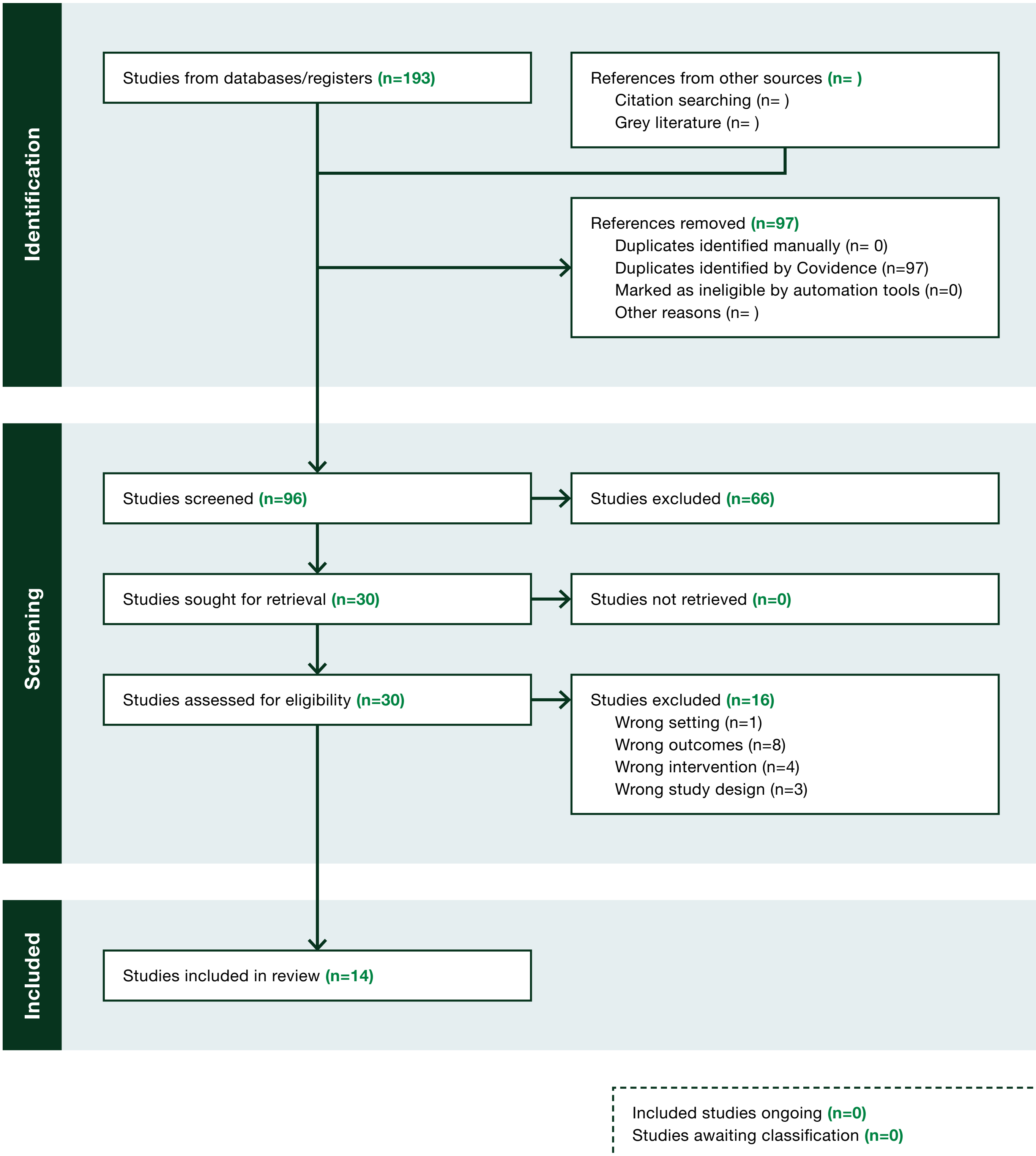
Flavored Water



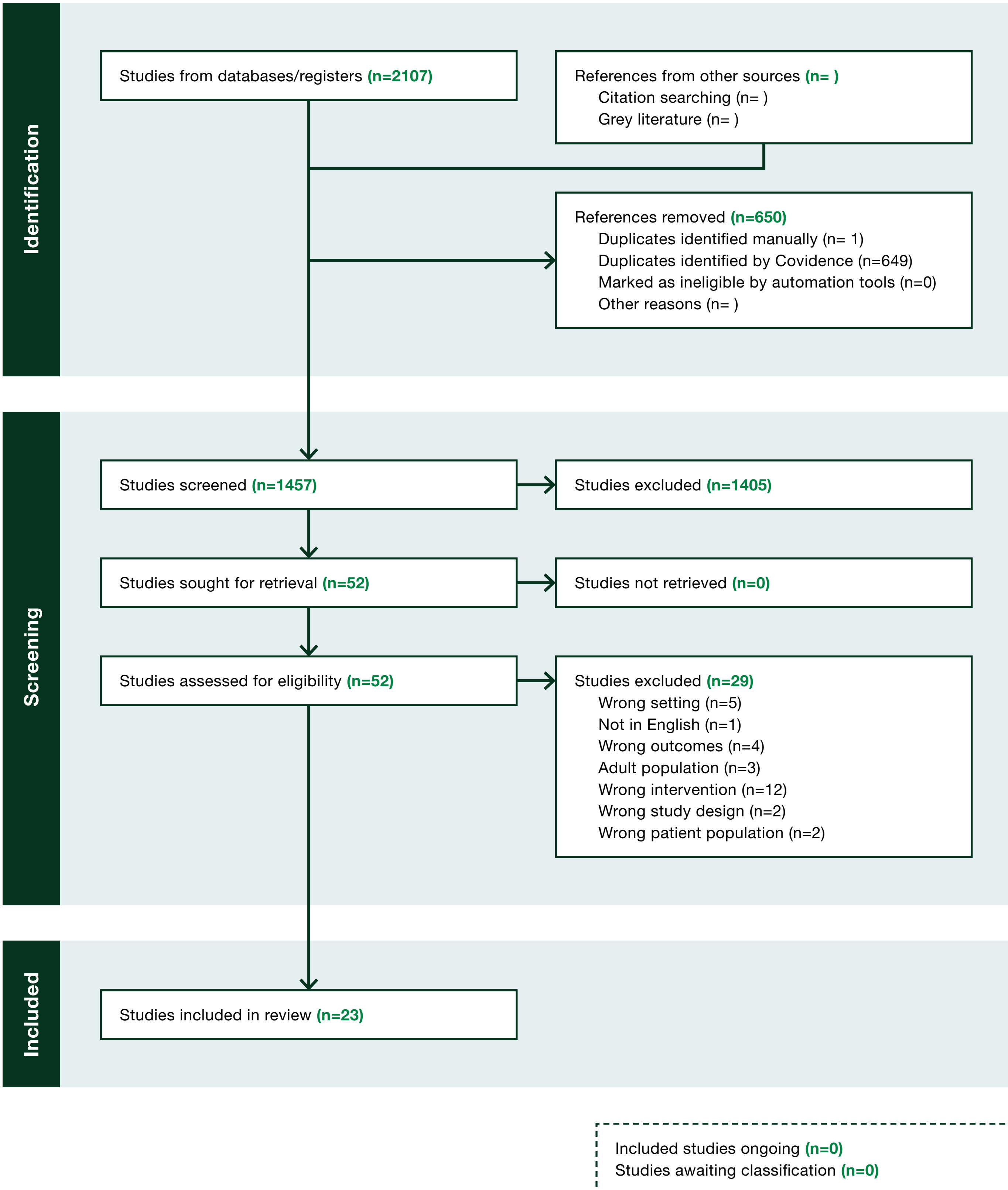
Plant-Based Milk Alternatives



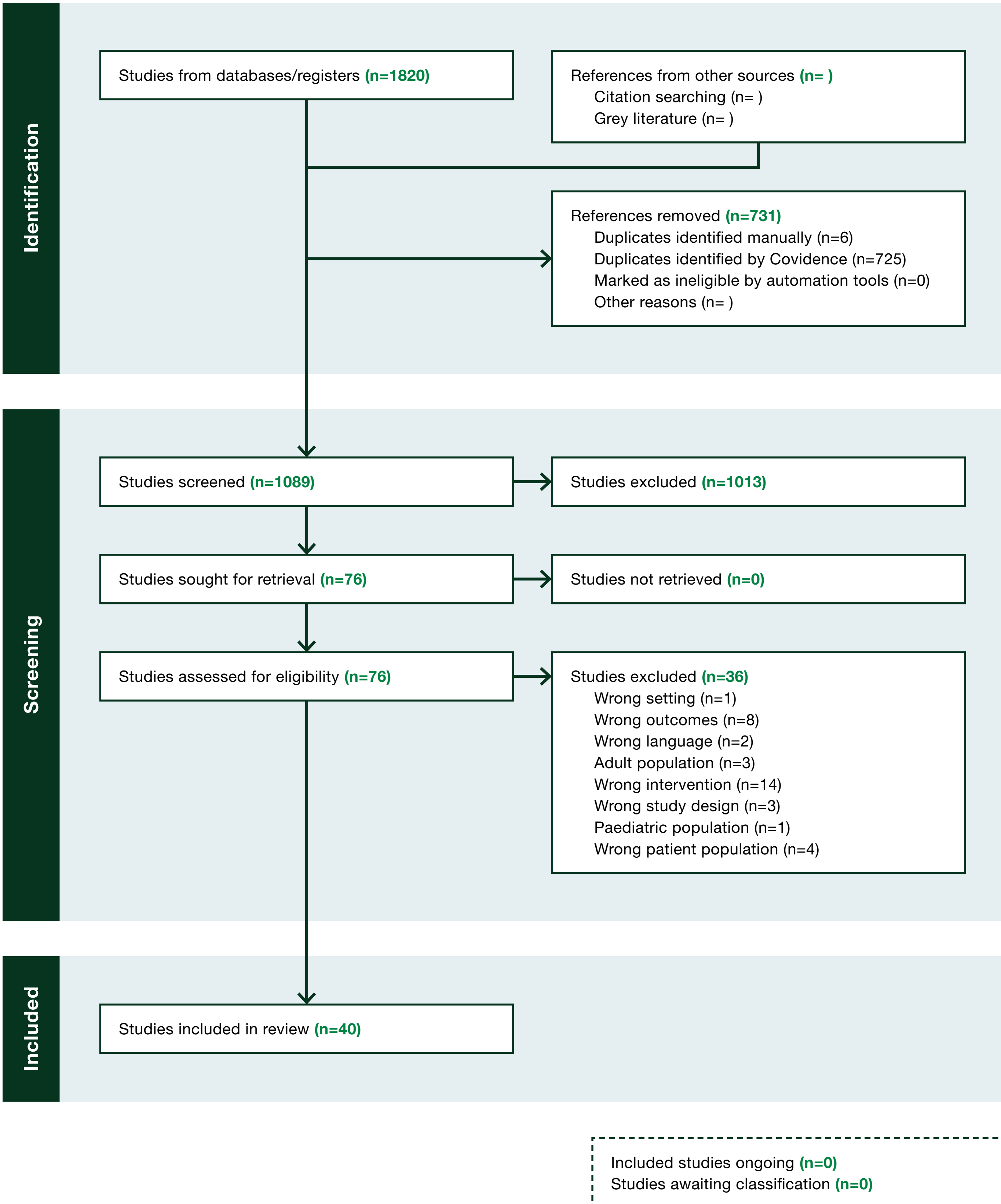
Flavored Milk



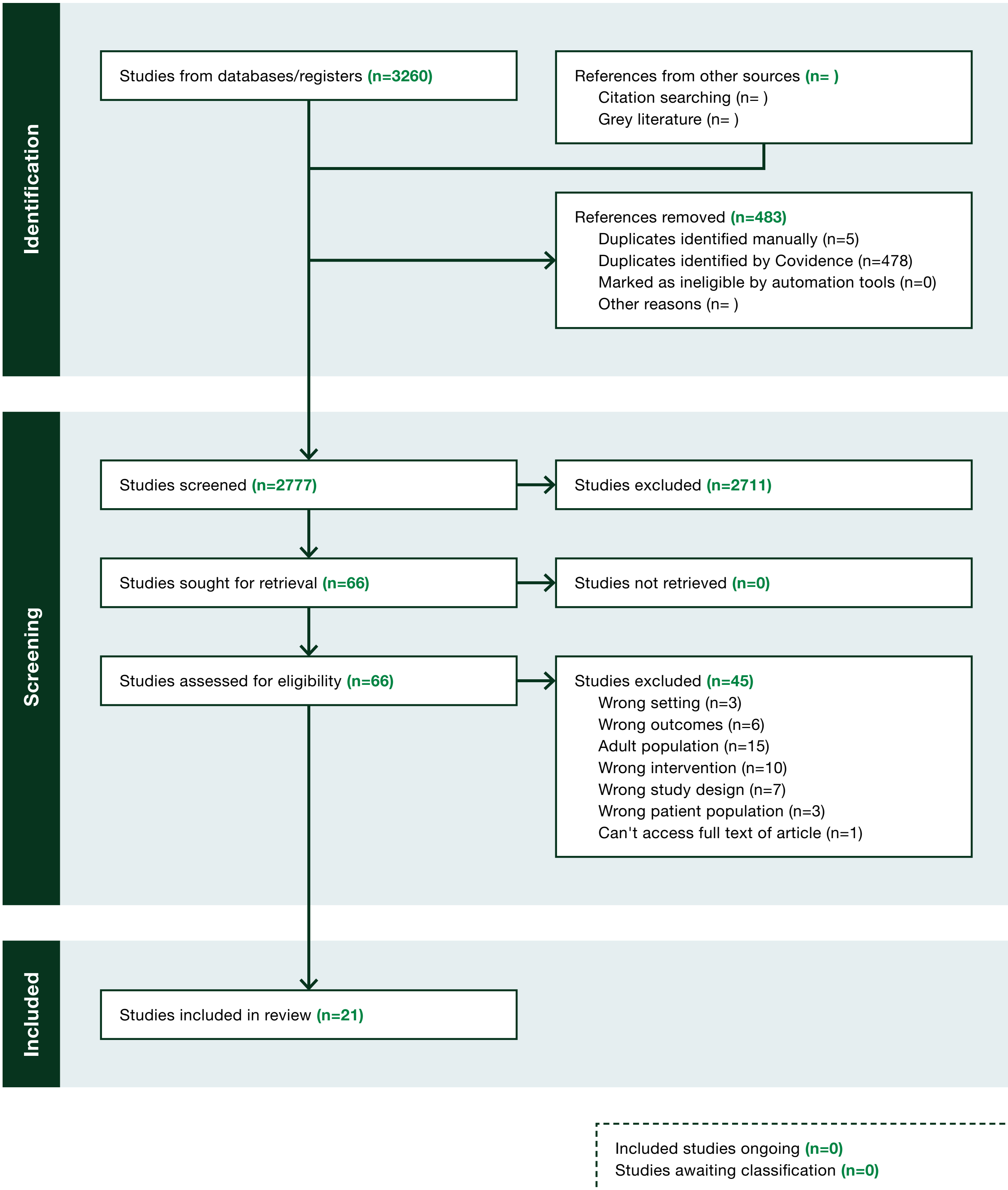
Plain Pasteurized Milk—Milk Fat



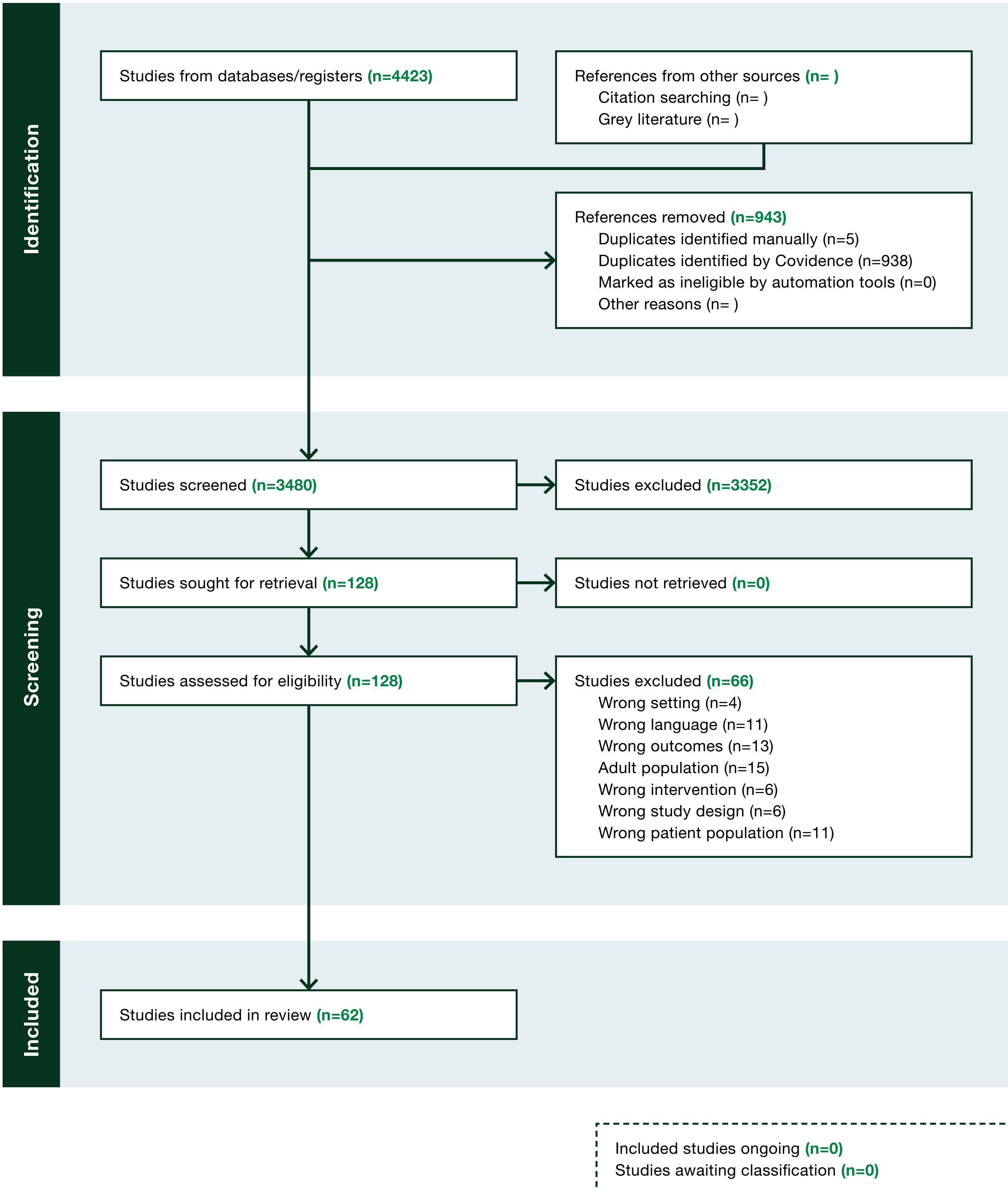
100% Juice


Identification
Studies from databases/registers (n=1820)
References from other sources (n=)
Citation searching (n=)
Grey literature (n=)
References removed (n=731)
Duplicates identified manually (n=6)
Duplicates identified by Covidence (n=725)
Marked as ineligible by automation tools (n=0)
Other reasons (n=)
Screening
Studies screened (n=1089)
Studies excluded (n=1013)
Studies sought for retrieval (n=76)
Studies not retrieved (n=0)
Studies assessed for eligibility (n=76)
Studies excluded (n=36)
Wrong setting (n=1)
Wrong outcomes (n=8)
Wrong language (n=2)
Adult population (n=3)
Wrong intervention (n=14)
Wrong study design (n=3)
Paediatric population (n=1)
Wrong patient population (n=4)
Included
Studies included in review (n=40)
Included studies ongoing (n=0)
Studies awaiting classification (n=0)

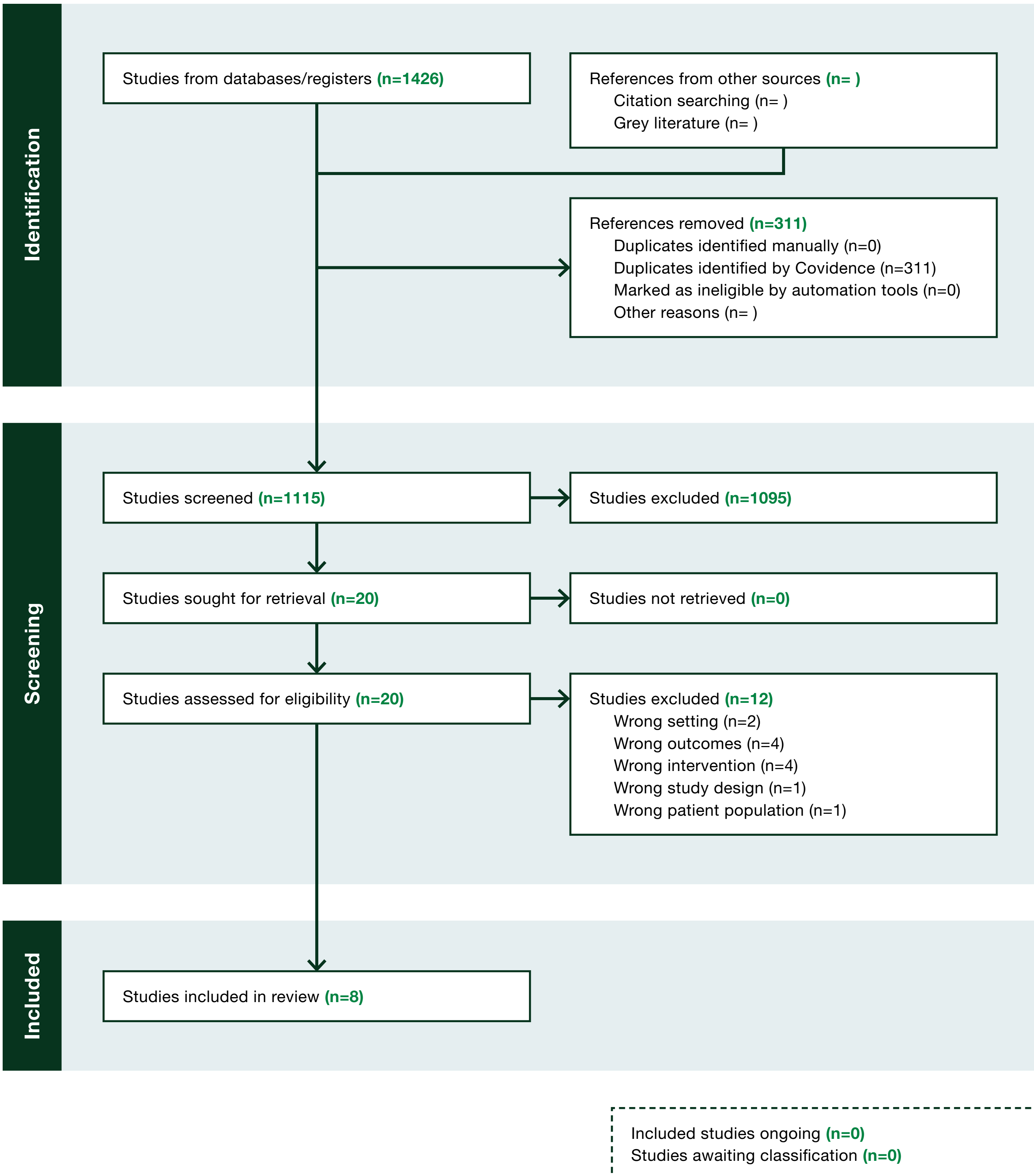
Beverages with Non-Sugar Sweeteners



Beverages with Caffeine and Other Stimulants



Beverages with Additives and Supplements



APPENDIX C. CITATIONS WITH FUNDING SOURCES

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Aghasi M, Golzarand M, Shab-Bidar S, Aminianfar A, Omidian M, Taheri F. Dairy intake and acne development: A meta-analysis of observational studies. Clin Nutr. 2019;38(3):1067-1075. doi:10.1016/j.clnu.2018.04.015	N/A	N/A	N/A	Milk fat (acne)
Ahmad SY, Friel JK, Mackay DS. Effect of sucralose and aspartame on glucose metabolism and gut hormones. Nutr Rev. 2020;78(9):725-746. doi:10.1093/nutrit/nuz099	N/A	S.Y.A. was supported by the Kuwait Civil Service and Institute for Medical Specialization and the Ministry of Health of Kuwait.	D.S.M. was an invited speaker at a seminar entitled “Conflicting Outcomes from Systematic Reviews: Is the Consumption of Low- Calorie Sweeteners a Benefit or a Risk for Weight Management?” at the American Society for Nutrition’s meeting Nutrition 2018 in Boston, Massachusetts, USA. He was sponsored by PepsiCo, which paid for his accommodation, conference fee, and honorarium. PepsiCo sells products that contain non-nutritive sweeteners. The other authors have no relevant interests to declare.	NSS (diabetes)
Ajibo C, Van Griethuysen A, Visram S, Lake AA. Consumption of energy drinks by children and young people: a systematic review examining evidence of physical effects and consumer attitudes. Public Health. 2024;227:274-281. doi:10.1016/j.puhe.2023.08.024	N/A	AVG received funding from the Council for Allied Health Professions Research North East hub small grant scheme for their time to work on this review.	N/A	Caffeine (diet quality, body weight, diabetes, CVD, oral health, cognitive function)
Albrecht JN, Werner H, Rieger N, et al. Association Between Homeschooling and Adolescent Sleep Duration and Health During COVID-19 Pandemic High School Closures. JAMA Netw Open. 2022;5(1):e2142100. doi:10.1001/jamanetworkopen.2021.42100	This work was supported by the Sleep and Health Clinical Research Priority Program of the University of Zurich (UZH) and the Children’s Research Center of the University Children’s Hospital Zurich (Ms Albrecht).	N/A	N/A	Caffeine (cognitive function)
Anderson JR, Gunstad J, Updegraff J, Sato A, Hagerdorn PL, Spitznagel MB. Biological sex and glucoregulation modulate postprandial cognition following dairy milk and fruit juice in healthy school-age children. Nutr Neurosci. 2020;23(5):374-383. doi:10.1080/1028415X.2018.1507963	This work was supported by the NationalDairy Council under Grant #2356.	N/A	MB Spitznagel serves on the Scientific Advisory Committee for Nutrition Research for the National Dairy Council.	Juice (diabetes, cognitive function)
Andrade L, Lee KM, Sylvetsky AC, Kirkpatrick SI. Low-calorie sweeteners and human health: a rapid review of systematic reviews. Nutr Rev. 2021;79(10):1145-1164. doi:10.1093/nutrit/nuaa123	This review was initially conducted under a contract with Health Canada and subsequently updated. The completion of the review was also supported by an Ontario Ministry of Research and Innovation Early Researcher Award to S.I.K.	N/A	N/A	NSS (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Antunes IC, Bexiga R, Pinto C, Roseiro LC, Quaresma MAG. Cow's Milk in Human Nutrition and the Emergence of Plant-Based Milk Alternatives. Foods. 2022;12(1):99. doi:10.3390/foods12010099	This research was funded by FCT, Fundação para a Ciência e Tecnologia IP, under grant UIDB/00276/2020, and PhD scholarship, under grant SFRH/BD/136921/2018; and the Associate Laboratory for Animal and Veterinary Sciences, LA/P/0059/2020, AL4AnimalS.	N/A	N/A	Plant milk (diet quality)
Babio N, Becerra-Tomás N, Nishi SK, et al. Total dairy consumption in relation to overweight and obesity in children and adolescents: A systematic review and meta-analysis. Obes Rev. 2022;23 Suppl 1:e13400. doi:10.1111/obr.13400	Ministerio de Ciencia, Innovación y Universidades; Canadian Institutes of Health Research; European Regional Development Fund; Instituto de Salud Carlos III	N/A	Dr. Nancy Babio declares that she received grant support through his institution from Danone S.A. but not for preparing this study. In addition, she was one of the members of the Scientific Advisory Board of the EU program for the promotion of milk and milk products within the framework of appropriate dietary practices (2017–2019). Dr. Nerea Becerra-Tomás declares that she received grant support through her institution from Danone S.A. Dr. Stephanie K. Nishi is a volunteer member of the not-for-profit organization Plant-Based Canada. Professor Jordi Salas-Salvado declares that he is a member of the Danone Institute Spain and that he received payments from Danone S.A. for the purposes of scientific and technical consulting but not for preparing this study. He has received personal consulting fees from Eroski and Mundipharma and has received grant support through his institution from the Nut and Dried Fruit Foundation and Eroski. The other authors declare that they have no conflicts of interest.	Milk fat (body weight)
Barajas-Torres GC, Klünder-Klünder M, Garduño-Espinosa J, Parra-Ortega I, Franco-Hernández MI, Miranda-Lora AL. Effects of Carbonated Beverage Consumption on Oral pH and Bacterial Proliferation in Adolescents: A Randomized Crossover Clinical Trial. Life (Basel). 2022;12(11):1776. doi:10.3390/life12111776	This research was funded by Federal Funds HIM 2017-084 SSA 1411.	N/A	N/A	Carbonated water (oral health) NSS (oral health)
Barfoot KL, May G, Lamport DJ, Ricketts J, Riddell PM, Williams CM. The effects of acute wild blueberry supplementation on the cognition of 7-10-year-old schoolchildren. Eur J Nutr. 2019;58(7):2911-2920. doi:10.1007/s00394-018-1843-6	South East Doctoral Training Centre and the Wild Blueberry Association. This work is part of an ESRC Case funded studentship.	N/A	N/A	Additives (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Barretto JR, Gouveia MADC, Alves C. Use of dietary supplements by children and adolescents. J Pediatr (Rio J). 2024;100 Suppl 1(Suppl 1):S31-S39. doi:10.1016/j.jped.2023.09.008	N/A	N/A	N/A	Additives (body weight, diabetes, bone density, cognitive function)
Beckett EL, Fayet-Moore F, Cassettari T, Starck C, Wright J, Blumfield M. Health effects of drinking 100% juice: an umbrella review of systematic reviews with meta-analyses. Nutr Rev. Published online April 29, 2024. doi:10.1093/nutrit/nuae036	This study received funding from Ausveg and Hort Innovation, research grant no. CT21004.	N/A	All authors independently work for or collaborate with FOODiQ Global (formerly Nutrition Research Australia), which gains funding for projects from government, not-for-profits, professional, community, and industry organizations. The funding body, Hort Innovation, provided general feedback on the broad study topic; however, it had no contribution to the final methodology, implementation, or interpretation of results, or drafting of the manuscript.	Juice (body weight, CVD)
Benton D, Young HA. Role of fruit juice in achieving the 5-a-day recommendation for fruit and vegetable intake [published correction appears in Nutr Rev. 2020 Mar 1;78(3):260. doi: 10.1093/nutrit/nuz084]. Nutr Rev. 2019;77(11):829-843. doi:10.1093/nutrit/nuz031	No external funding was received to support this work. The support of Swansea University while this paper was developed is gratefully acknowledged.	N/A	D.B. has served on the scientific advisory board of the European Fruit Juice Association although they had no role in any aspect of this work including its conception, review, or approval.	Juice (diet quality, body weight)
Brahmbhatt V. Caffeine and Sleep in East Tennessee students. Published online November 5, 2022. doi:10.1101/2022.11.04.22281900	N/A	N/A	N/A	Caffeine (cognitive function)
Bunch KT, Peterson MB, Smith MB, Bunch TJ. An Overview of the Risks of Contemporary Energy Drink Consumption and Their Active Ingredients on Cardiovascular Events. Curr Cardiovasc Risk Rep. 2023;17(3):39-48. doi:10.1007/s12170-023-00716-3	N/A	N/A	N/A	Caffeine (CVD, cognitive function)
Carman KB, Aslantaş D, Dinleyici M, Ünsal A, Aygar H, Akbulut S, Atalay B, Soysal A, Dağtekin G, Aydoğan S. The Prevalence of Energy Drink Consumption Among High School Students; Evaluation of the Effects on Perceived Stress and Sleep Quality. Türkiye Çocuk Hast Derg. 2021;15(1):12-8. doi:10.12956/tchd.628406	N/A	N/A	N/A	Caffeine (cognitive function)
Champilomati G, Notara V, Prapas C, et al. Breakfast consumption and obesity among preadolescents: An epidemiological study. Pediatr Int. 2020;62(1):81-88. doi:10.1111/ped.14050	N/A	N/A	N/A	Flavored milk (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Cooper RK, Lawson SC, Tonkin SS, Ziegler AM, Temple JL, Hawk LW. Caffeine enhances sustained attention among adolescents. Exp Clin Psychopharmacol. 2021;29(1):82-89. doi:10.1037/pha0000364	College of Arts and Sciences, University at Buffalo	A discretionary research fund was provided to Larry W. Hawk Jr. by the College of Arts and Sciences, University at Buffalo	N/A	Caffeine (cognitive function)
Cui A, Xiao P, He J, et al. Association between caffeine consumption and bone mineral density in children and adolescent: Observational and Mendelian randomization study. PLoS One. 2023;18(6):e0287756. doi:10.1371/journal.pone.0287756	Shaanxi Provincial Department of Science and Technology, Innovative Talents Promotion Plan - Youth Science and Technology Star Project (2021KJXX-57)	N/A	N/A	Caffeine (bone density)
Cusick CN, Langberg JM, Breaux R, Green CD, Becker SP. Caffeine Use and Associations With Sleep in Adolescents With and Without ADHD. J Pediatr Psychol. 2020;45(6):643-653. doi:10.1093/jpepsy/jsaa033	This work was supported by the Institute of Education Sciences, U.S. Department of Education (grant number R305A160126).	Dr. Stephen Becker is supported by the National Institute of Mental Health (grant number K23MH108603).	N/A	Caffeine (cognitive function)
Czarnecka K, Pilarz A, Rogut A, et al. Aspartame-True or False? Narrative Review of Safety Analysis of General Use in Products. Nutrients. 2021;13(6):1957. doi:10.3390/nu13061957	N/A	N/A	N/A	NSS (body weight)
Dalenberg JR, Patel BP, Denis R, et al. Short-Term Consumption of Sucralose with, but Not without, Carbohydrate Impairs Neural and Metabolic Sensitivity to Sugar in Humans. Cell Metab. 2020;31(3):493-502.e7. doi:10.1016/j.cmet.2020.01.014	This work was funded by NIH NIDCDR01 DC006706.	N/A	N/A	NSS (taste preference)
Damanhoury S, Morrison KM, Mian R, et al. Metabolically healthy obesity in children enrolled in the CANadian Pediatric Weight management Registry (CANPWR): An exploratory secondary analysis of baseline data. Clin Obes. 2022;12(1):e12490. doi:10.1111/cob.12490	The CANPWR study was supported by the Canadian Institutes of Health Research and the Heart and Stroke Foundation of Canada (CIHR; CANNeCTIN Pilot Project, grant number 120287 and MOP grant number FRN 123505 to KMM) and the MAC Obesity Research program funded by McMaster Children's Hospital and McMaster University (Hamilton, ON, Canada).	SD was supported by a scholarship from Umm AlQura University, Makkah; Kingdom of Saudi Arabia. GDCB was supported by an Alberta Health Services Chair in Obesity Research.	KMM reports consultant fees from Novo Nordisk Canada Inc. and Alcea Therapeutics Canada, outside of the submitted work. JH reports consulting fees from Novo Nordisk Canada Inc., outside of the submitted work. GDCB reports consulting fees from Novo Nordisk Canada Inc., outside of the submitted work. All other authors have no conflicts of interest.	Milk fat (body weight, CVD)
Dineva M, Rayman MP, Bath SC. Iodine status of consumers of milk-alternative drinks v. cows' milk: data from the UK National Diet and Nutrition Survey. Br J Nutr. 2021;126(1):28-36. doi:10.1017/S0007114520003876	This work was supported by the Faculty of Health and Medical Sciences at the University of Surrey, UK. The funder had no role in the design, analysis or writing of this article.	N/A	S. C. B. has received an honorarium from Oatly UK and Dairy UK for delivering webinars/online videos for Healthcare Professionals.	Plant milk (diet quality)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Dougkas A, Barr S, Reddy S, Summerbell CD. A critical review of the role of milk and other dairy products in the development of obesity in children and adolescents. Nutr Res Rev. 2019;32(1):106-127. doi:10.1017/S0954422418000227	A funding contribution and information on the nutrient composition and consumption trends of dairy products were provided by The Dairy Council	N/A	N/A	Milk fat (body weight)
Duke NN. Youth Beverage Intake and Reported Prediabetes: Choice and Frequency Matter. J Pediatr Health Care. 2021;35(2):216-225. doi:10.1016/j.pedhc.2020.10.005	N/A	N/A	N/A	Juice (diabetes)
Erdmann J, Wiciński M, Wódkiewicz E, et al. Effects of Energy Drink Consumption on Physical Performance and Potential Danger of Inordinate Usage. Nutrients. 2021;13(8):2506. doi:10.3390/nu13082506	N/A	N/A	N/A	Caffeine (diet quality, body weight, diabetes, CVD, oral health, cognitive function)
Fayet-Moore F, Cassettari T, McConnell A, Kim J, Petocz P. Australian children and adolescents who were drinkers of plain and flavored milk had the highest intakes of milk, total dairy, and calcium. Nutr Res. 2019;66:68-81. doi:10.1016/j.nutres.2019.03.001	Funding for the data analyses, writing, and submission of the manuscript was provided by Nestlé Research (Verschez-les-Blanc, Lausanne, Switzerland).	FFM, TC, AM, and PP received monetary compensation from the funder for their contribution to the manuscript.	JK is employed by Nestlé Australia Ltd.	Flavored milk (diet quality)
Feldmann A, Eidt G, Henz SL, Arthur RA. Probiotics-containing beverages and dental caries: A systematic review and meta-analysis. Eur J Oral Sci. 2024;132(3):e12980. doi:10.1111/eos.12980	N/A	Improvement of Higher Education Personnel (CAPES) which conceived a scholarship to AF (number 88887.474197/2020-00) and to GE (number 88882.181910/2018-01).	N/A	Additives (oral health)
Galland BC, de Wilde T, Taylor RW, Smith C. Sleep and pre-bedtime activities in New Zealand adolescents: differences by ethnicity. Sleep Health. 2020;6(1):23-31. doi:10.1016/j.sleh.2019.09.002	N/A	Tanja de Wilde was supported by the Department of Women's and Children's Health, University of Otago Summer Scholarship.	Rachael Taylor is in receipt of the KPS Fellowship in Early Childhood Obesity.	Caffeine (cognitive function)
Garduño-Picazo MG, Ruiz-Ramos M, Juárez-López M. Dental Erosion Risk Factors in 6 to 12 Year Old children in Mexico City. J Clin Pediatr Dent. 2020;44(2):95-99. doi:10.17796/1053-4625-44.2.5	N/A	N/A	N/A	Juice (oral health) Additives (oral health)
Ghazal TS, Levy SM, Childers NK, et al. Survival analysis of caries incidence in African-American school-aged children. J Public Health Dent. 2019;79(1):10-17. doi:10.1111/jphd.12289	The National Institute of Dental and Craniofacial Research grant: R01-DE016684 supported this study.	N/A	N/A	Juice (oral health)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Gil H, Chen QY, Khil J, et al. Milk Intake in Early Life and Later Cancer Risk: A Meta-Analysis. Nutrients. 2022;14(6):1233. doi:10.3390/nu14061233	N/A	Q.-Y.C. and J.K. are funded by the 2021 BK21-plus education program from the National Research Foundation of Korea	N/A	Milk fat (cancer)
González-Aragón Pineda ÁE, Borges-Yáñez SA, Irigoyen-Camacho ME, Lussi A. Relationship between erosive tooth wear and beverage consumption among a group of schoolchildren in Mexico City. Clin Oral Investig. 2019;23(2):715-723. doi:10.1007/s00784-018-2489-8	This research was partially funded by the National Council of Science and Technology (Consejo Nacional de Ciencia y Tecnología, CONACYT).	N/A	N/A	Juice (oral health)
Gutierrez E, Metcalfe JJ, Prescott MP. The Relationship between Fluid Milk, Water, and 100% Juice and Health Outcomes among Children and Adolescents. Nutrients. 2022;14(9):1892. doi:10.3390/nu14091892	This research was funded by HATCH ILLU-698-315 from the United States Department of Agriculture National Institute of Food and Agriculture	N/A	N/A	Milk fat (diet quality, body weight, bone density) Flavored milk (body weight, diet quality) Juice (diet quality, body weight)
Halldorsson TI, Kristjansson AL, Thorisdottir I, et al. Caffeine exposure from beverages and its association with self-reported sleep duration and quality in a large sample of Icelandic adolescents. Food Chem Toxicol. 2021;157:112549. doi:10.1016/j.fct.2021.112549	N/A	N/A	N/A	Caffeine (cognitive function)
Hunter SR, Reister EJ, Cheon E, Mattes RD. Low Calorie Sweeteners Differ in Their Physiological Effects in Humans. Nutrients. 2019;11(11):2717. doi:10.3390/nu11112717	N/A	N/A	N/A	NSS (body weight)
Islam N, Shafiee M, Vatanparast H. Trends in the consumption of conventional dairy milk and plant-based beverages and their contribution to nutrient intake among Canadians. J Hum Nutr Diet. 2021;34(6):1022-1034. doi:10.1111/jhn.12910	This work was sup- ported by the Dairy Farmers of Canada.	N/A	N/A	Plant milk (diet quality)
Iyer A, Hsu FC, Bonnecaze A, Skelton JA, Palakshappa D, Lewis KH. Association Between Child Sugary Drink Consumption and Serum Lipid Levels in Electronic Health Records. Clin Pediatr (Phila). 2024;63(7):893-901. doi:10.1177/00099228231200405	This research was supported through a grant from Healthy Eating Research, a national program of the Robert Wood Johnson Foundation (grant no 74370)	Dr. Palakshappa is supported by the National Heart, Lung, and Blood Institute of the National Institutes of Health under Award Number K23HL146902.	N/A	Juice (CVD)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Jakobsen DD, Brader L, Bruun JM. Effects of foods, beverages and macronutrients on BMI z-score and body composition in children and adolescents: a systematic review and meta-analysis of randomized controlled trials. Eur J Nutr. 2023;62(1):1-15. doi:10.1007/s00394-022-02966-0	The authors have received an unrestricted grant from Arla Foods Amba.	N/A	The second author (LB) is affiliated with Arla Foods Amba; however, she was only involved in the study selection and data extraction process if there were any doubts or discrepancies between the first and third author.	NSS (body weight)
Jansen EC, Corcoran K, Perng W, et al. Relationships of beverage consumption and actigraphy-assessed sleep parameters among urban-dwelling youth from Mexico. Public Health Nutr. Published online July 30, 2021. doi:10.1017/S136898002100313X	This work was supported by the US Environmental Protection Agency (US EPA) grant RD83543601 and National Institute for Environmental Health Sciences grants P01 ES02284401, R01 ES007821, R01 ES014930, R01 ES013744 and P30 ES017885. This study was also supported and partially funded by the National Institute of Public Health/Ministry of Health of Mexico.	Dr. Jansen reports support from the National Institute of Diabetes and Digestive and Kidney Diseases grant T32DK071212 and the National Institutes of Health/ National Heart, Lung, and Blood Institute grant T32HL110952 during the conduct of the study.	N/A	Juice (cognitive function) Caffeine (cognitive function)
Jessel CD, Narang A, Zuberi R, Bousman CA. Sleep Quality and Duration in Children That Consume Caffeine: Impact of Dose and Genetic Variation in ADORA2A and CYP1A. Genes (Basel). 2023;14(2):289. doi:10.3390/genes14020289	This research was funded by an Alberta Innovates Summer Research Studentship.	N/A	N/A	Caffeine (cognitive function)
Jones JC, Sugimoto D, Kobelski GP, et al. Parameters of cardiac symptoms in young athletes using the Heartbytes database. Phys Sportsmed. 2021;49(1):37-44. doi:10.1080/00913847.2020.1755908	N/A	N/A	N/A	Caffeine (CVD)
Kakleas K, Christodouli F, Karavanaki K. Nonalcoholic fatty liver disease, insulin resistance, and sweeteners: a literature review. Expert Rev Endocrinol Metab. 2020;15(2):83-93. doi:10.1080/17446651.2020.1740588	N/A	N/A	N/A	NSS (body weight)
Kaldenbach S, Leonhardt M, Lien L, Bjærtnes AA, Strand TA, Holten-Andersen MN. Sleep and energy drink consumption among Norwegian adolescents - a cross-sectional study. BMC Public Health. 2022;22(1):534. doi:10.1186/s12889-022-12972-w	This study was funded by Innlandet Hospital Trust (project number: 150377).	N/A	N/A	Caffeine (cognitive function)
Kanellopoulou A, Kosti RI, Notara V, et al. The Role of Milk on Children's Weight Status: An Epidemiological Study among Preadolescents in Greece. Children (Basel). 2022;9(7):1025. doi:10.3390/children9071025	N/A	N/A	N/A	Flavored milk (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Khouja C, Kneale D, Brunton G, et al. Consumption and effects of caffeinated energy drinks in young people: an overview of systematic reviews and secondary analysis of UK data to inform policy. BMJ Open. 2022;12(2):e047746. doi:10.1136/ bmjopen-2020-047746	This overview and secondary data analysis was funded by the National Institute for Health Research (NIHR) Policy Research Programme (PRP) for the Department of Health and Social Care (DHSC). It was funded through the NIHR PRP contract with the EPPI Centre at UCL (Reviews facility to support national policy development and implementation, PR-R6-0113-11003).	N/A	N/A	Caffeine (CVD, cognitive function)
Kim H, Park J, Lee S, Lee SA, Park EC. Association between energy drink consumption, depression and suicide ideation in Korean adolescents. Int J Soc Psychiatry. 2020;66(4):335-343. doi:10.1177/0020764020907946	N/A	N/A	N/A	Caffeine (cognitive function)
Kim K, Melough MM, Kim D, et al. Nutritional Adequacy and Diet Quality Are Associated with Standardized Height-for-Age among U.S. Children. Nutrients. 2021;13(5):1689. doi:10.3390/ nu13051689	N/A	N/A	N/A	Juice (body weight)
Korkmaz E, Kaptan A. Cross-Sectional Analysis of Prevalence and Aetiological Factors of Dental Erosion in Turkish Children Aged 7-14 Years. Oral Health Prev Dent. 2020;18:959-971. doi:10.3290/j.ohpd.a45436	Korkmaz E, Kaptan A. Cross-Sectional Analysis of Prevalence and Aetiological Factors of Dental Erosion in Turkish Children Aged 7-14 Years. Oral Health Prev Dent. 2020;18:959-971. Published 2020 Oct 27. doi:10.3290/j. ohpd.a45436	N/A	N/A	Juice (oral health)
Korkmaz E, Kaptan A. Cross-Sectional Analysis of Prevalence and Aetiological Factors of Dental Erosion in Turkish Children Aged 7-14 Years. Oral Health Prev Dent. 2020;18:959-971. doi:10.3290/j.ohpd.a45436	This work was supported by the Scientific Research Project Fund Sivas Cumhuriyet University [Grant number DIS-212].	N/A	N/A	Caffeine (oral health)
Kristjansson AL, Kogan SM, James JE, Sigfusdottir ID. Adolescent caffeine consumption and aggressive behavior: A longitudinal assessment. Subst Abus. 2021;42(4):450-453. doi:10.1080/08897077.2021.1876810	This work was supported by the European Research Council [ERC- CoG-2014-647860].	N/A	N/A	Caffeine (cognitive function)
Kucab M, Bellissimo N, Prusky C, Brett NR, Totosy de Zepetnek JO. Effects of a high-intensity interval training session and chocolate milk on appetite and cognitive performance in youth aged 9-13 years. Eur J Clin Nutr. 2021;75(1):172-179. doi:10.1038/ s41430-020-00718-z	This study was funded by a Ryerson Health Research Fund and Ryerson Faculty of Community Services Seed grant to NB and JTdeZ.	N/A	N/A	Flavored milk (diet quality)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Kummer K, Jensen PN, Kratz M, et al. Full-Fat Dairy Food Intake is Associated with a Lower Risk of Incident Diabetes Among American Indians with Low Total Dairy Food Intake. J Nutr. 2019;149(7):1238-1244. doi:10.1093/jn/nxz058	The Strong Heart Family Study (SHFS) is supported by the National Heart, Lung, and Blood Institute cooperative agreement grants U01 HL65520, U01 HL41642, U01 HL41652, U01 HL41654, U01 HL65521, and R01HL109301.	AMF is supported by grant 5KL2TR000421. MK has received reimbursements for travel, honoraria, and a research grant from dairy-related organizations	N/A	Milk fat (diabetes)
Kwon M, Kim H, Yang J, et al. Caffeinated Soda Intake in Children Is Associated with Neurobehavioral Risk Factors for Substance Misuse. Subst Use Misuse. 2024;59(1):79-89. doi:10.1080/10826084.2023.2259471	This work was supported by the Basic Science Research Program through the National Research Foundation (NRF) of Korea funded by the Ministry of Science, ICT, & Future Planning (NRF-2018R1C1B3007313 and NRF-2018R1A4A1025891); the Institute for Information & Communications Technology Planning & Evaluation (IITP) grant funded by the Korea government (MSIT) (No. 2019-0-01367, BabyMind); the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No. 2021M3E5D2A0102249311); and the Creative-Pioneering Researchers Program and the Convergence Research Grant through Seoul National University to W.-Y.A.	N/A	N/A	Caffeine (cognitive function)
Laamanen SE, Eloranta AM, Haapala EA, Sallinen T, Schwab U, Lakka TA. Associations of diet quality and food consumption with serum biomarkers for lipid and amino acid metabolism in Finnish children: the PANIC study. Eur J Nutr. 2024;63(2):623-637. doi:10.1007/s00394-023-03293-8	Open access funding provided by University of Eastern Finland (including Kuopio University Hospital). The PANIC study has been supported financially by grants from Ministry of Education and Culture of Finland, Ministry of Social Affairs and Health of Finland, Academy of Finland, Research Committee of the Kuopio University Hospital Catchment Area (State Research Funding), Finnish Innovation Fund Sitra, Social Insurance Institution of Finland, Finnish Cultural Foundation, Foundation for Paediatric Research, Diabetes Research Foundation in Finland, Finnish Foundation for Cardiovascular Research, Juho Vainio Foundation, Paavo Nurmi Foundation, Yrjö Jahnsson Foundation, and the city of Kuopio. The funding sources have not been involved in designing the study, collecting the data, analyzing the data, interpreting the results, writing the manuscript, or deciding to submit the paper for publication.	N/A	N/A	Milk fat (diet quality, CVD)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Lahoz-García N, Milla-Tobarra M, García-Hermoso A, Hernández-Luengo M, Pozuelo-Carrascosa DP, Martínez-Vizcaíno V. Associations between Dairy Intake, Body Composition, and Cardiometabolic Risk Factors in Spanish Schoolchildren: The Cuenca Study. Nutrients. 2019;11(12):2940. doi:10.3390/nu11122940	Movi 2 was funded by the Ministry of Education and Science- Junta de Comunidades de Castilla-La Mancha (grant numbers PII1I09-0259-9898, POII10-0208-5325); Ministry of Health (grant number FIS PI081297); and the Research Network on Preventative Activities and Health Promotion (grant number RD06/0018/0038). This research was funded by FEDER funds.	N/A	N/A	Milk fat (body weight, CVD)
Leal WE, Jackson DB, Boccio CM. Adolescent Energy Drink Consumption and Academic Risk: Results From the Monitoring the Future Study, 2010-2016. Health Educ Behav. 2022;49(2):281-290. doi:10.1177/10901981211043118	This research was partially supported by a Summer Faculty Research Fellowship from Texas A&M University–San Antonio.	N/A	N/A	Caffeine (cognitive function)
Li A, Han X, Liu L, et al. Dairy products and constituents: a review of their effects on obesity and related metabolic diseases. Crit Rev Food Sci Nutr. Published online September 19, 2023. doi:10.1080/10408398.2023.2257782	This work was supported by the National Natural Science Foundation of China 10.13039/501100001809 (82008600); the Key Project of Scientific Research Funds of Heilongjiang Province (CZKYF2021-2-B017); the Key Project of National Dairy Innovation Research Center of Inner Mongolia (2021-National Dairy Innovation Research Center-8); Characteristic Probiotics and New Fermented Food Team in Northeast Agricultural University (54940912).	N/A	N/A	Milk fat (body weight, CVD)
Li P, Mandilaras G, Jakob A, Dalla-Pozza R, Haas NA, Oberhoffer FS. Energy Drinks and Their Acute Effects on Arterial Stiffness in Healthy Children and Teenagers: A Randomized Trial. J Clin Med. 2022;11(8):2087. doi:10.3390/jcm11082087	This study (project title: EDUCATE Study: Energy Drinks—Unexplored Cardiovascular Alterations in TEens and TwEens) was supported by the German Heart Foundation/German Foundation of Heart Research.	N/A	N/A	Caffeine (CVD)
Liska D, Kelley M, Mah E. 100% Fruit Juice and Dental Health: A Systematic Review of the Literature. Front Public Health. 2019;7:190. Published 2019 Jul 12. doi:10.3389/fpubh.2019.00190	N/A	N/A	N/A	Juice (oral health)
Lunsford-Avery JR, Kollins SH, Kansagra S, Wang KW, Engelhard MM. Impact of daily caffeine intake and timing on electroencephalogram-measured sleep in adolescents. J Clin Sleep Med. 2022;18(3):877-884. doi:10.5664/jcsm.9736	This study was funded by the Duke Institute for Brain Sciences (DIBS).	Further funding was provided by National Institute of Mental Health grant K23MH108704 to J.R.L.-A.	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Luo J, Liu M, Zheng Z, Zhang Y, Xie R. Association of urinary caffeine and caffeine metabolites with bone mineral density in children and adolescents. Medicine (Baltimore). 2022;101(49): e31984. doi:10.1097/ MD.0000000000031984	This study Funded by the Scientific Research Project of Hunan Health and Family Planning Commission (A2017018).	N/A	N/A	Caffeine (bone density)
Magriplis E, Kanellopoulou A, Notara V, et al. The Association of Sugar-Sweetened Beverages to Children's Weights Status Is Moderated by Frequency of Adding Sugars and Sleep Hours. Children (Basel). 2022;9(7):1088. doi:10.3390/ children9071088	N/A	N/A	N/A	Flavored milk (body weight)
Mahboobi Z, Pakdaman A, Yazdani R, Azadbakht L, Montazeri A. Dietary free sugar and dental caries in children: A systematic review on longitudinal studies. Health Promot Perspect. 2021;11(3):271-280. doi:10.34172/hpp.2021.35	There was no grant related to this study and was done as part of PhD thesis supported by Tehran University of Medical Sciences, Tehran, Iran.	N/A	N/A	Juice (oral health)
Maillot M, Vieux F, Rehm C, Drewnowski A. Consumption of 100% Orange Juice in Relation to Flavonoid Intakes and Diet Quality Among US Children and Adults: Analyses of NHANES 2013-16 Data. Front Nutr. 2020;7:63. doi:10.3389/fnut.2020.00063	Support for analyses of publicly available federal data from the National Health and Nutrition Examination Survey (NHANES) was provided to the University of Washington by the State of Florida Citrus Commission. The Florida Citrus Commission and the Florida Department of Citrus were established in 1935 as an agency of the state government to provide marketing, research and regulatory support to the entire industry. The Florida Citrus Commission (FCC) is a nine-member board appointed by the Governor of Florida to represent citrus growers, processors, and packers.	N/A	N/A	Juice (diet quality, body weight)
Maillot M, Vieux F, Rehm CD, Rose CM, Drewnowski A. Consumption Patterns of Milk and 100% Juice in Relation to Diet Quality and Body Weight Among United States Children: Analyses of NHANES 2011-16 Data. Front Nutr. 2019;6:117. doi:10.3389/fnut.2019.00117	Support for analyses of publicly available federal data from the National Health and Nutrition Examination Survey (NHANES) was provided to the University of Washington by the Kellen Company.	N/A	N/A	Juice (diet quality) Milk fat (diet quality, body weight)
Mandilaras G, Li P, Dalla-Pozza R, Haas NA, Oberhoffer FS. Energy Drinks and Their Acute Effects on Heart Rhythm and Electrocardiographic Time Intervals in Healthy Children and Teenagers: A Randomized Trial. Cells. 2022;11(3):498. doi:10.3390/ cells11030498	This study (project title: EDUCATE Study: Energy Drinks—Unexplored Cardiovascu- lar Alterations in TEens and TwEens) was supported by the German Heart Foundation/German Foundation of Heart Research.	N/A	N/A	Caffeine (CVD)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Mansour B, Amarah W, Nasralla E, Elias N. Energy drinks in children and adolescents: demographic data and immediate effects. Eur J Pediatr. 2019;178(5):649-656. doi:10.1007/s00431-019-03342-7	N/A	N/A	N/A	Caffeine (CVD)
Marinoni M, Parpinel M, Gasparini A, Ferraroni M, Edefonti V. Psychological and socio-educational correlates of energy drink consumption in children and adolescents: a systematic review. Eur J Pediatr. 2022;181(3):889-901. doi:10.1007/s00431-021-04321-7	N/A	Valeria Edefonti was supported by Università degli Studi di Milano "Piano di Sostengo alla Ricerca 2021."	N/A	Caffeine (cognitive function)
Marshall TA, Curtis AM, Cavanaugh JE, Warren JJ, Levy SM. Child and Adolescent Sugar-Sweetened Beverage Intakes Are Longitudinally Associated with Higher Body Mass Index z Scores in a Birth Cohort Followed 17 Years. J Acad Nutr Diet. 2019;119(3):425-434. doi:10.1016/j.jand.2018.11.003	National Institutes of Health (R03-DE023784, R01-DE12101, R01-DE09551, UL1-RR024979, UL1-TR000442, UL1-TR001013, M01-RR00059), The Roy J. Carver Charitable Trust, and the Delta Dental of Iowa Foundation	N/A	N/A	Juice (body weight)
Martinez-Ospina A, Sudfeld CR, González SA, Sarmiento OL. School Food Environment, Food Consumption, and Indicators of Adiposity Among Students 7-14 Years in Bogotá, Colombia. J Sch Health. 2019;89(3):200-209. doi:10.1111/josh.12729	This study was funded by the Administrative Department of Science, Technology, and Innovation, Bogotá, Colombia (Colciencias) (Convocatoria 569-2012, Contrato 750-2013) and the Research Office at Universidad de Los Andes (Convocatoria inter-facultades 2013, Convocatoria de terminación de proyectos 2016).	N/A	N/A	Caffeine (body weight)
Masengo L, Sampasa-Kanyinga H, Chaput JP, Hamilton HA, Colman I. Energy drink consumption, psychological distress, and suicidality among middle and high school students. J Affect Disord. 2020;268:102-108. doi:10.1016/j.jad.2020.03.004	The Ontario Student Drug Use and Health Survey, a centre for Addiction and Mental Health initiative, was funded in part through ongoing support from the Ontario Ministry of Health and Long-Term Care, as well as targeted funding from several provincial agencies. This research paper was partly supported by the Research Council of Norway through its Centres of Excellence funding scheme, project number 262700, and the Canada Research Chairs program for Ian Colman.	N/A	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Mathew GM, Reichenberger DA, Master L, Buxton OM, Chang AM, Hale L. Too Jittery to Sleep? Temporal Associations of Actigraphic Sleep and Caffeine in Adolescents. Nutrients. 2021;14(1):31. doi:10.3390/nu14010031	Research reported in this publication was supported by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD) of the National Institutes of Health under award numbers R01HD073352 (to LH), R01HD36916, R01HD39135, and R01HD40421, as well as a consortium of private foundations.	N/A	Outside of the current work, O.M.B. received subcontract grants to Pennsylvania State University from Proactive Life (formerly Mobile Sleep Technologies) doing business as SleepSpace (National Science Foundation grant #1622766 and National Institutes of Health/National Institute on Aging Small Business Innovation Research Program R43AG056250, R44 AG056250), honoraria/travel support for lectures from Boston University, Boston College, Tufts School of Dental Medicine, Harvard Chan School of Public Health, New York University, and Allstate, consulting fees from Sleep Number, and an honorarium for his role as the Editor-in-Chief of Sleep Health (sleephealthjournal.org).	Caffeine (cognitive function)
Mayengbam S, Virtanen H, Hittel DS, et al. Metabolic consequences of discretionary fortified beverage consumption containing excessive vitamin B levels in adolescents. PLoS One. 2019;14(1):e0209913. doi:10.1371/journal.pone.0209913	The research was funded by the Alberta Children's Hospital Research Institute and the Natural Sciences and Engineering Research Council of Canada (JS).	SM is funded through an Eyes High Postdoctoral Fellowship and an Alberta Innovates Health Solutions Postdoctoral Fellowship.	N/A	Additives (diabetes)
Mayer-Davis E, Leidy H, Mattes R, et al. Beverage Consumption and Growth, Size, Body Composition, and Risk of Overweight and Obesity: A Systematic Review. Alexandria (VA): USDA Nutrition Evidence Systematic Review; July 2020.	Noel et al (2013), as referenced in the review, was funded by American Diabetes Association; UK Medical Research Council; Wellcome Trust; University of Bristol; NHLBI.	N/A	N/A	Flavored milk (body weight) Juice (body weight)
Maziarz L, Dial L, Fevrier B, Ivoska W. Correlates of Caffeinated Energy Drinks, Substance Use, and Behavior Among Adolescents. Internet Journal of Allied Health Sciences and Practice. 2022;20(4). doi:10.46743/1540-580X/2022.2198	N/A	N/A	N/A	Caffeine (cognitive function)
McGovern C, Rifas-Shiman SL, Switkowski KM, et al. Association of cow's milk intake in early childhood with adiposity and cardiometabolic risk in early adolescence. Am J Clin Nutr. 2022;116(2):561-571. doi:10.1093/ajcn/nqac103	The US NIH grants R01 HD034568 and UG3 OD023286 supported this work.	JWB is supported by US NIH NIDDK grant K23DK115682.	N/A	Milk fat (body weight, CVD)
Melough MM, Sathyanarayana S, Zohoori FV, et al. Impact of Fluoride on Associations between Free Sugars Intake and Dental Caries in US Children. JDR Clin Trans Res. 2023;8(3):215-223. doi:10.1177/23800844221093038	N/A	N/A	N/A	Juice (diet quality, oral health)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Michael SL, Lowry R, Merlo C, Cooper AC, Hyde ET, McKeon R. Physical activity, sedentary, and dietary behaviors associated with indicators of mental health and suicide risk. Prev Med Rep. 2020;19:101153. doi:10.1016/j.pmedr.2020.101153	N/A	N/A	N/A	Additives (cognitive function)
Mihaiescu T, Turti S, Souca M, et al. Caffeine and Taurine from Energy Drinks—A Review. Cosmetics. 2024;11(1):12. doi:10.3390/cosmetics11010012	N/A	N/A	N/A	Caffeine (body weight, CVD, oral health, cognitive function)
Mitchell ES, Musa-Veloso K, Fallah S, Lee HY, Chavez PJ, Gibson S. Contribution of 100% Fruit Juice to Micronutrient Intakes in the United States, United Kingdom and Brazil. Nutrients. 2020;12(5):1258. doi:10.3390/nu12051258	This study was funded by PepsiCo, Inc.	N/A	Authors Ellen Siobhan Mitchell and Peter John De Chavez are employed by PepsiCo, Inc and contributed to the conceptualization and/or writing of the manuscript. Authors K.M.-V., H.-Y.L., and S.F. are employees of Intertek Health Sciences, Inc., and have worked for PepsiCo as paid scientific and regulatory consultants. The views expressed in this article are those of the authors and do not necessarily reflect the position or policy of PepsiCo or Intertek Health Sciences Inc.	Juice (diet quality, body weight)
Moore LL, Zhou X, Wan L, Singer MR, Bradlee ML, Daniels SR. Fruit Juice Consumption, Body Mass Index, and Adolescent Diet Quality in a Biracial Cohort. Beverages. 2023; 9(2):42. doi:10.3390/beverages9020042	This research was funded by National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), grant number #R21 DK075068. Additional funding from the Juice Products Association.	N/A	N/A	Juice (diet quality, body weight)
Moussa M, Hansz K, Rasmussen M, et al. Cardiovascular Effects of Energy Drinks in the Pediatric Population. Pediatr Emerg Care. 2021;37(11):578-582. doi:10.1097/PEC.0000000000002165	N/A	N/A	N/A	Caffeine (cognitive function)
Muñoz-Urtubia N, Vega-Muñoz A, Estrada-Muñoz C, Salazar-Sepúlveda G, Contreras-Barraza N, Castillo D. Healthy Behavior and Sports Drinks: A Systematic Review. Nutrients. 2023;15(13):2915. doi:10.3390/nu15132915	The Article Processing Charge (APC) was partially funded by Universidad Católica de la Santísima Concepción (Code: APC2023). Additionally, the publication fee (APC) was partially financed through the Publication Incentive Fund, 2023, by the Universidad Autónoma de Chile (Code: CC456001), Universidad Andres Bello (Code: CC21500), Universidad de Santiago de Chile Code: APC2023), and Universidad de Las Americas (Code: APC2023).	N/A	N/A	Additives (oral health)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Murphy MM, Barraj LM, Brisbois TD, Duncan AM. Frequency of fruit juice consumption and association with nutrient intakes among Canadians. Nutr Health. 2020;26(4):277-283. doi:10.1177/0260106020944299	This work was supported by PepsiCo R&D	N/A	MMM and LMB are employees of Exponent, Inc.; PepsiCo, Inc. is a client of Exponent, Inc. TDB is an employee of PepsiCo. AMD has no conflicts.	Juice (diet quality)
Murray RD. 100% Fruit Juice in Child and Adolescent Dietary Patterns. J Am Coll Nutr. 2020;39(2):122-127. doi:10.1080/07315724.2019.1615013	This paper was presented at a session of The American Society for Nutrition Annual Meeting, held in Boston, MA, June 10, 2018, a session sponsored by the Juice Products Association (JPA).	N/A	JPA provided an honorarium for presenting at the ASN symposium and for drafting a manuscript based on the presentation.	Juice (diet quality, body weight)
Nadeem IM, Shanmugaraj A, Sakha S, Horner NS, Ayeni OR, Khan M. Energy Drinks and Their Adverse Health Effects: A Systematic Review and Meta-analysis. Sports Health. 2021;13(3):265-277. doi:10.1177/1941738120949181	N/A	N/A	N/A	Caffeine (CVD, cognitive function)
Naveed S, Sallinen T, Eloranta AM, et al. Effects of 2-year dietary and physical activity intervention on cognition in children-a nonrandomized controlled trial. Scand J Med Sci Sports. 2023;33(11):2340-2350. doi:10.1111/sms.14464	The PANIC study has been supported financially by grants from the Juho Vainio Foundation, Academy of Finland, Ministry of Education and Culture of Finland, Ministry of Social Affairs and Health of Finland, Research Committee of the Kuopio University Hospital Catchment Area (State Research Funding), Finnish Innovation Fund Sitra, Social Insurance Institution of Finland, Finnish Cultural Foundation, Foundation for Paediatric Research, Diabetes Research Foundation in Finland, Finnish Foundation for Cardiovascular Research, Paavo Nurmi Foundation, Yrjö Jahnsson Foundation, and the city of Kuopio.	The work of SB was funded by the UK Medical Research Council (MC_UU_12015/3) and the NIHR Biomedical Research Centre in Cambridge (IS-BRC-1215-20014).	N/A	Milk fat (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Nguyen M, Jarvis SE, Chiavaroli L, et al. Consumption of 100% Fruit Juice and Body Weight in Children and Adults: A Systematic Review and Meta-Analysis. JAMA Pediatr. 2024;178(3):237-246. doi:10.1001/jamapediatrics.2023.6124	This study was supported by funding from the Ontario Graduate Scholarship, Peterborough KM Hunter Charitable Foundation Graduate Award, Dalton Whitebread Scholarship Fund, and SMART Healthy Cities Trainee Award (Ms Nguyen).	N/A	Dr. Chiavaroli reported being a Mitacs-Elevate postdoctoral fellow jointly funded by the Government of Canada and the Canadian Sugar Institute and being previously employed as a casual clinical coordinator at INQUIS Clinical Research Ltd (formerly Glycemic Index Laboratories Inc), a contract research organization, during the conduct of the study. Dr Zurbau reported being a part-time research associate at INQUIS Clinical Research Ltd, a contract research organization and receiving consulting fees from Glycemic Index Foundation. Dr Khan reported receiving research support from the Canadian Institutes of Health Research, the International Life Science Institute, and National Honey Board and funding from the Toronto 3D Knowledge Synthesis and Clinical Trials Foundation. Drs Tobias, Hu, and Malik reported receiving funding from the National Institutes of Health/National Institute of Diabetes and Digestive and Kidney Diseases (grant RO1DK125803) for related research during the conduct of this study. Dr Hanley reported receiving research grants from the Canadian Institutes of Health Research, Diabetes Canada, the Canadian Foundation for Innovation, the Canada Research Chairs Program, and the Canadian Foundation for Innovation and Dairy Farmers of Canada. Dr Sievenpiper reported receiving research support from the Canadian Foundation for Innovation, Ontario Research Fund, Province of Ontario Ministry of Research and Innovation and Science, Canadian Institutes of Health Research, Diabetes Canada, American Society for Nutrition, International Nut and Dried Fruit Council Foundation, National Honey Board (US Department of Agriculture), Institute for the Advancement of Food and Nutrition Sciences (formerly ILSI North America), Pulse Canada, Quaker Oats Center of Excellence, The United Soybean Board, The Tate and Lyle Nutritional Research Fund at the University of Toronto, The Glycemic Control and Cardiovascular Disease in Type 2 Diabetes Fund at the University of Toronto (a fund established by the Alberta Pulse Growers), The Plant Protein Fund at the University of Toronto (a fund which has received contributions from International Flavors & Fragrances), and The Nutrition Trialists Network Research Fund at the University of Toronto (a fund established by an inaugural donation from the Calorie Control Council); receiving food donations to support randomized clinical trials from the Almond Board of California, California Walnut Commission, Peanut Institute, Barilla, Unilever/ Upfield, Unico/ Primo, Loblaw Companies, Quaker, Kellogg Canada, Danone, Nutrartis, Soylent, and Dairy Farmers of Canada; receiving travel support, speaker fees and/or honoraria from ASN, Danone, Dairy Farmers of Canada, FoodMinds LLC, Nestlé, Abbott, General Mills, Nutrition Communications, International Food Information Council, Calorie Control Council, International Sweeteners Association, International Glutamate Technical Committee, Phynova, Arab Beverages Association, and Brightseed; having had ad hoc consulting arrangements with Perkins Coie LLP, Tate & Lyle, and Inquis Clinical Research; being a former member of the European Fruit Juice Association Scientific Expert Panel and former member of the Soy Nutrition Institute Scientific Advisory Committee; being on the Clinical Practice Guidelines Expert Committees of Diabetes Canada, European Association for the study of Diabetes, Canadian Cardiovascular Society, and Obesity Canada/Canadian Association of Bariatric Physicians and Surgeons; serving as an unpaid member of the Board of Trustees and formerly served as an unpaid scientific advisor for the Carbohydrates Committee of the Institute for the Advancement of Food and Nutritional Sciences; and serving as a director at large of the Canadian Nutrition Society, founding member of the International Carbohydrate Quality Consortium, executive board member of the Diabetes and Nutrition Study Group of the European Association for the Study of Diabetes, and director of the Toronto 3D Knowledge Synthesis and Clinical Trials Foundation outside the submitted work. Dr Malik reported receiving funding from the Canada Research Chairs Program; Connaught New Researcher Award, University of Toronto; The Joannah & Brian Lawson Centre for Child Nutrition, University of Toronto; Temerty Faculty of Medicine Pathway Grant, University of Toronto; and the Canada Foundation for Innovation; Ontario Research Fund and serving as a consultant for the city and county of San Francisco for litigation related to health warning labels on sugar-sweetened beverages. No other disclosures were reported.	Juice (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Nicklas TA, O'Neil CE, Saab R, Fulgoni VL. Trends in Orange Juice Consumption and Nutrient Adequacy in Children 2003-2016. Int J Child Health Nutr. 2020;9(3):100-114. doi:10.6000/1929-4247.2020.09.03.2	This research project was supported by the Florida Department of Citrus, and USDA–Agricultural Research Service through specific cooperative agreement 58-3092-5-001.	N/A	N/A	Juice (diet quality, body weight)
Nicol K, Nugent AP, Woodside JV, Hart KH, Bath SC. The impact of replacing milk with plant-based alternatives on iodine intake: a dietary modelling study. Eur J Nutr. 2024;63(2):599-611. doi:10.1007/s00394-023-03286-7	Biotechnology and Biological Sciences Research Council, BB/T008776/1, Katie Nicol.	K.N is supported by the Biotechnology and Biological Sciences Research Council Food- BioSystems (BBSRC-FBS; Grant number: BB/T008776/1, Reference number: 2459093).	S. C. B. has received an honorarium from Oatly UK and Dairy UK for delivering webinars/online videos for Health- care Professionals.	Plant milk (diet quality)
Nuss T, Morley B, Scully M, Wakefield M. Energy drink consumption among Australian adolescents associated with a cluster of unhealthy dietary behaviours and short sleep duration. Nutrition Journal. 2021;20(1):64. doi:10.1186/s12937-021-00719-z	The 2018 NaSSDA study was principally funded by state Cancer Councils through Cancer Council Australia, with additional funding support received from the South Australian Health and Medical Research Institute.	M.W. is supported by a Principal Research Fellowship from the National Health and Medical Research Council.	N/A	Caffeine (diet quaity, cognitive function)
Oberhoffer FS, Dalla-Pozza R, Jakob A, Haas NA, Mandilaras G, Li P. Energy drinks: effects on pediatric 24-h ambulatory blood pressure monitoring. A randomized trial. Pediatr Res. 2023;94(3):1172-1179. doi:10.1038/s41390-023-02598-y	This study (project title: EDUCATE-Study: Energy-Drinks—Unexplored Cardiovascular Alterations in TEens and TwEens) was supported by the German Heart Foundation/ German Foundation of Heart Research. Open Access funding enabled and organized by Projekt DEAL.	N/A	N/A	Caffeine (CVD, cognitive function)
Oberhoffer FS, Li P, Jakob A, Dalla-Pozza R, Haas NA, Mandilaras G. Energy Drinks Decrease Left Ventricular Efficiency in Healthy Children and Teenagers: A Randomized Trial. Sensors (Basel). 2022;22(19):7209. doi:10.3390/s22197209	This study (project title: EDUCATE-Study: Energy-Drinks—Unexplored Cardiovascular Alterations in TEens and TwEens) was supported by the German Heart Foundation/German Foundation of Heart Research.	N/A	N/A	Caffeine (CVD)
Oberhoffer FS, Li P, Jakob A, Dalla-Pozza R, Haas NA, Mandilaras G. Energy Drinks: Effects on Blood Pressure and Heart Rate in Children and Teenagers. A Randomized Trial. Front Cardiovasc Med. 2022;9:862041. doi:10.3389/fcvm.2022.862041	This study (project title: EDUCATE-Study: Energy-Drinks – Unexplored Cardiovascular Alterations in TEens and TwEens) was supported by the German Heart Foundation/German Foundation of Heart Research.	N/A	N/A	Caffeine (CVD)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Ong J, Roem J, Ducharme-Smith K, et al. Association of Sodium and Sugar-Sweetened Beverage Intake With Cardiovascular Disease Risk Factors in Adolescents and Young Adults With Obesity. Clin Pediatr (Phila). 2024;63(5):669-679. doi:10.1177/00099228231186666	The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by NIH/NHLBI (K23 HL119622 and R56 HL139620 [to TB]). This publication was made possible by the Johns Hopkins Institute for Clinical and Translational Research (ICTR) which is funded in part by grant number UL1 TR003098 from the National Center for Advancing Translational Sciences (NCATS) a component of the National Institutes of Health (NIH), and NIH Roadmap for Medical Research.	N/A	N/A	NSS (body weight, CVD)
O'Sullivan TA, Schmidt KA, Kratz M. Whole-Fat or Reduced-Fat Dairy Product Intake, Adiposity, and Cardiometabolic Health in Children: A Systematic Review. Adv Nutr. 2020;11(4):928-950. doi:10.1093/advances/nmaa011	N/A	KAS was supported by grant number T32 CA094880 from the NIH.	MK has received reimbursement for travel and honoraria for speaking as well as a research grant from dairy-related organizations. TAOS has previously received a research grant from a dairy-related organization. KAS's dissertation project was funded by a grant from dairy-related organizations.	Milk fat (body weight, CVD)
Peckham JG, Kropp JD, Mroz TA, Haley-Zitlin V, Granberg E. Students choosing fat-free chocolate milk during school lunch consume more calories, total sugar, protein, minerals and vitamins at lunch. Public Health Nutr. 2021;24(7):1818-1827. doi:10.1017/S1368980021000161	The authors received funding to support data compilation and analysis through the Healthcare Research Initiative in the College of Business and Behavioral Science at Clemson University. The Institute of Food and Agricultural Science at the University of Florida supported the analysis through the Early Career Scientist Seed Funding program (J.D.K.). The project was also supported by the USDA National Institute of Food and Agriculture, Hatch Grant (J.D.K., grant number 102216).	N/A	N/A	Flavored milk (diet quality)
Poirier KL, Totosy de Zepetnek JO, Bennett LJ, et al. Effect of Commercially Available Sugar-Sweetened Beverages on Subjective Appetite and Short-Term Food Intake in Boys. Nutrients. 2019;11(2):270. doi:10.3390/nu11020270	This study was supported by a New Investigators Award to Nick Bellissimo from Mount Saint Vincent University; by a Ryerson University, Faculty of Community Services SRC grant; and by a Nova Scotia Heart and Stroke Foundation, BrightRed Graduate Research Award to Kelly L. Poirier.	N/A	N/A	Flavored milk (diet quality)
Potvin J, Ramos Socarras L, Forest G. Sleeping through a Lockdown: How Adolescents and Young Adults Struggle with Lifestyle and Sleep Habits Upheaval during a Pandemic. Behav Sleep Med. 2022;20(3):304-320. doi:10.1080/15402002.2021.2019035	N/A	N/A	N/A	Caffeine (CVD, cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Pucci S, Pereira MG. The Moderator Role of Caffeine Intake in Adolescents' Sleep and Health Behaviors. Journal of Child & Adolescent Substance Abuse. 2019;28(1):39–44. https://doi.org/10.1080/1067828X.2018.1561573	The present research had a support of Erasmus Mundus (Lot 15) EMUNDUS15 Financial Agreement reference 2099- 1670/001-001-ECW with a scholarship to the first author.	N/A	N/A	Caffeine (CVD, cognitive function)
Puupponen M, Tynjälä J, Välimaa R, Paakkari L. Associations between adolescents' energy drink consumption frequency and several negative health indicators. BMC Public Health. 2023;23(1):258. doi:10.1186/s12889-023-15055-6	Open Access funding provided by University of Jyväskylä (JYU). This publication was funded by the University of Jyväskylä, Faculty of Sport and Health Sciences.	N/A	N/A	Caffeine (diet quality, oral health, cognitive function)
Ratliff JC, Riedt CS, Fulgoni VL 3rd. Consumption of low-calorie sweetened beverages and water is associated with lower intake of carbohydrates and sugars and not associated with glycemic response in U.S. non-diabetic adolescents: Results from the 2001-2014 National Health and Nutrition Examination Surveys. Nutrition. 2019;67-68S:100003. doi:10.1016/j.nutx.2019.100003	This study was funded by the Keurig Dr Pepper.	Analyses of the National Health and Nutrition Examination Sur- vey (NHANES) were supported by Keurig Dr Pepper.	JCR and CSR are employees of Keurig Dr Pepper. VLF consults with members of the food industry and conducts analyses of NHANES for numerous companies and organizations.	NSS (diet quality, diabetes)
Ricciuto L, Fulgoni VL 3rd, Gaine PC, Scott MO, DiFrancesco L. Intakes of Added Sugars, with a Focus on Beverages and the Associations with Micronutrient Adequacy in US Children, Adolescents, and Teens (NHANES 2003-2018). Nutrients. 2023;15(15):3285. doi:10.3390/nu15153285	The funding for this research was provided by The Sugar Association, Inc.	N/A	L.R. and L.D., as independent consultants, provide nutrition and regulatory consulting to various food manufacturers, commodity groups, and health organizations. V.L.F.III, as Vice President of Nutrition Impact, LLC., conducts NHANES analyses for numerous members of the food, beverage, and dietary supplement industry. P.C.G. and M.O.S. are employed by The Sugar Association, Inc.	Flavored milk (diet quality) Caffeine (diet quality)
Ricklefs-Johnson K, Pikosky MA. Perspective: The Benefits of Including Flavored Milk in Healthy Dietary Patterns. Adv Nutr. 2023;14(5):959-972. doi:10.1016/j.advnut.2023.06.002	N/A	N/A	The authors are employed by National Dairy Council.	Flavored milk (diet quality, oral health)
Riley MD, Hendrie GA, Baird DL. Drink Choice is Important: Beverages Make a Substantial Contribution to Energy, Sugar, Calcium and Vitamin C Intake among Australians. Nutrients. 2019;11(6):1389. doi:10.3390/nu11061389	The Australian Beverages Council Limited (ABCL) part-funded the secondary analyses of the 2011–2012 NNPAS outlined in this manuscript, after funding a comprehensive analysis by the authors of water based beverages using data from the same survey.	N/A	N/A	Flavored milk (diet quality)
Rodak K, Kokot I, Kratz EM. Caffeine as a Factor Influencing the Functioning of the Human Body-Friend or Foe?. Nutrients. 2021;13(9):3088. doi:10.3390/nu13093088	N/A	N/A	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Rousham EK, Goudet S, Markey O, et al. Unhealthy Food and Beverage Consumption in Children and Risk of Overweight and Obesity: A Systematic Review and Meta-Analysis [published correction appears in Adv Nutr. 2022 Oct 2;13(5):2065. doi: 10.1093/advances/nmac069]. Adv Nutr. 2022;13(5):1669-1696. doi:10.1093/advances/nmac032	N/A	N/A	N/A	Juice (body weight) NSS (body weight)
Ruxton CHS, Myers M. Fruit Juices: Are They Helpful or Harmful? An Evidence Review. Nutrients. 2021;13(6):1815. doi:10.3390/nu13061815	This research was funded by an unrestricted grant from the Fruit Juice Science Centre https://fruitjuicesciencecentre.eu (accessed on 26 May 2021).	N/A	CHSR provides consultancy services to the European Fruit Juice Association (AIJN), innocent Ltd. and serves as a member of the Tea Advisory Panel. MM provides consultancy services to the European Fruit Juice Association (AIJN).	Juice (body weight)
Sakaki JR, Gao S, Ha K, et al. Childhood beverage intake and risk of hypertension and hyperlipidaemia in young adults. Int J Food Sci Nutr. 2022;73(7):954-964. doi:10.1080/09637486.2022.2091524	The Florida Department of Citrus, an executive agency of the state of Florida, provided funding for this project to Ock K. Chun, Contract Doc #17–16. Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School provided the data of the Growing Up Today Study (GUTS) for this study (life-course and CVD/lung disease infrastructure, grant #U01 HL145386).	JEH and JEC were supported by the National Institutes of Health (U01 HL145386).	N/A	Juice (diet quality, CVD)
Sakaki JR, Li J, Gao S, et al. Associations between fruit juice and milk consumption and change in BMI in a large prospective cohort of U.S. adolescents and preadolescents. Pediatr Obes. 2021;16(9):e12781. doi:10.1111/ijpo.12781	The Florida Department of Citrus, an executive agency of the state of Florida, provided funding for this project to Ock K. Chun, Contract Doc #17-16. We would like to thank the Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital and Harvard Medical School for providing the data of the Growing Up Today Study (GUTS) for this study. Supported by grants U01 HL145386 and P30 DK046200.	N/A	N/A	Milk fat (body weight) Juice (body weight)
Sakaki JR, Li J, Melough MM, et al. Orange juice intake and anthropometric changes in children and adolescents. Public Health Nutr. 2021;24(14):4482-4489. doi:10.1017/S1368980020003523	This study was supported by the Florida Department of Citrus, an executive agency of the State of Florida, to Dr. Ock K. Chun, Contract Doc #17-16.	N/A	N/A	Juice (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Sakaki JR, Melough MM, Li J, et al. Associations between 100% Orange Juice Consumption and Dietary, Lifestyle and Anthropometric Characteristics in a Cross-Sectional Study of U.S. Children and Adolescents. Nutrients. 2019;11(11):2687. doi:10.3390/nu11112687	This study was supported by the Florida Department of Citrus, an executive agency of the state of Florida, to Ock K. Chun, Contract Doc #17-16.	N/A	N/A	Juice (diet quality, body weight)
Sakaki JR, Rodriguez NR, Fernandez ML, Puglisi MJ, Chen MH, Chun OK. Fruit juice and childhood obesity: a review of epidemiologic studies. Crit Rev Food Sci Nutr. 2023;63(24):6723-6737. doi:10.1080/10408398.2022.2044284	N/A	N/A	N/A	Juice (body weight)
Samman M, Kaye E, Cabral H, Scott T, Sohn W. The effect of diet drinks on caries among US children: Cluster analysis. J Am Dent Assoc. 2020;151(7):502-509. doi:10.1016/j.adaj.2020.03.013	N/A	N/A	N/A	Juice (oral health) NSS (oral health)
Saxvig IW, Evanger LN, Pallesen S, et al. Circadian typology and implications for adolescent sleep health. Results from a large, cross-sectional, school-based study. Sleep Med. 2021;83:63-70. doi:10.1016/j.sleep.2021.04.020	The present study was funded through a postdoctoral grant provided by Helse Vest RHF.	N/A	N/A	Caffeine (cognitive function)
Scheffers FR, Boer JMA, Gehring U, et al. The association of pure fruit juice, sugar-sweetened beverages and fruit consumption with asthma prevalence in adolescents growing up from 11 to 20 years: The PIAMA birth cohort study. Prev Med Rep. 2022;28:101877. doi:10.1016/j.pmedr.2022.101877	This work is part of the research programme Doctoral Grant for Teachers with project number 023.005.010, which is financed by the Dutch Research Council (NWO). The Prevention and Incidence of Asthma and Mite Allergy Study has been funded by grants from the Netherlands Organization for Health Research and Development; the Netherlands Organization for Scientific Research; the Lung Foundation of the Netherlands; the Ministry of Planning, Housing, and the Environment; the Ministry of Health, Wel- fare, and Sport; and the National Institute for Public Health and the Environment.	N/A	N/A	Juice (asthma)
Scholz-Ahrens KE, Ahrens F, Barth CA. Nutritional and health attributes of milk and milk imitations. Eur J Nutr. 2020;59(1):19-34. doi:10.1007/s00394-019-01936-3	N/A	N/A	N/A	Plant milk (diet quality)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Schröder H, Cruz Muñoz V, Urquizu Rovira M, et al. Determinants of the Consumption of Regular Soda, Sport, and Energy Beverages in Spanish Adolescents. Nutrients. 2021;13(6):1858. doi:10.3390/nu13061858	This work was supported by grants:19th Grant for Research Projects in Primary Health Care 2016 from the IDIAP Jordi Gol Foundation (code 4R17/57). Precipita (FECYT crowdfunding platform). "1st Research Grant from the North Metropolitana Primary Care Division 2017" and "2nd Research Grant from the North Metropolitan Primary Care Division 2018", both from the Catalan Institute of Health (Generalitat de Catalunya).	N/A	N/A	Additives (cognitive function)
Shahdadian F, Boozari B, Saneei P. Association between short sleep duration and intake of sugar and sugar-sweetened beverages: A systematic review and meta-analysis of observational studies. Sleep Health. 2023;9(2):159-176. doi:10.1016/j.sleh.2022.07.006	This study was financially supported by Isfahan University of Medical Sciences, Isfahan, Iran (no. 199224).	N/A	N/A	Caffeine (cognitive function)
Shearer J, Reimer RA, Hittel DS, Gault MA, Vogel HJ, Klein MS. Caffeine-Containing Energy Shots Cause Acute Impaired Glucoregulation in Adolescents. Nutrients. 2020;12(12):3850. doi:10.3390/nu12123850	The research was funded by the Alberta Children's Hospital Research Institute, the National Science and Engineering Council of Canada (JS), and the Foods for Health Discovery Theme.	N/A	N/A	Caffeine (diabetes)
Shum B, Georgia S. The Effects of Non-Nutritive Sweetener Consumption in the Pediatric Populations: What We Know, What We Don't, and What We Need to Learn. Front Endocrinol (Lausanne). 2021;12:625415. doi:10.3389/fendo.2021.625415	N/A	BS is supported by the Pfeiffer Foundation. SG is supported by the Harvey Family Foundation, the Paul Lester Foundation, and the Saban Research Institute.	N/A	NSS (diet quality, body weight, diabetes)
Silva-Maldonado P, Arias-Rico J, Romero-Palencia A, Román-Gutiérrez AD, Ojeda-Ramírez D, Ramírez-Moreno E. Consumption Patterns of Energy Drinks in Adolescents and Their Effects on Behavior and Mental Health: A Systematic Review. J Psychosoc Nurs Ment Health Serv. 2022;60(2):41-47. doi:10.3928/02793695-20210818-04	N/A	N/A	N/A	Caffeine (body weight, diabetes, CVD, cognitive function)
Şimşek Y, Tekgül N. Sleep Quality in Adolescents in Relation to Age and Sleep-related Habitual and Environmental Factors. jpr. 2019;6(4):307-313. doi:10.4274/jpr.galenos.2019.86619	N/A	N/A	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Sipple LR, Barbano DM, Drake M. Invited review: Maintaining and growing fluid milk consumption by children in school lunch programs in the United States. Journal of Dairy Science. 2020;103(9):7639-7654. doi:10.3168/jds.2020-18216	Funding was provided in part by the National Dairy Council (Rosemont, IL).	N/A	N/A	Milk fat (diet quality, body weight, diabetes, CVD, bone density, taste preference) Flavored milk (diet quality)
Soczynska I, da Costa BR, O'Connor DL, et al. Plant-Based Milk Consumption and Growth in Children 1-10 Years of Age. J Nutr. 2024;154(3):985-993. doi:10.1016/j.tjnut.2023.12.046	Funding was provided by the Canadian Institutes of Health Research Strategy for Patient Oriented Research (SPOR) Innovative Clinical Trial Grant [162962 (to JLM)].	N/A	N/A	Plant milk (body weight)
Soós R, Gyebrovszki Á, Tóth Á, Jeges S, Wilhelm M. Effects of Caffeine and Caffeinated Beverages in Children, Adolescents and Young Adults: Short Review. Int J Environ Res Public Health. 2021;18(23):12389. doi:10.3390/ijerph182312389	This research was funded by GINOP-2.3.2.-15-2016-00047.	N/A	N/A	Caffeine (cognitive function)
Svensson Å, Warne M, Gillander Gådin K. Longitudinal Associations Between Energy Drink Consumption, Health, and Norm-Breaking Behavior Among Swedish Adolescents. Front Public Health. 2021;9:597613. doi:10.3389/fpubh.2021.597613	This work was supported by The Public Health Agency of Sweden [Grant number HFÅ2008/212].	N/A	N/A	Caffeine (cognitive function)
Swindell N, Berridge D, McNarry MA, et al. Lifestyle Behaviors Associated With Body Fat Percent in 9- to 11-Year-Old Children. Pediatr Exerc Sci. 2021;33(1):40-47. doi:10.1123/pes.2020-0010	N/A	N/A	N/A	Milk fat (body weight) NSS (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Sycamnias L, Kerr JA, Lange K, et al. Polygenic Risk Scores and the Risk of Childhood Overweight/Obesity in Association With the Consumption of Sweetened Beverages: A Population-Based Cohort Study. Child Obes. 2024;20(5):354-365. doi:10.1089/chi.2023.0012	The Child Health Check Point has been supported to date by the National Health and Medical Research Council (NHMRC) of Australia (Project Grants 1041352, 1109355), The Royal Children's Hospital Foundation (2014-241), Murdoch Children's Research Institute, The University of Melbourne, National Heart Foundation of Australia (100660), Financial Markets Foundation for Children (2014-055, 2016-310), Cure Kids, New Zealand Ministry of Business, Innovation and Employment, University of Auckland Faculty Development Research Fund (3712987), National Centre for Longitudinal Data (at the DSS), and Victorian Deaf Education Institute. Research at the Murdoch Children's Research Institute is supported by the Victorian Government's Operational Infrastructure Program. D.B. is supported by the NHMRC Investigator Grant (1175744). M.W. was supported by the NHMRC Senior Research Fellowship 1046518, Principal Research Fellowship 1160906, and Cure Kids New Zealand.	N/A	N/A	NSS (body weight)
Sylvetsky AC, Figueroa J, Zimmerman T, Swithers SE, Welsh JA. Consumption of low-calorie sweetened beverages is associated with higher total energy and sugar intake among children, NHANES 2011-2016. Pediatr Obes. 2019;14(10):e12535. doi:10.1111/ijpo.12535	Sumner M. Redstone Global Center for Prevention and Wellness Pilot Studies Program	N/A	N/A	NSS (diet quality)
Temple JL. Review: Trends, Safety, and Recommendations for Caffeine Use in Children and Adolescents. J Am Acad Child Adolesc Psychiatry. 2019;58(1):36-45. doi:10.1016/j.jaac.2018.06.030	N/A	Dr. Temple's salary and research support were provided from National Institutes of Health e National Institute on Drug Abuse grants DA021759 and DA030386 and National Institute of Diabetes and Digestive and Kidney Disease grant DK106265.	N/A	Caffeine (diet quality, taste preference, cognitive function)
Thompson HR. Effect of Removing Chocolate Milk on Milk and Nutrient Intake Among Urban Secondary School Students. Prev Chronic Dis. 2020;17. doi:10.5888/pcd17.200033	This work was funded by the US Department of Agriculture, National Institute of Food and Agriculture, (grant no. 2015-68001- 23236), Technology and Design Innovation to Support 21st Century School Nutrition.	N/A	N/A	Flavored milk (diet quality)
Tobiassen PA, Køster-Rasmussen R. Substitution of sugar-sweetened beverages with non-caloric alternatives and weight change: A systematic review of randomized trials and meta-analysis. Obes Rev. 2024;25(2):e13652. doi:10.1111/obr.13652	N/A	N/A	N/A	NSS (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Toews I, Lohner S, Küllenberg de Gaudry D, Sommer H, Meerpohl JJ. Association between intake of non-sugar sweeteners and health outcomes: systematic review and meta-analyses of randomised and non-randomised controlled trials and observational studies [published correction appears in BMJ. 2019 Jan 15;364:l156. doi: 10.1136/bmj.l156]. BMJ. 2019;364:k4718. doi:10.1136/bmj.k4718	The research was funded by WHO.	N/A	N/A	NSS (body weight, diabetes, CVD)
Torres-Gonzalez M, Cifelli CJ, Agarwal S, Fulgoni VL 3rd. Association of Milk Consumption and Vitamin D Status in the US Population by Ethnicity: NHANES 2001-2010 Analysis. Nutrients. 2020;12(12):3720. doi:10.3390/nu12123720	The study and the writing of the manuscript were supported by National Dairy Council, Rosemont, IL.	N/A	M.T.-G. and C.J.C. are employees of National Dairy Council, Rosemont, IL; S.A. as Principal of NutriScience, L.L.C. performs consulting and database analyses for various food and beverage companies and related entities; V.L.F.III is Senior Vice President of Nutrition Impact and received a research grant from National Dairy Council to conduct these analyses.	Milk fat (Vitamin D, Serum 25-hydroxyvitamin D (25(OH)D) concentrations)
Torres-Ugalde YC, Romero-Palencia A, Román-Gutiérrez AD, Ojeda-Ramírez D, Guzmán-Saldaña RME. Caffeine Consumption in Children: Innocuous or Deleterious? A Systematic Review. Int J Environ Res Public Health. 2020;17(7):2489. doi:10.3390/ijerph17072489	N/A	N/A	N/A	Caffeine (CVD, cognitive function)
Vanderhout SM, Aglipay M, Torabi N, et al. Whole milk compared with reduced-fat milk and childhood overweight: a systematic review and meta-analysis. Am J Clin Nutr. 2020;111(2):266-279. doi:10.1093/ajcn/nqz276	Funding was provided by the Canadian Institutes of Health Research (CIHR) Institute of Human Development, Child and Youth Health (grant number MOP-333560).	N/A	N/A	Milk fat (body weight)
Vanderhout SM, Keown-Stoneman CDG, Birken CS, O'Connor DL, Thorpe KE, Maguire JL. Cow's milk fat and child adiposity: a prospective cohort study. Int J Obes (Lond). 2021;45(12):2623-2628. doi:10.1038/s41366-021-00948-6	Funding was provided by the Canadian Institutes of Health Research (CIHR) Institute of Human Development, Child and Youth Health (grant number MOP-333560).	JLM received an unrestricted research grant for a completed investigator-initiated study from the Dairy Farmers of Canada (2011–2012) and Ddrops provided non-financial support (vitamin D supplements) for an investigator-initiated study on vitamin D and respiratory tract infections (2011–2015). All other authors have no potential conflicts of interest.	N/A	Milk fat (body weight)
Veselska ZD, Husarova D, Kosticova M. Energy Drinks Consumption Associated with Emotional and Behavioural Problems via Lack of Sleep and Skipped Breakfast among Adolescents. Int J Environ Res Public Health. 2021;18(11):6055. doi:10.3390/ijerph18116055	This research was funded by the Slovak Research and Development Agency under the Contract no.s APVV-15-0012 and APVV-18-0070, and by the Scientific Grant Agency of the Ministry of Education, Science, Research and Sport of the Slovak Republic and the Slovak Academy of Sciences, Reg. No. 1/0177/20.	N/A	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Vézina-Im LA, Beaulieu D, Turcotte S, et al. Association between Beverage Consumption and Sleep Quality in Adolescents. Nutrients. 2024;16(2):285. doi:10.3390/nu16020285	This research was funded by a grant from the Centre de recherche du CISSS de Chaudière- Appalaches and Fondation de l'Hôtel-Dieu de Lévis to D.B., L.-A.V.-I., and V.L. as principal investigators.	N/A	N/A	Juice (cognitive function) Caffeine (cognitive function)
Vieux F, Maillot M, Rehm CD, Drewnowski A. Tea Consumption Patterns in Relation to Diet Quality among Children and Adults in the United States: Analyses of NHANES 2011-2016 Data. Nutrients. 2019;11(11):2635. doi:10.3390/nu11112635	Analyses of publicly available NHANES 2100–2016 data were supported by Unilever.	N/A	F.V. and M.M. are employed by MS-Nutrition, a data analysis and research consulting firm. A.D. has received grants, contracts, honoraria and speaking fees from both public and private entities with an interest in the nutrient profiling of individual foods and total diets.	Caffeine (diet quality)
Vogel C, Shaw S, Strömmer S, et al. Inequalities in energy drink consumption among UK adolescents: a mixed-methods study. Public Health Nutr. Published online December 6, 2022. doi:10.1017/S1368980022002592	UK Medical Research Council, UK NIHR Programme Grants for Applied Research (RP-PG-0216- 20004) and NIHR Southampton Biomedical Research Centre.	M.B., J.B. and S.St. have received grant research support from Danone Nutricia Early Life Nutrition.	C.V. and J.B. have a non-financial research collaboration with a UK supermarket chain. C.C. has received consultancy, lecture fees and honoraria from AMGEN, GSK, Alliance for Better Bone Health, MSD, Eli Lilly, Pfizer, Novartis, Servier, Medtronic and Roche.	Caffeine (diet quality)
Walton J, Kehoe L. Current perspectives and challenges in the estimation of fruit juice consumption across the lifecycle in Europe. Nutr Res Rev. Published online February 15, 2024. doi:10.1017/S095442242400009X	Funding for this work was provided by the Fruit Juice Science Centre (https://fruitjuicesciencecentre.eu). Fruit Juice Science Centre had no role in the analysis or writing of this review.	JW and LK were paid a fee from the Fruit Juice Science Centre for the production of this manuscript.	N/A	Juice (diet quality)
Wan L, Jakkilinki PD, Singer MR, Bradlee ML, Moore LL. A longitudinal study of fruit juice consumption during preschool years and subsequent diet quality and BMI. BMC Nutr. 2020;6:25. doi:10.1186/s40795-020-00347-6	This work was supported by Grant 5R01 HL35653–10 from the National Heart, Lung, and Blood Institute with additional funding from the Juice Products Association	N/A	N/A	Juice (diet quality, body weight)
Wang J, Jin G, Gu K, Sun J, Zhang R, Jiang X. Association between milk and dairy product intake and the risk of dental caries in children and adolescents: NHANES 2011-2016. Asia Pac J Clin Nutr. 2021;30(2):283-290. doi:10.6133/apjcn.202106_30(2).0013	N/A	N/A	N/A	Milk fat (oral health)
Ward AL, Jospe M, Morrison S, et al. Bidirectional associations between sleep quality or quantity, and dietary intakes or eating behaviors in children 6-12 years old: a systematic review with evidence mapping. Nutr Rev. 2021;79(10):1079-1099. doi:10.1093/nutrit/nuaa125	This review was supported by Department of Medicine postdoctoral fellowships (A.L.W., M.J., and A.N.R.) and a University of Otago doctoral scholarship (S.M.).	N/A	N/A	Caffeine (cognitive function)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
White MJ, Armstrong SC, Kay MC, Perrin EM, Skinner A. Associations between milk fat content and obesity, 1999 to 2016. Pediatr Obes. 2020;15(5):e12612. doi:10.1111/ijpo.12612	N/A	N/A	Dr. Sarah Armstrong has received a research grant from Astra Zeneca, has a data safety monitor for Novo Nordisk, and has received a speaker honorarium from Rhythm Pharmaceuticals.	Milk fat (body weight)
Wong VCH, Maguire JL, Omand JA, et al. A Positive Association Between Dietary Intake of Higher Cow's Milk-Fat Percentage and Non-High-Density Lipoprotein Cholesterol in Young Children. J Pediatr. 2019;211:105-111.e2. doi:10.1016/j.jpeds.2019.03.047	The TARGet Kids! research network is supported by Canadian Institutes of Health Research (CIHR) Institute of Human Development, Child and Youth Health, CIHR Institute of Nutrition, Metabolism, and Diabetes, the SickKids Foundation, the St. Michael's Hospital Foundation, and the SickKids-University of Toronto Ontario Student Opportunity Trust Fund (Restracomp). The Pediatric Outcomes Research Team is supported by a grant from the SickKids Foundation.	C.B. received a research grant from the Centre for Addiction and Mental Health Foundation (CAMH 2017-2020). J.M. received an unrestricted research grant for a completed investigator-initiated study from the Dairy Farmers of Canada (2011-2012) and Ddrops provided non-financial support (vitamin D supplements) for an investigator-initiated study on vitamin D and respiratory tract infections (2011-2015). P.P. received unrestricted research grants for completed investigator-initiated studies from Danone Institute of Canada (2002-2004 and 2006-2009), Dairy Farmers of Ontario (2008-2010), and Mead Johnson Nutrition provided non-financial support (Fer-In-Sol liquid iron supplement) (2011-2017) for an ongoing investigator-initiated trial of iron deficiency in young children that was funded by Canadian Institutes of Health Research (FRN #115059).	N/A	Milk fat (CVD)
Yazdani R, Albujeer ANH, Rahnama E, Kharazifard MJ. Effect of Xylitol on Salivary Streptococcus Mutans: A Systematic Review and Meta-analysis. Journal of Contemporary Medical Sciences. 2019;5(2):64-70. doi:10.22317/jcms.v5i2.582	N/A	N/A	N/A	NSS (oral health)
Young J, Conway EM, Rother KI, Sylvetsky AC. Low-calorie sweetener use, weight, and metabolic health among children: A mini-review. Pediatr Obes. 2019;14(8):e12521. doi:10.1111/ijpo.12521	This work was funded in part by the Department of Exercise and Nutrition Science at the George Washington University and in part by the Intramural Research Program of the National Institute of Diabetes and Digestive and Kidney Diseases at the National Institutes of Health.	N/A	N/A	NSS (body weight, diabetes, CVD)
Yu L, Mei H, Shi D, et al. Association of caffeine and caffeine metabolites with obesity among children and adolescents: National Health and Nutrition Examination Survey (NHANES) 2009-2014. Environ Sci Pollut Res Int. 2022;29(38):57618-57628. doi:10.1007/s11356-022-19836-1	N/A	N/A	N/A	Caffeine (body weight)

Citations	Funding Disclosures	Financial Relationships of the Authors	Conflicts of interest	Beverage Type (Outcome)
Zhang, H., Lee, Z. X., & Qiu, A. (2020). Caffeine intake and cognitive functions in children. Psychopharmacology, 237(10), 3109–3116. https://doi.org/10.1007/s00213-020-05596-8	The ABCD Study is supported by the National Institutes of Health and additional federal partners under award numbers U01DA041022, U01DA041028, U01DA041048, U01DA041089, U01DA041106, U01DA041117, U01DA041120, U01DA041134, U01DA041148, U01DA041156, U01DA041174, U24DA041123, and U24DA041147. This research is also supported by Singapore Ministry of Education (Academic research fund tier 1; NUHSRO/ 2017/052/T1-SRP-Partnership/01), and NUS Institute of Data Science, Singapore.	N/A	N/A	Caffeine (cognitive function)
Zheng M, Rangan A, Huang RC, et al. Modelling the Effects of Beverage Substitution during Adolescence on Later Obesity Outcomes in Early Adulthood: Results from the Raine Study. Nutrients. 2019;11(12):2928. doi:10.3390/nu11122928	The core management of the Raine Study is funded by the University of Western Australia, Curtin University, Telethon Kids Institute, Women and Infants Research Foundation, Edith Cowan University, Murdoch University, The University of Notre Dame Australia, and the Raine Medical Research Foundation. The 14 year follow-up was funded by National Health Medical Research Council (NHMRC) project grant (ID 211912 and ID 003209) and the Raine Medical Research Foundation. The 22 year follow-up was funded by NHMRC project grants (ID 1027449, 1044840, and 1021855).	M.Z. is funded by the NHMRC Early Career Fellowship.	N/A	NSS (body weight) Caffeine (body weight)
Zhong L, Han X, Li M, Gao S. Modifiable dietary factors in adolescent sleep: A systematic review and meta-analysis. Sleep Med. 2024;115:100-108. doi:10.1016/j.sleep.2024.02.009	This study was supported by a fund from the National Natural Science Foundation of China (82270924, 81970732), National High Level Hospital Clinical Research Funding (2022-PUMCH-C-014) and the CAMS Innovation Fund for Medical Sciences (CIFMS 2021-I2M-1-016).	N/A	N/A	Caffeine (cognitive function)

APPENDIX D. EVIDENCE GRADING METHODOLOGY AND FINDINGS

Methodology

Upon completion of data extraction for the scoping review, beverage types and outcomes with one or more rigorous studies or reviews were identified for evidence grading. Eligible study types included those with more rigorous designs—randomized controlled trials (RCTs), quasi-experimental studies, and/or observational prospective cohort studies. Studies of cross-sectional design were not considered eligible for evidence grading.

The following beverages and outcomes met the criteria for evidence grading:

- Milk fat and cardiovascular disease (CVD) outcomes;
- 100% juice and (1) CVD outcomes and (2) oral health;
- Sweetened flavored milk and diet quality; and
- Caffeinated beverages and (1) CVD outcomes and (2) cognitive, sleep, and behavioral outcomes.

Evidence grading was not conducted for carbonated water, flavored water, plant-based milk alternatives, and beverages with additives due to insufficient evidence. Evidence grading was also not conducted by this panel for outcomes related to body weight as this was included in the 2025 Dietary Guidelines Advisory Committee process.

Evidence Grading Process

Primary studies were identified during the scoping review—both from the original studies included by beverage type and outcome and from the included reviews and meta-analyses (described in **Appendix A**). Primary studies were included in the evidence review process if they met all inclusion criteria for the scoping review with exception for the date of publication. Any primary article identified from a systematic review or meta-analysis included in the scoping review was deemed eligible regardless of publication date if it met all other inclusion criteria. Data extraction was completed for all primary studies identified.

Research evidence was evaluated using criteria adapted from the *What Works For Health* and USDA's DGA evidence rating systems and rated in categories from "evidence-based" (highest confidence) to "insufficient evidence" (lowest confidence). See **Table D1** for more detailed category descriptions used by the subcommittee conducting the evidence grading.

Grading teams of two researchers met to review and assess the following elements for each beverage type and outcome of interest (adapted from *DGA protocol*):

a. The number of studies eligible (by study type or design).

b. Consistency of direction and magnitude of effect across the body of evidence.
The teams considered whether differences might be due to study design, measure of exposure or outcome, differences in exposure or level/length of exposure, or differences in population characteristics.

c. Quality (directness) of evidence.
The teams considered the extent to which studies are designed to directly examine the relationship among the interventions/exposures, comparators, and outcome of primary interest in the scoping review.

d. Precision, or the degree of certainty in study outcomes.
The teams considered measures of variability, such as the width and range of confidence intervals (CI), the number of studies, and sample sizes, within and across studies.

e. Generalizability to the U.S. population aged 5–18.

All four members of the grading team discussed and finalized grade recommendations

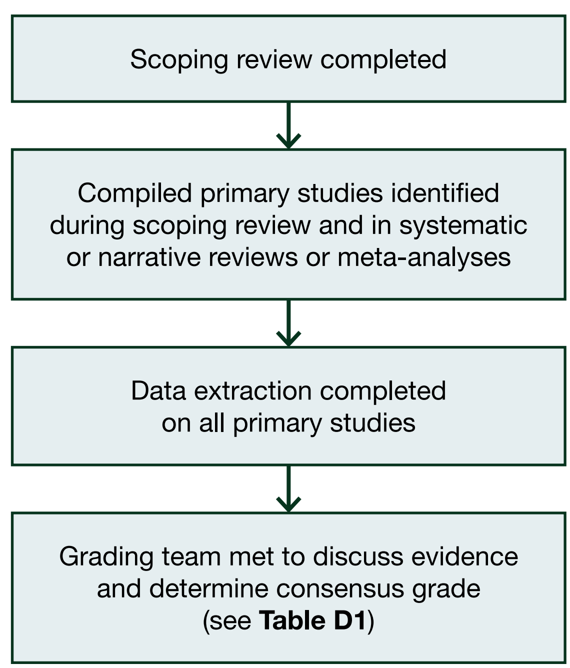


Table D1: Grading of Evidence

Rating	Description	Evidence Criteria: Amount and Type	Evidence Criteria: Quality of Evidence
Evidence Based	Evidence is consistent and includes findings from at least 3 high-quality studies with robust designs.	■ 3 experimental studies, or ■ 3 quasi-experimental studies with matched concurrent comparisons	Studies have: ■ Strong design ■ Statistically significant positive finding(s) for a specified outcome that are in a consistent direction with a clinically relevant magnitude of effect
Evidence Informed	Evidence is consistent, includes findings from at least 2 robust studies or 3 studies with slightly less robust designs or with minor limitations, and/or is from less relevant populations.	■ 2 experimental studies, or ■ 2 quasi-experimental studies with matched concurrent comparisons, or ■ 3 quasi-experimental studies with unmatched comparisons	Studies have statistically significant positive finding(s) for a specified outcome.
Insufficient Evidence	Evidence with this rating has limited research documenting effects, or mixed findings indicating the need for more research with stronger designs to confirm effects.	■ Generally, no more than 1 experimental or quasi-experimental study with a matched concurrent comparison, or ■ 2 or fewer quasi-experimental studies with unmatched comparisons or pre-post measures	■ Quality varies, but is often low ■ Findings vary, mixed evidence, or inconclusive

Note: Adapted from the What Works For Health evidence rating criteria available at *https://www.countyhealthrankings.org/take-action-to-improve-health/what-works-for-health/our-methods*.

Evidence Grading Findings

The following beverage types and outcomes were determined to be candidates for evidence grading: Plain Pasteurized Milk Fat Content—CVD; Sweetened Flavored Milk—diet quality; 100% Juice—CVD and dental caries; and Beverages with Caffeine—cognitive function (including sleep) and CVD. Evidence grading for carbonated water, flavored water, plant-based milk alternatives, and beverages with additives were deemed to have insufficient evidence for grading.

The 2025 Dietary Guidelines Advisory Committee was conducting a review of the strength of the evidence for beverage types and outcomes related to body weight at the time of this expert panel. Due to limited time and funds for this project, a similar review was omitted from this panel's evidence grading process.

Table D2 provides a summary of the results of the Evidence Grading process.

Table D2. Grading of Evidence Summary of Findings

Plain Pasteurized Milk Fat Content		
Cardiovascular Disease Outcomes		
Insufficient Evidence	LDL cholesterol, non-HDL cholesterol, HDL cholesterol, Triglycerides, Blood pressure, fasting glucose, insulin, leptin, adiponectin, apoA1, apoB, Lp(a)	6 studies ▪ 2 cluster randomized controlled trials ▪ 4 prospective cohort studies
100% Juice		
Cardiovascular Disease Outcomes		
Insufficient Evidence	Hypertension or hyperlipidemia	1 study ▪ 1 prospective cohort study
Oral Health		
Insufficient Evidence	Dental caries	2 studies ▪ 2 longitudinal prospective cohort studies
Insufficient Evidence	Tooth wear	2 studies ▪ 2 longitudinal prospective cohort studies
Sweetened Flavored Milk		
Diet Quality		
Insufficient Evidence	Nutrient intakes, food group intakes, or overall diet quality	4 studies ▪ 1 prospective cohort study ▪ 3 experimental studies with randomized crossover design
Beverages with Caffeine		
Cardiovascular Disease Outcomes		
Insufficient Evidence	Arterial stiffness, heart rhythm, left ventricular efficiency, Supraventricular extrasystoles, QT-RR, and QTc interval	2 studies ▪ 2 randomized, single-blind, placebo-controlled, crossover clinical trials from the same parent study)
Insufficient Evidence	Heart rate	7 studies ▪ 1 double-blind crossover counterbalanced study ▪ 1 double-blind placebo-controlled, dose-response design ▪ 1 randomized double-blind counterbalanced study ▪ 3 randomized, single-blind, place-controlled, crossover clinical trials from the same parent study ▪ 1 two-stage experimental study

Evidence-Based	Increased systolic and diastolic blood pressure	6 studies ▪ 1 double-blind crossover counterbalanced study ▪ 1 double-blind placebo-controlled, dose-response design ▪ 1 randomized double-blind counterbalanced study ▪ 2 randomized, single-blind, placebo controlled, crossover clinical trials from the same parent study ▪ 1 two-stage experimental study
Cognitive Function, Sleep, and Behavior/Affect		
Insufficient Evidence	Academic achievement, accuracy on a number task, sustained attention to task, time spent in REM sleep, sleep awakenings, aggressive behavior, conduct disorder, teacher-reported ADHD symptoms, global health assessment, anxiety, nervousness, depressive symptoms, headaches, risk taking behaviors	9 studies ▪ 6 prospective cohort studies ▪ 3 placebo-controlled trials
Insufficient Evidence	Sleep Duration	3 studies ▪ 3 prospective cohort studies
Evidence Informed	Delayed Sleep Onset	2 studies ▪ 2 prospective cohort studies

Plain Pasteurized Milk Fat Content—CVD

Six studies met the criteria for evidence grading. Two studies were cluster randomized controlled trials (1,2) and four were prospective cohort studies (3–6). Two of the prospective cohort studies lacked a clearly defined comparator of interest (3,6). Three studies examined associations between dairy fat in the overall diet rather than specifically from milk (1,3,4) and weren't considered relevant as the outcome of interest was fat intake from milk.

Based on evidence grading, 2 experimental or quasi-experimental studies with comparison groups examined associations between milk fat content and the following cardiovascular outcomes: LDL cholesterol (2), non-HDL cholesterol (2), HDL cholesterol (2,5), Triglycerides (2,5), systolic blood pressure (5), fasting glucose (5), Homeostatic Model Assessment of Insulin Resistance (HOMA-IR) (5), leptin (5), adiponectin (5), apoA1 (2), apoB (2), Lp(a) (2) and metabolic risk z-score (5). The majority of outcomes were based on a single study and the outcomes with two studies had mixed findings. Therefore, there is insufficient evidence to make a conclusion on the relationship between milk fat content and cardiovascular outcomes in children and adolescents.

Studies reviewed for plain pasteurized milk fat content and CVD outcomes:

1. Hendrie GA, Golley RK. Changing from regular-fat to low-fat dairy foods reduces saturated fat intake but not energy intake in 4-13-y-old children. Am J Clin Nutr. 2011 May;93(5):1117-27. doi: 10.3945/ajcn.110.010694. Epub 2011 Mar 23. PMID: 21430121.

2. Villalpando S, Lara Zamudio Y, Shamah-Levy T, Mundo-Rosas V, Manzano AC, Lamadrid-Figueroa H. Substitution of whole cows' milk with defatted milk for 4 months reduced serum total cholesterol, HDL-cholesterol and total apoB in a sample of Mexican school-age children (6-16 years of age). Br J Nutr. 2015 Sep 14;114(5):788-95. doi: 10.1017/S0007114515002330. Epub 2015 Jul 23. PMID: 26202784.

3. O'Sullivan TA, Bremner AP, Mori TA, Beilin LJ, Wilson C, Hafekost K, Ambrosini GL, Huang RC, Oddy WH. Regular Fat and Reduced Fat Dairy Products Show Similar Associations with Markers of Adolescent Cardiometabolic Health. Nutrients. 2016 Jan 2;8(1):22. doi: 10.3390/nu8010022. PMID: 26729163; PMCID: PMC4728636.

4. te Velde SJ, Snijder MB, van Dijk AE, Brug J, Koppes LL, van Mechelen W, Twisk JW. Dairy intake from adolescence into adulthood is not associated with being overweight and metabolic syndrome in adulthood: the Amsterdam Growth and Health Longitudinal Study. J Hum Nutr Diet. 2011 Jun;24(3):233-44. doi: 10.1111/j.1365-277X.2010.01149.x. Epub 2011 Feb 21. PMID: 21332840.

5. McGovern C, Rifas-Shiman SL, Switkowski KM, Woo Baidal JA, Lightdale JR, Hivert MF, Oken E, Aris IM. Association of cow's milk intake in early childhood with adiposity and cardiometabolic risk in early adolescence. Am J Clin Nutr. 2022 Aug 4;116(2):561-571. doi: 10.1093/ajcn/nqac103. PMID: 35441227; PMCID: PMC9348987.

6. Wong VCH, Maguire JL, Omand JA, Dai DWH, Lebovic G, Parkin PC, O'Connor DL, Birken CS; TARGet Kids! Collaboration. A Positive Association Between Dietary Intake of Higher Cow's Milk-Fat Percentage and Non-High-Density Lipoprotein Cholesterol in Young Children. J Pediatr. 2019 Aug;211:105-111.e2. doi: 10.1016/j.jpeds.2019.03.047. Epub 2019 May 17. PMID: 31104850.

100% Juice—CVD

A single prospective cohort study met the criteria for evidence grading. The study assessed risk of incident hypertension or hyperlipidemia by intake of fruit juice. Based on evidence grading, there is insufficient rigorous evidence to make a conclusion on the relationship between intake of fruit juice and hypertension or hyperlipidemia (1).

Studies reviewed for 100% juice and CVD outcomes:

1. Sakaki JR, Gao S, Ha K, Chavarro JE, Chen MH, Sun Q, Hart JE, Chun OK. Childhood beverage intake and risk of hypertension and hyperlipidaemia in young adults. Int J Food Sci Nutr. 2022 Nov;73(7):954-964. doi: 10.1080/09637486.2022.2091524. Epub 2022 Jun 27. PMID: 35761780; PMCID: PMC9951226.

100% Juice—oral health

Four longitudinal studies examining oral health outcomes met the criteria for evidence grading; all were prospective cohort studies.

Two studies looked at outcomes of dental caries (1,2). These studies did not observe a statistically significant association between 100% fruit juice and caries over time. Studies were conducted with smaller (<200 participants), non-representative samples. Based on evidence grading there is insufficient rigorous evidence to make a conclusion on the relationship between intake of 100% fruit juice intake and dental caries.

Two studies looked at outcome measures of tooth wear (3,4). These studies did not observe a statistically significant association between "fruit juice" and tooth wear over time but neither study specified the exposure as 100% juice. Based on evidence grading there is insufficient rigorous evidence to make a conclusion on the relationship between intake of 100% fruit juice intake and tooth wear.

Studies reviewed for 100% juice and oral health outcomes:

1. Ghazal TS, Levy SM, Childers NK, Carter KD, Caplan DJ, Warren JJ, Kolker JL. Survival analysis of caries incidence in African-American school-aged children. J Public Health Dent. 2019 Dec;79(1):10-17. doi: 10.1111/jphd.12289. Epub 2018 Sep 20. PMID: 30238461; PMCID: PMC6420363.

2. Chankanka O, Marshall TA, Levy SM, Cavanaugh JE, Warren JJ, Broffitt B, Kolker JL. Mixed dentition cavitated caries incidence and dietary intake frequencies. Pediatr Dent. 2011 May-Jun;33(3):233-40. PMID: 21703076; PMCID: PMC3690298.

3. Dugmore CR, Rock WP. A multifactorial analysis of factors associated with dental erosion. Br Dent J. 2004 Mar 13;196(5):283-6; discussion 273. doi: 10.1038/sj.bdj.4811041. PMID: 15017418.

4. El Aidi H, Bronkhorst EM, Huysmans MC, Truin GJ. Multifactorial analysis of factors associated with the incidence and progression of erosive tooth wear. Caries Res. 2011;45(3):303-12. doi: 10.1159/000328671. Epub 2011 Jun 8. PMID: 21654171.

Sweetened Flavored Milk—diet quality

Four studies met the criteria for evidence grading; one prospective cohort study (1), one randomized crossover design (2), one randomized trial (3) and one randomized repeated-measures design (4).

Energy intake was the only dietary outcome assessed in the three experimental studies. Thus, based on evidence grading there is insufficient rigorous evidence to make a conclusion on the relationship between intake of sweetened milk and overall diet quality.

Studies reviewed for sweetened flavored milk and diet quality:

1. Noel SE, Ness AR, Northstone K, Emmett P, Newby PK. Associations between flavored milk consumption and changes in weight and body composition over time: differences among normal and overweight children. Eur J Clin Nutr. 2013;67(3):295-300. doi:10.1038/ejcn.2012.123

2. Bennett L, Totosy De Zepetnek J, Brett N, et al. Effect of Commercially Available Sugar-Sweetened Beverages on Subjective Appetite and Short-Term Food Intake in Girls. Nutrients. 2018;10(4):394. doi:10.3390/nu10040394.

3. Poirier KL, Totosy De Zepetnek JO, Bennett LJ, et al. Effect of Commercially Available Sugar-Sweetened Beverages on Subjective Appetite and Short-Term Food Intake in Boys. Nutrients. 2019;11(2):270. doi:10.3390/nu11020270

4. Vien S, Luhovyy BL, Patel BP, et al. Pre- and within-meal effects of fluid dairy products on appetite, food intake, glycemia, and regulatory hormones in children. Appl Physiol Nutr Metab. 2017;42(3):302-310. doi:10.1139/apnm-2016-0251

Beverages with Caffeine—CVD

Nine studies were identified as eligible for evidence grading. This included 1 crossover, counterbalanced study (1); 1 placebo-controlled, dose-response design (2); 1 randomized placebo-controlled study (3); 5 randomized, placebo-controlled, crossover clinical trials from the same parent study (4–8); and a two-stage experimental study (9).

There was only one rigorous study that examined the relationship between intake of caffeinated beverages and each of the following cardiovascular outcomes in children and adolescents: arterial stiffness (4), heart rhythm (5), left ventricular efficiency (6), Supraventricular extrasystoles (5), QT-RR (5), and QTc interval (5). Thus, there is insufficient evidence on the relationship between intake of caffeinated beverages and these specific cardiovascular outcomes.

Grading of studies examining the association between consumption of caffeinated beverages and heart rate revealed inconsistent findings (1,2,3,5,6,8,9). Thus, there is insufficient evidence regarding the relationship between intake of caffeinated beverages and heart rate.

A significant number of high-quality studies suggest that consumption of caffeinated beverages increased systolic blood pressure (1–3, 7–9) and diastolic blood pressure (1–3, 7–9) (Evidence-based).

Studies reviewed for beverages with caffeine and CVD outcomes:

1. Turley K, Eusse PA, Thomas MM, Townsend JR, Morton AB. Effects of different doses of caffeine on anaerobic exercise in boys. Pediatr Exerc Sci. 2015 Feb;27(1):50-6. doi: 10.1123/pes.2014-0032. PMID: 25051124.

2. Temple JL, Ziegler AM, Graczyk A, Bendlin A, Sion T, Vattana K. Cardiovascular responses to caffeine by gender and pubertal stage. Pediatrics. 2014 Jul;134(1):e112-9. doi: 10.1542/peds.2013-3962. Epub 2014 Jun 16. PMID: 24935999; PMCID: PMC4067640.

3. Turley KR, Bland JR, Evans WJ. Effects of different doses of caffeine on exercise responses in young children. Med Sci Sports Exerc. 2008 May;40(5):871-8. doi: 10.1249/MSS.0b013e318165984c. PMID: 18408611.

4. Li P, Mandilaras G, Jakob A, Dalla-Pozza R, Haas NA, Oberhoffer FS. Energy Drinks and Their Acute Effects on Arterial Stiffness in Healthy Children and Teenagers: A Randomized Trial. J. Clin. Med. 2022, 11, 2087. https://doi.org/10.3390/jcm11082087

5. Mandilaras G, Li P, Dalla-Pozza R, Haas NA, Oberhoffer FS. Energy Drinks and Their Acute Effects on Heart Rhythm and Electrocardiographic Time Intervals in Healthy Children and Teenagers: A Randomized Trial. Cells 2022, 11, 498. https://doi.org/10.3390/cells11030498

6. Oberhoffer FS, Li P, Jakob A, Dalla-Pozza R, Haas NA, Mandilaras G. Energy Drinks Decrease Left Ventricular Efficiency in Healthy Children and Teenagers: A Randomized Trial. Sensors 2022, 22, 7209. https://doi.org/10.3390/s22197209

7. Oberhoffer FS, Li P, Jakob A, Dalla-Pozza R, Haas NA and Mandilaras G. Energy Drinks: Effects on Blood Pressure and Heart Rate in Children and Teenagers. A Randomized Trial. Front. Cardiovasc. Med. 2022;9:862041. doi: 10.3389/fcvm.2022.862041

8. Oberhoffer FS, Dalla-Pozza R, Jakob A, Haas NA, Mandilaras G, Li P. Energy drinks: effects on pediatric 24-h ambulatory blood pressure monitoring. A randomized trial. Pediatr Res. 2023 Sep;94(3):1172-1179. doi: 10.1038/s41390-023-02598-y. Epub 2023 Apr 15. PMID: 37061642; PMCID: PMC10444612.

9. Mansour B, Amarah W, Nasralla E, Elias N. Energy drinks in children and adolescents: demographic data and immediate effects. Eur J Pediatr. 2019 May;178(5):649-656. doi: 10.1007/s00431-019-03342-7. Epub 2019 Feb 15. PMID: 30770983.

Beverages with Caffeine—cognitive function, sleep, and behavior/affect

Eleven studies examining cognitive outcomes, including cognitive function, sleep, and behavior or affect, met the criteria for evidence grading. These included 8 prospective cohort studies (1–8) and 3 studies that used placebo-controlled trials (9–11). Based on evidence grading, due to the limited number of studies, there is insufficient rigorous evidence to make a conclusion on the relationship between intake of caffeinated beverages and the following outcomes in children and adolescents:

- **Cognitive function:** academic achievement (1), accuracy on a number task (9), and sustained attention to task (10);
- **Sleep:** time spent in REM sleep (4), sleep awakenings (5); and
- **Behavior/affect:** aggressive behavior (6), conduct disorder (8), teacher-reported ADHD symptoms (8), global health assessment (7), anxiety (8), nervousness (5), depressive symptoms (8), headaches (9), risk taking behaviors (11).

Grading of three studies examining the association between consumption of caffeinated beverages and sleep duration revealed inconsistent findings (2–4). Thus, there is insufficient rigorous evidence to make a conclusion on the relationship between intake of caffeinated beverages and sleep duration.

Grading of two studies examining the association between consumption of caffeinated beverages and later sleep onset were consistent, suggesting increased consumption of beverages with caffeine may delay sleep onset (1,4) (Evidence informed).

Studies reviewed for beverages with caffeine and cognitive function, sleep, and behavioral outcomes:

1. Smith AP, Richards G. Energy drinks, caffeine, junk food, breakfast, depression and academic attainment of secondary school students. J Psychopharmacol. 2018 Aug;32(8):893-899. doi: 10.1177/0269881118783314. Epub 2018 Jun 27. PMID: 29947575.

2. Mathew GM, Reichenberger DA, Master L, Buxton OM, Chang AM, Hale L. Too Jittery to Sleep? Temporal Associations of Actigraphic Sleep and Caffeine in Adolescents. Nutrients. 2021 Dec 23;14(1):31. doi: 10.3390/nu14010031. PMID: 35010906; PMCID: PMC8746933.

3. Patte KA, Qian W, Leatherdale ST. Modifiable predictors of insufficient sleep durations: A longitudinal analysis of youth in the COMPASS study. Prev Med. 2018 Jan;106:164-170. doi: 10.1016/j.ypmed.2017.10.035. Epub 2017 Nov 9. PMID: 29109016.

4. Lunsford-Avery JR, Kollins SH, Kansagra S, Wang KW, Engelhard MM. Impact of daily caffeine intake and timing on electroencephalogram-measured sleep in adolescents. J Clin Sleep Med. 2022 Mar 1;18(3):877-884. doi: 10.5664/jcsm.9736. PMID: 34710040; PMCID: PMC8883093.

5. Whalen DJ, Silk JS, Semel M, Forbes EE, Ryan ND, Axelson DA, Birmaher B, Dahl RE. Caffeine consumption, sleep, and affect in the natural environments of depressed youth and healthy controls. J Pediatr Psychol. 2008 May;33(4):358-67. doi: 10.1093/jpepsy/jsm086. Epub 2007 Oct 18. PMID: 17947257; PMCID: PMC2492889.

6. Kristjansson AL, Kogan SM, James JE, Sigfusdottir ID. Adolescent caffeine consumption and aggressive behavior: A longitudinal assessment. Subst Abus. 2021;42(4):450-453. doi: 10.1080/08897077.2021.1876810. Epub 2021 Jan 25. PMID: 33492197.

7. Richards G, Smith AP. Caffeine Consumption and General Health in Secondary School Children: A Cross-sectional and Longitudinal Analysis. Front Nutr. 2016 Nov 28;3:52. doi: 10.3389/fnut.2016.00052. PMID: 27965962; PMCID: PMC5124578.

8. Marmorstein NR. Energy Drink and Coffee Consumption and Psychopathology Symptoms Among Early Adolescents: Cross-Sectional and Longitudinal Associations. J Caffeine Res. 2016 Jun 1;6(2):64-72. doi: 10.1089/jcr.2015.0018. PMID: 27274416; PMCID: PMC4892225.

9. Heatherley SV, Hancock KM, Rogers PJ. Psychostimulant and other effects of caffeine in 9- to 11-year-old children. J Child Psychol Psychiatry. 2006 Feb;47(2):135-42. doi: 10.1111/j.1469-7610.2005.01457.x. PMID: 16423144.

10. Cooper RK, Lawson SC, Tonkin SS, Ziegler AM, Temple JL, Hawk LW. Caffeine enhances sustained attention among adolescents. Exp Clin Psychopharmacol. 2021 Feb;29(1):82-89. doi: 10.1037/pha0000364. Epub 2020 May 21. PMID: 32437192; PMCID: PMC11181358.

11. Temple JL, Ziegler AM, Graczyk AM, Crandall A. Effects of acute and chronic caffeine on risk-taking behavior in children and adolescents. J Psychopharmacol. 2017 May;31(5):561-568. doi: 10.1177/0269881117691568. Epub 2017 Feb 15. PMID: 28198658.

APPENDIX E. EXISTING BEVERAGE RECOMMENDATIONS

Consistency and Completeness in Evidence-Based Beverage Recommendations for Children and Adolescents (updated 7.8.24)

A qualitative analysis of consistency and completeness across existing policy statements and evidence-based recommendations/guidelines on beverage consumption was conducted using four criteria: 1) consumption, 2) type, 3) frequency, and 4) amount. The details of this analysis are provided in the following tables.

A: Generally well-established recommendations with broad agreement on consumption, type, frequency, and amount

B: Limited evidence or lack of agreement on consumption, type, frequency, or amount

C: Inconsistency/conflict in guidance for two or more criteria (e.g., consumption, type, frequency, or amount)

A	Sugar-sweetened beverages	■ **Consumption:** Agreement not to consume. ■ **Type:** Some organizations/authorities provided examples; most used the term broadly. ■ **Amount/Frequency:** Variation in guidance, such as: remove, eliminate, not necessary, limit, avoid, decrease, reduce.
B	Plain drinking water	■ **Consumption:** Agreement to consume. ■ **Type:** Variation in guidance, such as: fluoridated, plain, unsweetened, tap, bottled, carbonated, or sparkling. ■ **Amount:** A majority of organizations/authorities did not provide guidance. Three organizations did and were in alignment. ■ **Frequency:** Variation in guidance, such as: as requested by child, during meals, with snacks, and throughout the day.
B	100% juice	■ **Consumption:** Agreement that can be consumed up to a maximum amount. ■ **Type:** Variation by organization in type of juice: pasteurized, reconstituted, dilution, carbonation, no added sweeteners. ■ **Amount/Frequency:** A lot of variation in quantitative guidance/maximum amount to serve per day or per meal.
B	Plain pasteurized milk	■ **Consumption:** Agreement that can be consumed up to a maximum amount. ■ **Type:** General agreement on fat type (low-fat or fat-free); one organization specifically recommended pasteurized milk. ■ **Amount:** Variation in quantitative guidance, or the maximum amount to consume. ■ **Frequency:** Variation in guidance, such as: serve per day vs. serve per meal.
B	Plant-based milk alternatives	■ **Consumption:** Limited guidance available. When addressed, agreement that certain types can be consumed as a substitute for plain cow's milk. ■ **Type:** Of the organizations/authorities that provided guidance, there was variation, such as: only fortified soy vs specific nutrient requirements. ■ **Amount:** Of the organizations/authorities that provided guidance, aligned with plain milk guidance. ■ **Frequency:** Of the organizations/authorities that provided guidance, aligned with plain milk guidance.
C	Sweetened flavored milk	■ **Consumption:** Disagreement on consumption. ■ **Type:** Of the organizations/authorities that allow flavored milk, the guidance for fat types aligned with their plain milk guidance (fat-free or low-fat). ■ **Amount:** A majority of organizations/authorities provide guidance to avoid or limit. Of those that recommend limited consumption, guidance was not provided. Of those that allowed flavored milk, guidance aligned with plain milk. ■ **Frequency:** Of the organizations/authorities that allowed flavored milk, the guidance was in alignment with plain milk guidance.
C	Beverages with non-sugar sweeteners	■ **Consumption:** Limited and mixed guidance on consumption; many organizations/authorities indicate additional research is needed. ■ **Type:** Variation in terminology, such as: non-nutritive sweeteners, low-calorie sweeteners, and non-sugar sweeteners. ■ **Amount/Frequency:** When addressed, generally recommended to limit or advise against consuming. Of those organizations/authorities that recommended limited consumption, quantitative guidance was not provided.
C	Beverages with caffeine	■ **Consumption:** Limited and mixed guidance on consumption. ■ **Type:** Most guidance focused on energy drinks, specifically, and did not address other types of beverages with caffeine. ■ **Amount/Frequency:** When addressed, generally advised not to consume. Quantitative guidance, or a maximum amount, was not provided.

Evidence-Based Beverage Recommendations for Children and Adolescents

<table>
<thead>
<tr><th>Organization/
Authority</th><th>5–10 years
(Middle Childhood)</th><th>12–14 years
(Middle School)</th><th>15–18 years
(High School)</th></tr>
</thead>
<tbody>
<tr><td colspan="4">Plain Drinking Water</td></tr>
<tr><td>American Academy of Pediatrics (AAP)</td><td colspan="3">■ The ideal beverage for children at all meals and during the day is water. (quick reference guide and Pediatric Nutrition, 8th edition)
■ Parents should be encouraged to routinely offer plain, unflavored water to children, particularly for fluids consumed outside of meals and snacks. (Pediatric Nutrition, 8th edition)
■ Pediatricians are encouraged to routinely counsel children and families to decrease sugary drink consumption and increase water consumption. (2019 policy statement)
■ Pediatricians can advocate for water fluoridation in the local community and can maximize the preventive value of fluoride by assessing a child's exposure to fluoride and determine the need for topical or systemic supplements. (Pediatric Nutrition, 8th edition)
■ Make sure the child (5–10 years) drinks fluoridated water. Children who do not drink fluoridated water and are at high risk of caries should take prescribed fluoride supplements. (Bright Futures, 4th edition)
■ Adolescents (11–21 years) also…should drink fluoridated water. (Bright Futures, 4th edition)</td></tr>
<tr><td>American Academy of Pediatric Dentistry (AAPD)</td><td colspan="3">■ The use of fluoride for the prevention and control of caries is both safe and highly effective in reducing dental caries prevalence. Consumption of optimally-fluoridated community water is a cost-effective method to prevent and control caries at the population level. Fluoride dietary supplements can be cautiously considered for children at caries risk who drink less than optimally fluoridated water as supplementation, in the face of all other sources of fluoride, could exceed the recommended amount of daily fluoride intake. (2023 Clinical Guide)
■ Systemic fluoride intake via optimal fluoridation of drinking water or professionally-prescribed supplements is recommended to 16 years of age. (2022 policy statement)</td></tr>
<tr><td>American Heart Association (AHA)</td><td>Boys and girls between the ages of 4–8 years should consume at least 1.7 liters (roughly 7 cups) of total water each day. Girls between the ages of 9–13 years should consume at least 2.1 L (roughly 9 cups), and boys in the same age group should consume at least 2.4 L (roughly 10 cups). (2023 policy statement)</td><td>Girls between the ages of 9–13 years should consume at least 2.1 L (roughly 9 cups) of total water each day, and boys in the same age group should consume at least 2.4 L (roughly 10 cups) of total water daily. (2023 policy statement)</td><td>Not addressed</td></tr>
<tr><td>Academy of Nutrition and Dietetics (The Academy)</td><td colspan="3">■ The following fluid estimates should be used as a starting point. Fluid needs may be affected by a variety of individual factors that influence perspiration, such as temperature and physical activity. Adequate Intakes (AI) for fluid needs are as follows:
• Children aged 5 to 8 years need 1,700 mL (1.7 L or 7 cups) total water per day
• Boys aged 9 to 11 years need 2,400 mL (2.4 L or 10 cups) total water per day
• Girls aged 9 to 11 years need 2,100 mL (2.1 L or 9 cups) total water per day
■ Alternatively, the following formula can be used to estimate fluid needs based on body weight:
• 10–20 kg of body weight = 1000 mL + 50 mL per kg for each kg above 10 kg
• > 20 kg of body weight = 1500 mL + 20 mL per kg for each kg above 20 kg
(2023, Pediatric Nutrition Care Manual, "Normal Nutrition, School-Age Children, Comparative Standards: Fluid Needs")
■ Sample menus include ½–1 cup of water at each meal/snack (except breakfast which has ¾ cup 1% milk). (2023, Pediatric Nutrition Care Manual, "School-Age Child Nutrition Therapy")
■ Guidance to choose: 1) low-fat or fat-free milk, 2) fortified soy milk, 3) water, 4) low-calorie beverages. (2023, Pediatric Nutrition Care Manual, "Adolescent Nutrition Therapy")
■ As part of the HHFKA, free water must be available in the cafeteria during lunch and breakfast service. (2018, position paper)</td></tr>
</tbody>
</table>

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
Dietary Guidelines for Americans, 2020–2025 (DGA)	■ Beverages that are calorie-free—especially **water**—or that contribute beneficial nutrients, such as fat-free and low-fat milk and 100% juice, should be the primary beverages consumed. Coffee, tea, and **flavored waters** are also options, but the most nutrient-dense options for these beverages include little, if any, sweeteners or cream; (this is general throughout the lifespan). ■ Decreasing consumption of sugar-sweetened beverages to reduce added sugars intake will help youth achieve a healthy dietary pattern. Beverages that contain no added sugars should be the primary choice for children and adolescents. These include **water** and unsweetened fat-free or low-fat milk—including low-lactose or lactose-free options or fortified soy beverage—and 100% juice within recommended amounts. (*DGA, 2020–2025*)		
Child and Adult Care Food Program (CACFP)	In the Child and Adult Care Food Program (CACFP), centers and homes are required to offer **water** to children **throughout the day.** Water is not a meal component in the CACFP. There is **no minimum serving amount for water.** However, water may be served: together with meals and snacks, in between meals and snacks, as requested. (*Offering Water in CACFP, 2021*)		
National School Lunch Program (NSLP)	■ Lunch: Schools must make **potable water** available and accessible **without restriction** to children at no charge in the place(s) where lunches are served during the meal service. ■ Competitive food: **Plain water or plain carbonated water (no container size limit)**. (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)		
Centers for Disease Control and Prevention (CDC)	■ The Healthy, Hunger-Free Kids Act of 2010 requires schools participating in the National School Lunch Program (NSLP) to make **free water** available to students **during mealtimes where they are served**. (*Water Access in Schools*) ■ Choose **water (tap or unsweetened, bottled, or sparkling)**. (*Rethink Your Drink*)		
World Health Organization (WHO)	*Not addressed*		
National Academies of Science, Engineering, and Medicine (NASEM)	**Total water* recommendations** (adequate intake) by age group (page 610): ■ Children 4–8 years: **1.7 Liters per day (L/d)**. This includes approximately 1.2 L (≈ 5 cups) as total beverages, including drinking water. ■ Females 9–13 years: **2.1 L/d**. This includes approximately 1.6 L (≈ 7 cups) as total beverages, including drinking water. ■ Males 9–13 years: **2.4 L/d.** This includes approximately 1.8 L (≈ 8 cups) as total beverages, including drinking water. *Total water includes all water contained in food, beverages, and drinking water. (*2005, Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*)	**Total water* recommendations** (AI) by age group (page 610): ■ Females 9–13 years: **2.1 L/d.** This includes approximately 1.6 L (≈ 7 cups) as total beverages, including drinking water. ■ Males 9–13 years: **2.4 L/d.** This includes approximately 1.8 L (≈ 8 cups) as total beverages, including drinking water. ■ Females 14–18 years: **2.3 L/d.** This includes approximately 1.8 L (≈ 8 cups) as total beverages, including drinking water. ■ Males 14–18 years: **3.3 L/d.** This includes approximately 2.6 L (≈ 11 cups) as total beverages, including drinking water. *Total water includes all water contained in food, beverages, and drinking water. (*2005, Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*)	**Total water* recommendations** (AI) by age group (page 610): ■ Females 14–18 years: **2.3 L/d.** This includes approximately 1.8 L (≈ 8 cups) as total beverages, including drinking water. ■ Males 14–18 years: **3.3 L/d.** This includes approximately 2.6 L (≈ 11 cups) as total beverages, including drinking water. *Total water includes all water contained in food, beverages, and drinking water. (*2005, Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*)

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Authority</th><th>5–10 years
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(Middle School)</th><th>15–18 years
(High School)</th></tr>
<tr><td colspan="4">100% Juice</td></tr>
<tr><td>AAP</td><td colspan="3">■ Fruit juice offers no nutritional benefits over whole fruit for infants and children and has no essential role in healthy, balanced diets of children. One hundred percent fresh or reconstituted fruit juice can be a healthy part of the diet of children older than 1 year when consumed as part of a well-balanced diet. (Bright Futures, 4th edition)
■ Consumption of unpasteurized juice products should be strongly discouraged in infants, children and adolescents. (quick reference guide; Pediatric Nutrition, 8th edition; Bright Futures, 4th edition)
■ 5–6 years: The intake of juice should be limited to, at most, 4 to 6 ounces/day. (quick reference guide; Pediatric Nutrition, 8th edition; Bright Futures, 4th edition)
■ 7–18 years: juice intake should be limited to 8 ounces or 1 cup of the recommended 2 to 2.5 cups of fruit servings per day. (quick reference guide; Pediatric Nutrition, 8th edition; Bright Futures, 4th edition)</td></tr>
<tr><td>AAPD</td><td colspan="3">Four to six ounces for children four through six years of age, and eight ounces for children seven through 18 years of age. (2022 policy statement)</td></tr>
<tr><td>AHA</td><td colspan="3">Sweetened beverages and naturally sweet beverages, such as fruit juice, should be limited to 4 to 6 oz per day for children 1 to 6 years old, and to 8 to 12 oz per day for children 7 to 18 years old. (2005 position statement)</td></tr>
<tr><td>The Academy</td><td colspan="3">■ Guidance to limit: 1) sweetened and flavored milks (such as chocolate milk or strawberry milk), 2) unfortified non-dairy milks, 3) 100% fruit juice to no more than 4–6 oz per day, 4) flavored juice drinks, and 5) sugar-sweetened beverages under 'Foods to Limit'. (2023, Pediatric Nutrition Care Manual, “School-Age Child Nutrition Therapy”)
■ Portion size for children aged 4–12 years: 4 oz (Pediatric Nutrition Assessment, 3rd edition)
■ Guidance to limit: 1) 100% fruit juice to 1 cup or less per day, 2) sodas, 3) fruit drinks, and 4) sports drinks. (2023, Pediatric Nutrition Care Manual, “Adolescent Nutrition Therapy”)</td></tr>
<tr><td>DGA</td><td colspan="3">■ At least half of the recommended amount of fruit should come from whole fruit, rather than 100% juice. When juices are consumed, they should be 100% juice and always pasteurized or 100% juice diluted with water (without added sugars).
■ Beverages that contain no added sugars should be the primary choice for children and adolescents (2–18 years). These include water and unsweetened fat-free or low-fat milk—including low-lactose or lactose-free options or fortified soy beverage—and 100% juice within recommended amounts.
■ 2–18 years: Although 100% fruit juice without added sugars can be part of a healthy dietary pattern, it is lower in dietary fiber than whole fruit. Dietary fiber is a dietary component of public health concern. With the recognition that fruit should mostly be consumed in whole forms, the amount of fruit juice in the USDA Food Patterns ranges from 4 fluid ounces at the lower calorie levels and no more than 10 fluid ounces at the highest calorie levels. See Table A-32 for calorie levels. (DGA, 2020–2025)</td></tr>
<tr><td>CACFP</td><td colspan="3">Pasteurized, full-strength juice may be used to fulfill the entire fruit or vegetable requirement at a meal or snack. Vegetable juice or fruit juice may only be served at one meal, including snack, per day.
■ Breakfast = ½ cup (all ages)
■ Lunch or supper = ¼–½ cup (all ages)
■ Snack = ½ cup for 5 years; ¾ cup 6–18 years
(eCFR :: 7 CFR 226.20 — Requirements for meals.)</td></tr>
</table>

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
NSLP	■ Lunch: **No more than half** of the fruit or vegetable offerings may be in the form of juice **(~¼ – ~ cup)**. All juice must be **100% full-strength and pasteurized**. ■ Snack: A serving of vegetable or fruit, or full-strength **vegetable or fruit juice**, or an equivalent quantity of any combination of these foods. Juice must not be served when fluid milk is served as the only other component. ■ Competitive food: **100 percent fruit/vegetable juice**, and **100 percent fruit and/or vegetable juice diluted with water** (with or without carbonation and with no added sweeteners) **(no more than 8 fluid ounces)**. *eCFR :: 7 CFR Part 210 — National School Lunch Program*	■ Lunch: **No more than half** of the fruit or vegetable offerings may be in the form of juice **(~¼ – ~ cup)**. All juice must be **100% full-strength and pasteurized**. ■ Snack: A serving of vegetable or fruit, or full-strength **vegetable or fruit juice**, or an equivalent quantity of any combination of these foods. Juice must not be served when fluid milk is served as the only other component. ■ Competitive food: **100 percent fruit/vegetable juice**, and **100 percent fruit and/or vegetable juice diluted with water** (with or without carbonation and with no added sweeteners) **(no more than 12 fluid ounces)**. *eCFR :: 7 CFR Part 210 — National School Lunch Program*	■ Lunch: **No more than half** of the fruit or vegetable offerings may be in the form of juice **(~½ cup)**. All juice must be **100% full-strength and pasteurized**. ■ Snack: A serving of vegetable or fruit, or full-strength **vegetable or fruit juice**, or an equivalent quantity of any combination of these foods. Juice must not be served when fluid milk is served as the only other component. ■ Competitive food: **100 percent fruit/vegetable juice**, and **100 percent fruit and/or vegetable juice diluted with water** (with or without carbonation and with no added sweeteners) **(no more than 12 fluid ounces)**. *eCFR :: 7 CFR Part 210 — National School Lunch Program*
CDC	Water just won't do? Reach for drinks that contain important nutrients such as low fat or fat free milk; unsweetened, fortified milk alternatives; or **100% fruit or vegetable juice** first. (*Rethink Your Drink*)		
WHO	*Not addressed*		
NASEM	*Not addressed*		

Plain Pasteurized Milk

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
AAP	■ **Low-fat or fat-free, preferably unflavored**. (*quick reference guide*) ■ Health care professionals should encourage parents to provide **several servings of low-fat or fat-free milk daily**. (*Bright Futures, 4th edition*) ■ Adolescents require **4 servings a day of low-fat (1%) or nonfat milk or other low-fat dairy products** to provide adequate amounts of calcium and vitamin D for strong bones. (*Pediatric Nutrition, 8th edition*)		
AAPD	*Not addressed*		
AHA	Prevent and reverse any rules that weaken the school nutrition standards to ensure the nutrition standards are aligned with the most current Dietary Guidelines for Americans as required by law. (*2020 policy statement*)		
The Academy	■ Guidance to choose: 1) **plain, pasteurized 1% or non-fat (skim) milk** and 2) fortified non-dairy milk (soy, almond, rice) under 'Foods to Choose. Sample menus for 5–11 year olds includes ¾ cup 1% milk at breakfast. (2023, *Pediatric Nutrition Care Manual*, "School-Age Child Nutrition Therapy") ■ Guidance to choose: 1) **low-fat or fat-free milk**, 2) fortified soy milk, 3) water, 4) low-calorie beverages. 1 serving of dairy = 1 cup milk or 1 cup fortified non-dairy milk with at least 7 grams of protein. (2023, *Pediatric Nutrition Care Manual*, "Adolescent Nutrition Therapy") ■ Portion sizes: Milk, yogurt, cheese = 7–12 y: ½–1 cup (4–8 oz). (*Pediatric Nutrition Assessment, 3rd edition*)		

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
DGA	Nutrient-dense options within the dairy group are **unsweetened fat-free and low-fat (1%) milk**, yogurt, cheese, fortified soy beverages and yogurt, and **low-lactose and lactose-free dairy products**. ■ Ages 5–8 = **2.5 cup eq/day** dairy* ■ Ages 9–13 = **3 cup eq/day** dairy* *which includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products or fortified soy beverages (*DGA, 2020–2025*)	Nutrient-dense options within the dairy group are **unsweetened fat-free and low-fat (1%) milk**, yogurt, cheese, fortified soy beverages and yogurt, and **low-lactose and lactose-free dairy products**. ■ Ages 9–13 = **3 cup eq/day** dairy* ■ Ages 14–18 = **3 cup eq/day** dairy* *which includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products or fortified soy beverages (*DGA, 2020–2025*)	Nutrient-dense options within the dairy group are **unsweetened fat-free and low-fat (1%) milk**, yogurt, cheese, fortified soy beverages and yogurt, and **low-lactose and lactose-free dairy products**. ■ Ages 14–18 = 3 cup eq/day dairy* *which includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products or fortified soy beverages (*DGA, 2020–2025*)
CACFP	At each meal served, **fluid milk** must be served as a beverage or on cereal, or a combination of both. As a snack, milk may be served as one of the two required components. **Lactose-free and reduced-lactose milk** that meet the fat content and flavor specifications for each age group may also be offered. ■ 5 years old: Either **unflavored low-fat (1 percent) or unflavored fat-free (skim) milk** must be served. **Minimum of 6 fl oz/meal** served. ■ 6–18 years old: **Low-fat (1 percent fat or less) or fat-free (skim) milk** must be served. Milk may be **unflavored or flavored. Minimum of 8 fl oz/meal** served. (*eCFR :: 7 CFR 226.20 — Requirements for meals.*)	At each meal served, **fluid milk** must be served as a beverage or on cereal, or a combination of both. As a snack, milk may be served as one of the two required components. **Lactose-free and reduced-lactose milk** that meet the fat content and flavor specifications for each age group may also be offered. ■ 6–18 years old. **Low-fat (1 percent fat or less) or fat-free (skim) milk** must be served. **Milk may be unflavored or flavored. Minimum of 8 fl oz/meal served**. (*eCFR :: 7 CFR 226.20 — Requirements for meals.*)	

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
NSLP	■ Lunch Grades K–5: **5 cups/week; 1 cup/day** ■ All fluid milk must be **fat-free (skim) or low-fat (1 percent fat or less). Milk may be unflavored or flavored**, provided that unflavored milk is offered at each meal service. ■ Schools must offer students a variety (at least two different options) of fluid milk. All milk must be fat-free (skim) or low-fat (1 percent fat or less). Milk with higher fat content is not allowed. Low-fat or fat-free lactose-free and reduced-lactose fluid milk may also be offered. Milk may be unflavored or flavored, provided that unflavored milk is offered at each meal service. ■ All fluid milk served in the Program must be **pasteurized fluid milk** which meets State and local standards for such milk. All fluid milk must have vitamins A and D at levels specified by the Food and Drug Administration and must be consistent with State and local standards for such milk. ■ Afterschool snacks may, but are not required, to contain a serving of fluid milk as a beverage, or on cereal, or used in part for each purpose. ■ Competitive foods: **Low fat or non-fat milk, flavored or unflavored** (no more than **8 fluid ounces**). (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)	■ Lunch Grades 6–8: **5 cups/week; 1 cup/day** ■ All fluid milk must be **fat-free (skim) or low-fat (1 percent fat or less). Milk may be unflavored or flavored**, provided that unflavored milk is offered at each meal service. ■ Schools must offer students a variety (at least two different options) of fluid milk. All milk must be fat-free (skim) or low-fat (1 percent fat or less). Milk with higher fat content is not allowed. Low-fat or fat-free lactose-free and reduced-lactose fluid milk may also be offered. Milk may be unflavored or flavored, provided that unflavored milk is offered at each meal service. ■ All fluid milk served in the Program must be **pasteurized fluid milk** which meets State and local standards for such milk. All fluid milk must have vitamins A and D at levels specified by the Food and Drug Administration and must be consistent with State and local standards for such milk. ■ Afterschool snacks may, but are not required, to contain a serving of fluid milk as a beverage, or on cereal, or used in part for each purpose. ■ Competitive foods: **Low fat or non-fat milk, flavored or unflavored** (no more than **12 fluid ounces**). (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)	■ Lunch Grades 9–12: **5 cups/week; 1 cup/day** ■ All fluid milk must be **fat-free (skim) or low-fat (1 percent fat or less). Milk may be unflavored or flavored**, provided that unflavored milk is offered at each meal service. ■ Schools must offer students a variety (at least two different options) of fluid milk. All milk must be fat-free (skim) or low-fat (1 percent fat or less). Milk with higher fat content is not allowed. Low-fat or fat-free lactose-free and reduced-lactose fluid milk may also be offered. Milk may be unflavored or flavored, provided that unflavored milk is offered at each meal service. ■ All fluid milk served in the Program must be **pasteurized fluid milk** which meets State and local standards for such milk. All fluid milk must have vitamins A and D at levels specified by the Food and Drug Administration and must be consistent with State and local standards for such milk. ■ Afterschool snacks may, but are not required, to contain a serving of fluid milk as a beverage, or on cereal, or used in part for each purpose. ■ Competitive foods: **Low fat or non-fat milk, flavored or unflavored** (no more than **12 fluid ounces**). (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)
CDC	Water just won't do? Reach for drinks that contain important nutrients such as **low fat or fat free milk**; unsweetened, fortified milk alternatives; or 100% fruit or vegetable juice first. (*Rethink Your Drink*)		
WHO	*Not addressed*		
NASEM	*Not addressed*		
Flavored Milk			
AAP	■ Low-fat or fat-free, **preferably unflavored** (*quick reference guide*) ■ The ideal beverage for children at all meals and during the day is water, whereas low-fat or fat-free, **preferably unflavored, milk** also has an important place in the diet of children beginning at 12 months of age. (*Pediatric Nutrition, 8th edition*)		
AAPD	The AAPD especially recognizes the importance of and supports: recommendations from the USDA for individuals aged two and older to consume a diet of nutrient-dense, lean or low-fat foods from across five food groups (i.e., fruits, vegetables, protein, grains, and **dairy) that are prepared without added salt, starches, sugars, or fat**. (*2020 policy statement*)		
AHA	Prevent and reverse any rules that weaken the school nutrition standards to ensure the nutrition standards are aligned with the most current Dietary Guidelines for Americans as required by law. (*2022 policy statement*)		

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
The Academy	▪ Guidance to limit: 1) **sweetened and flavored milks (such as chocolate milk or strawberry milk)**, 2) unfortified non-dairy milks, 3) 100% fruit juice to **no more than 4–6 oz per day**, 4) flavored juice drinks, and 5) sugar-sweetened beverages under ‘Foods to Limit’. (2023, *Pediatric Nutrition Care Manual*, “School-Age Child Nutrition Therapy”) ▪ Advocate for healthy child-care and school environments that include comprehensive nutrition education coupled with the provision of meals, beverages, and snacks that meet the DGA. (*2018 position paper*)		
DGA	Decreasing consumption of sugar-sweetened beverages to reduce added sugars intake will help youth achieve a healthy dietary pattern. Beverages that contain no added sugars should be the primary choice for children and adolescents (2–18 years). These include water and **unsweetened fat-free or low-fat milk**—including low-lactose or lactose-free options or fortified soy beverage. (*DGA 2020–2025*)		
CACFP	▪ Age 5: **Unflavored only** ▪ Ages 6–18: **Milk may be flavored or unflavored** (1% or skim). *eCFR :: 7 CFR 226.20 — Requirements for meals.*	▪ Ages 6–18: **Milk may be flavored or unflavored** (1% or skim). *eCFR :: 7 CFR 226.20 — Requirements for meals.*	
NSLP	▪ Lunch: 5 cups/week; 1 cup/day of fat-free (skim) or low-fat (1 percent fat or less). **Milk may be unflavored or flavored.** ▪ Afterschool snacks may contain a serving of fluid milk as a beverage, or on cereal, or used in part for each purpose. ▪ Competitive foods: Low-fat or non-fat **flavored or unflavored (no more than 8 fl oz)**. *eCFR :: 7 CFR Part 210 — National School Lunch Program* By July 1, 2025, **flavored milk** offered in schools must not contain more than 10 grams of added sugar per 8 fluid ounces. (*2024 Final Rule*)	▪ Lunch: 5 cups/week; 1 cup/day of fat-free (skim) or low-fat (1 percent fat or less). **Milk may be unflavored or flavored.** ▪ Afterschool snacks may contain a serving of fluid milk as a beverage, or on cereal, or used in part for each purpose. ▪ Competitive foods: Low-fat or non-fat **flavored or unflavored (no more than 12 fl oz)**. *eCFR :: 7 CFR Part 210 — National School Lunch Program* By July 1, 2025, **flavored milk** offered in schools must not contain more than 10 grams of added sugar per 8 fluid ounces. Flavored milk sold as a competitive beverage to middle and high school students, must contain no more than 15 grams of added sugar per 12 fluid ounces (For clarification, USDA proposed a higher added sugars limit for flavored milk sold as a competitive food in middle and high schools due to the larger serving size. The serving size for milk offered as part of a reimbursable meal is 8 fluid ounces. Milks sold to middle and high school students as a competitive food may be up to 12 fluid ounces). (*2024 Final Rule*)	
CDC	*Not addressed*		
WHO	*Not addressed*		
NASEM	*Not addressed*		
Plant-Based Milk Alternatives			
AAP	▪ For children who are unable to consume milk or dairy products, health care professionals can recommend the consumption of other calcium-rich foods, calcium-fortified products (e.g., some orange juice and breads), and **soy milk foods and beverages that are similar to milk and dairy products in their content of calcium and vitamin D**. Parents should be alert to the nutritional content of other products sold as “milk” (e.g., almond milk, hemp milk) that may not provide equivalent calcium, vitamin D, or protein. A dietary supplement containing calcium and vitamin D may be recommended for children who do not consume enough of either through their diets. (*Bright Futures, 4th edition*) ▪ The AAP recommends that pediatricians ask about dairy intake, **nondairy sources of calcium and vitamin D**, use of calcium and/or vitamin D supplements, and soda consumption during the adolescent health maintenance visits. The AAP also recommends **encouraging increased dietary intake of calcium and vitamin D-containing foods and beverages**. (*Pediatric Nutrition, 8th edition*)		
AAPD	*Not addressed*		
AHA	Prevent and reverse any rules that weaken the school nutrition standards to ensure the nutrition standards are aligned with the most current Dietary Guidelines for Americans, as required by law. (*2020 policy statement*)		

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(High School)</th></tr>
<tr><td>The Academy</td><td colspan="3">

- Guidance to choose: 1) plain, pasteurized 1% or non-fat (skim) milk and **2) fortified non-dairy milk** (soy, almond, rice) under 'Foods to Choose'.
- Guidance to limit: 1) sweetened and flavored milks (such as chocolate milk or strawberry milk), **2) unfortified non-dairy milks**, 3) 100% fruit juice to no more than 4–6 oz per day, 4) flavored juice drinks, and 5) sugar-sweetened beverages under 'Foods to Limit'.
- Sample menus include ¾ cup 1% milk at breakfast. Vegetarian menus have ½–1 cup milk at each meal, and vegan menus have ½ cup fortified soy milk at each meal.

(2023, _Pediatric Nutrition Care Manual_, “School-Age Child Nutrition Therapy”)

- Guidance to choose: 1) low-fat or fat-free milk, **2) fortified soy milk**, 3) water, 4) low-calorie beverages.
- 1 serving of dairy = 1 cup milk or 1 cup **fortified non-dairy milk with at least 7 grams of protein**.

(2023, _Pediatric Nutrition Care Manual_, “Adolescent Nutrition Therapy”)

</td></tr>
<tr><td>DGA</td><td colspan="3">

- Individuals who are lactose intolerant can choose low-lactose and lactose-free dairy products. For individuals who choose dairy alternatives, **fortified soy beverages** (commonly known as “soy milk”) and soy yogurt—which are **fortified with calcium, vitamin A, and vitamin D**—are included as part of the dairy group because they are similar to milk and yogurt based on nutrient composition and in their use in meals. Other products sold as “milks” but made from plants (e.g., almond, rice, coconut, oat, and hemp “milks”) may contain calcium and be consumed as a source of calcium, but they are not included as part of the dairy group because their overall nutritional content is not similar to dairy milk and fortified soy beverages. Therefore, consuming these beverages does not contribute to meeting the dairy group recommendation.
- 2–18 years: Beverages that contain no added sugars should be the primary choice for children and adolescents (2–18 years). These include water and unsweetened fat-free or low-fat milk—including low-lactose or lactose-free options or **fortified soy beverage**.
- 2–18 years: Nutrient-dense options within the dairy group are unsweetened fat-free and low-fat (1%) milk, yogurt, cheese, fortified soy beverages and yogurt, and low-lactose and lactose-free dairy products. Dairy and **fortified soy alternatives** provide protein and a variety of nutrients that are under-consumed during these life stages.
- Ages 5–8 = 2.5 cup eq/day dairy*
- Ages 9–13 = 3 cup eq/day dairy*
- Ages 14–18 = 3 cup eq/day dairy*

*Which includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products or fortified soy beverages

(_Dietary Guidelines for Americans, 2020–2025_)

</td></tr>
<tr><td>CACFP</td><td colspan="3">

Non-dairy fluid milk substitutions that provide the nutrients listed in the following table and are fortified in accordance with fortification guidelines issued by the Food and Drug Administration may be provided for non-disabled children and adults who cannot consume fluid milk due to medical or special dietary needs when requested in writing by the child's parent or guardian, or by, or on behalf of, an adult participant. An institution or facility need only offer the non-dairy beverage that it has identified as an allowable fluid milk substitute according to the following table (nutrients per cup/8 fl oz).

<table>
<tr><th>Protein</th><th>Calcium</th><th>Vitamin A</th><th>Vitamin D</th><th>Magnesium</th><th>Phosphorous</th><th>Potassium</th><th>Riboflavin</th><th>Vitamin B-12</th></tr>
<tr><td>8g</td><td>276 mg</td><td>500 IU</td><td>100 IU</td><td>24 mg</td><td>222 mg</td><td>349 mg</td><td>0.44 mg</td><td>1.1 mcg</td></tr>
</table>

eCFR :: 7 CFR 226.20 — Requirements for meals.

</td></tr>
</table>

<table>
<tr><th>Organization/ Authority</th><th>5–10 years (Middle Childhood)</th><th>12–14 years (Middle School)</th><th>15–18 years (High School)</th></tr>
<tr><td>NSLP</td><td colspan="3">

- Lunch: If a school chooses to offer one or more substitutes for fluid milk for non-disabled students with medical or special dietary needs, the n**ondairy beverage(s) must provide the nutrients listed** in the following table. Fluid milk substitutes must be fortified in accordance with fortification guidelines issued by the Food and Drug Administration. A school need only offer the nondairy beverage(s) that it has identified as allowable fluid milk substitutes according to the following chart (nutrients per cup/8 fl oz).

<table>
<tr><th>Protein</th><th>Calcium</th><th>Vitamin A</th><th>Vitamin D</th><th>Magnesium</th><th>Phosphorous</th><th>Potassium</th><th>Riboflavin</th><th>Vitamin B-12</th></tr>
<tr><td>8g</td><td>276 mg</td><td>500 IU</td><td>100 IU</td><td>24 mg</td><td>222 mg</td><td>349 mg</td><td>0.44 mg</td><td>1.1 mcg</td></tr>
</table>

- Competitive foods: **Nutritionally equivalent milk alternatives** as permitted according to the above table **(8 fl oz max elementary; 12 fl oz max middle and high school)**.

eCFR :: 7 CFR Part 210 — National School Lunch Program
</td></tr>
<tr><td>CDC</td><td colspan="3">Water just won't do? Reach for drinks that contain important nutrients such as low-fat or fat-free milk; unsweetened, **fortified milk alternatives**; or 100% fruit or vegetable juice first. (*Rethink Your Drink*)</td></tr>
<tr><td>WHO</td><td colspan="3">*Not addressed*</td></tr>
<tr><td>NASEM</td><td colspan="3">*Not addressed*</td></tr>
<tr><th colspan="4">Sugar-Sweetened Beverages (SSBs)</th></tr>
<tr><td>AAP</td><td colspan="3">

- There is no evidence for health benefits and some evidence for negative health effects of **sweetened beverages (sodas, iced teas, sports drinks, juice drinks)**. Therefore, health promotion efforts should aim at removing all sweetened beverages from the diets of children. SSB are not recommended, including, but not limited to, **soft drinks/soda, fruit drinks, fruit- flavored drinks, fruitades, sports drinks, energy drinks, sweetened waters, and sweetened coffee and tea beverages**. (*quick reference guide*)
- Pediatricians are encouraged to routinely counsel children and families to **decrease sugary drink consumption** and increase water consumption. (*2019 policy statement*)
- It is important to **avoid the frequent consumption of sugar-sweetened beverages** and snacks. (*Bright Futures, 4th edition*)
- Evidence to date suggests that consumption of **sugar-sweetened beverages should be limited**. (*Pediatric Nutrition, 8th edition*)
</td></tr>
<tr><td>AAPD</td><td colspan="3">

- The AAPD encourages collaboration with other dental and medical organizations, governmental agencies, education officials, parent and consumer groups, and corporations to increase public awareness of the adverse effects of frequent and/or inappropriate intake of **sugar-sweetened beverages** and low nutrient-dense snack foods on children's oral health and general health."
- The AAPD encourages school officials and parent groups to consider the importance of maintaining healthy choices in vending machines in schools and encourages the promotion of food and beverages of high nutritional value; bottled water and other more **healthy choices should be available instead of soft drinks**. (*2022 policy statement*)
</td></tr>
<tr><td>AHA</td><td colspan="3">Pediatricians are encouraged to routinely counsel children and families to **decrease sugary drink consumption** and increase water consumption. (*2019 policy statement*)</td></tr>
<tr><td>The Academy</td><td colspan="3">

- **Guidance to limit:** 1) sweetened and flavored milks (such as chocolate milk or strawberry milk), 2) unfortified non-dairy milks, 3) 100% fruit juice to no more than 4–6 oz per day, **4) flavored juice drinks, and 5) sugar-sweetened beverages** under 'Foods to Limit'. (2023, *Pediatric Nutrition Care Manual*, "School-Age Child Nutrition Therapy")
- **Guidance to limit:** 1) 100% fruit juice to 1 cup or less per day, **2) sodas, 3) fruit drinks**, and 4) sports drinks. (2023, *Pediatric Nutrition Care Manual*, "Adolescent Nutrition Therapy")
- Dietary interventions to consider for pediatric patients 2–17 years of age (unless otherwise noted below) with overweight or obesity: "Healthy Nutrition Guidelines targeting specific changes in eating habits (eg, r**educing intake of sugary drinks**; establishing a regular meal and snack pattern; eating age-appropriate portions of protein sources and starchy foods; selecting healthier snacks; eating more fruit and non-starchy vegetables; selecting healthier options when eating out, etc.). (*2022 position paper*)
</td></tr>
</table>

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
DGA	■ Beverages that are calorie-free—especially water—or that contribute beneficial nutrients, such as fat-free and low-fat milk and 100% juice, should be the primary beverages consumed. Coffee, tea, and flavored waters also are options, but the most nutrient-dense options for these beverages include **little, if any, sweeteners or cream**. ■ 2–18 years: **SSBs such as soda, fruit drinks, and sports and energy drinks** are **not necessary** in the child or adolescent diet nor are they a component of the USDA Dietary Patterns. ■ **Decreasing consumption of sugar-sweetened beverages** to reduce added sugars intake will help youth achieve a healthy dietary pattern. Beverages that contain no added sugars should be the primary choice for children and adolescents. ■ Consuming beverages with **no added sugars** is particularly important for young children ages 2 through 8, when only a small number of calories remains for other uses after meeting food group and nutrient needs with nutrient-dense choices. (*DGA, 2020–2025*)		
CACFP	*Not addressed*		
NSLP	*Not addressed*		
CDC	■ **Limiting sugary drink intake** can help individuals maintain a healthy weight and have healthy dietary patterns. ■ Sugar-sweetened beverages are any liquids that are sweetened with various forms of added sugars like brown sugar, corn sweetener, corn syrup, dextrose, fructose, glucose, high-fructose corn syrup, honey, lactose, malt syrup, maltose, molasses, raw sugar, and sucrose. ■ **Examples of SSBs include**, but are not limited to, regular soda (not sugar-free), fruit drinks, sports drinks, energy drinks, sweetened waters, and coffee and tea beverages with added sugars. (*Get the Facts: Sugar-Sweetened Beverages and Consumption*)		
WHO	■ WHO recommends a reduced intake of free sugars throughout the life course (strong recommendation). ■ In both adults and children, WHO recommends reducing the intake of free sugars to less than 10% of total energy intake (strong recommendation). WHO suggests a further reduction of the intake of free sugars to below 5% of total energy intake (conditional recommendation) ■ There is increasing concern that intake of free sugars—particularly in the form of **sugar-sweetened beverages**—increases overall energy intake and may reduce the intake of foods containing more nutritionally adequate calories, leading to an unhealthy diet, weight gain and increased risk of NCDs. (*Sugar Intake for Adults and Children, 2015*)		
NASEM	*Not addressed*		
Beverages with Non-Sugar Sweeteners			
AAP	■ When substituted for caloric-sweetened foods or beverages, **NNS (current FDA-approved NNS include saccharin, aspartame, acesulfame potassium, sucralose, neotame, stevia, and advantame)** can reduce weight gain or promote small amounts of weight loss (~1 kg) in children (and adults); however, data are limited, and use of NNSs in isolation is unlikely to lead to substantial weight loss. With the exception of aspartame and neotame in children with phenylketonuria, there are no absolute contraindications to use of NNSs by children. The long-term effects of NNS use in children and adolescents, including use pertaining to weight loss or weight management, are currently unknown. (*2019 policy statement*) ■ The use of beverages sweetened with **no- or low-calorie artificial sweeteners** remains controversial, because they may perpetuate the habit of drinking sweetened beverages and may lead to a disconnect between perception and actual energy intake or to the displacement of nutrient-rich beverages. However, they can provide an alternative to full-calorie sodas. Because there is no evidence of benefits of these products over plain water, a**rtificially sweetened beverages currently have a limited place in a child's diet**. (*2015 practice guideline*)		
AAPD	Furthermore, the AAPD encourages: education of health professionals and the public regarding healthy beverage choices and daily sugar-consumption recommendations, as well as the sugar content of foods and beverages; additional research on the benefits and effects of long-term use of **low-calorie sweeteners** by children. (*2022 policy statement*)		

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
AHA	On the basis of the available evidence, the writing group concluded that, at this time, it is prudent to **advise against prolonged consumption of LCS beverages by children**. Although water is the optimal beverage choice, children with diabetes mellitus who consume a balanced diet and closely monitor their blood glucose may be able to prevent excessive glucose excursions by substituting LCS beverages for sugar-sweetened beverages [SSBs] when needed. (*2018 policy statement*) (the term low-calorie sweeteners is used in this statement to refer to both zero- and reduced-energy food additives. The term low-calorie sweeteners includes the 6 high-intensity sweeteners currently approved by the US Food and Drug Administration (saccharin, aspartame, acesulfame-K, sucralose, neotame, and advantame) and 2 additional high-intensity sweeteners: steviol glycosides, obtained from the leaves of the stevia plant (Stevia rebaudiana), and extracts obtained from Siraitia grosvenorii Swingle fruit, also known as luo han guo or monk fruit.)		
The Academy	Guidance to choose: 1) low-fat or fat-free milk, 2) fortified soy milk, 3) water, **4) low-calorie beverages**. (2023, *Pediatric Nutrition Care Manual*, “Adolescent Nutrition Therapy”)		
DGA	It should be noted that replacing added sugars with **low- and no-calorie sweeteners** may reduce calorie intake in the short-term and aid in weight management, yet questions remain about their effectiveness as a long-term weight management strategy. For additional information about high-intensity sweeteners permitted for use in food in the United States, see fda.gov/food/food-additives-petitions/high-intensity-sweeteners. (*DGA, 2020–2025*)		
CACFP	*Not addressed*		
NSLP	*Not addressed*		Competitive food: **Calorie-free, flavored water**, with or without carbonation (no more than 20 fluid ounces). (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)
CDC	*Not addressed*		
WHO	The WHO suggests that **non-sugar sweeteners (acesulfame K, aspartame, advantame, cyclamates, neotame, saccharin, sucralose, stevia and stevia derivatives)** not be used as a means of achieving weight control or reducing the risk of noncommunicable diseases (conditional recommendation). (*Use of Non-Sugar Sweeteners, 2023*)		
NASEM	*Not addressed*		
Beverages with Caffeine			
AAP	■ **Do not consume caffeinated beverages. Energy drinks** pose potential health risks primarily because of stimulant content; therefore, they are not appropriate for children and adolescents and **should never be consumed**. (*quick reference guide*) ■ Given the absence of health benefits and concerns regarding caffeine consumption and excessive energy intakes from these drinks, the AAP recommends that children **do not consume caffeine**. Pediatricians should inquire about the use of sports and energy drinks during routine health visits. (*Pediatric Nutrition, 8th edition*) ■ The American Academy of Pediatrics recommends that **sports and energy drinks** not be consumed by children to avoid excess energy intake and any level of caffeine intake. (*Pediatric Nutrition, 8th edition*) ■ Understand that **energy drinks** pose potential health risks primarily because of stimulant content; therefore, **they are not appropriate for children and adolescents and should never be consumed**. (*2011, Clinical Report*)		
AAPD	Consumption of SSB in the form of sodas or sport, **energy**, and fruit-flavored drinks and, to a lesser extent, 100 percent juice has been associated with an increased risk for developing dental caries. (*2022 policy statement*)		
AHA	Prevent and reverse any rules that weaken the school nutrition standards to ensure the nutrition standards are aligned with the most current Dietary Guidelines for Americans as required by law. (*2020 policy statement*)		
The Academy	Guidance to limit: 1) 100% fruit juice to 1 cup or less per day, 2) sodas, 3) fruit drinks, and **4) sports drinks**. (2023, *Pediatric Nutrition Care Manual*, “Adolescent Nutrition Therapy”)		

Organization/ Authority	5–10 years (Middle Childhood)	12–14 years (Middle School)	15–18 years (High School)
DGA	■ Caffeine is a substance that is Generally Recognized as Safe (GRAS) in cola-type beverages by the Food and Drug Administration (FDA). For healthy adults, the FDA has cited 400 milligrams per day of caffeine as an amount not generally associated with dangerous, negative effects. ■ 2–18 years: SSBs such as soda, fruit drinks, and sports and **energy drinks** are **not necessary** in the child or adolescent diet nor are they a component of the USDA Dietary Patterns. (*DGA, 2020–2025*)		
CACFP	*Not addressed*		
NSLP	Competitive foods: Foods and beverages available to elementary and middle school-aged students must be **caffeine-free**, with the exception of trace amounts of naturally occurring caffeine substances. (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)		Competitive foods and beverages available to high school-aged students **may contain caffeine**. (*eCFR :: 7 CFR Part 210 — National School Lunch Program*)
CDC	■ The American Academy of Pediatrics states that caffeine and other stimulant substances contained in **energy drinks have no place in the diet of children and adolescents**. ■ The National Federation of State High School Associations recommends that young athletes **should not use energy drinks for hydration**, and information about the potential risk should be widely distributed to young athletes. (*The Buzz on Energy Drinks*)		
WHO	*Not addressed*		
NASEM	Various national organizations and individuals have put forth recommendations for the use of **energy drinks** among children, including the American Academy of Pediatrics, perhaps the largest pediatric organization in the world. In 2013, the American Medical Association voted that marketing energy drinks to children and adolescents less than 18 years old should be suspended (p. 62). Some workshop participants who spoke urged that until such investigation demonstrates the safety of caffeinated energy drinks in children…it would be prudent to **restrict their use**. (*Caffeine in Food and Dietary Supplements, 2014*)		

APPENDIX F. SAMPLE DRINK SCENARIOS BY AGE

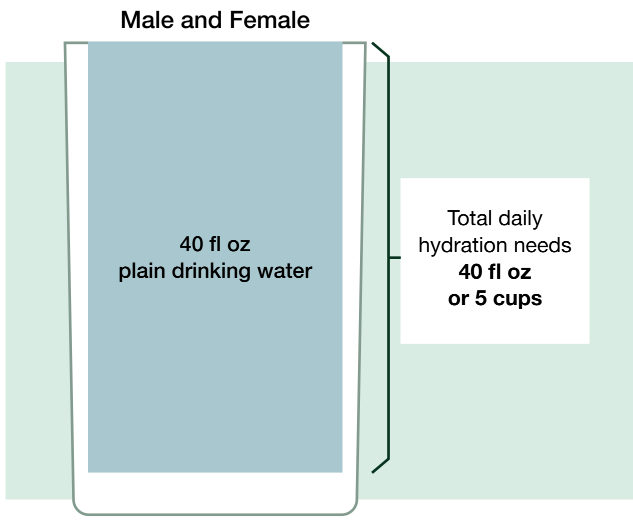
As referenced in the **Plain Drinking Water** section of this report, plain, fluoridated water should be the primary beverage consumed to meet daily hydration needs; however, the specific amount of water consumed by an individual each day may be adjusted based on the total amount of other beverages (e.g., milk, 100% juice) consumed, as well as other factors that result in water losses (e.g., climate and physical activity). This appendix provides several example scenarios for how daily water intake may be adjusted based on age and consumption of other beverages.

Children ages 5 to 8 years

For a child 5–8 years of age, the estimated total water needs from both food and beverages is 57 fl oz (7 cups) per day. The estimated proportion of total water consumed from foods is 30% (~17 fl oz), leaving approximately 70% of total daily water needs coming from beverages (~40 fl oz). The following scenarios are examples of how a child 5–8 years of age might meet their total hydration needs from beverages (~40 fl oz) in a day.

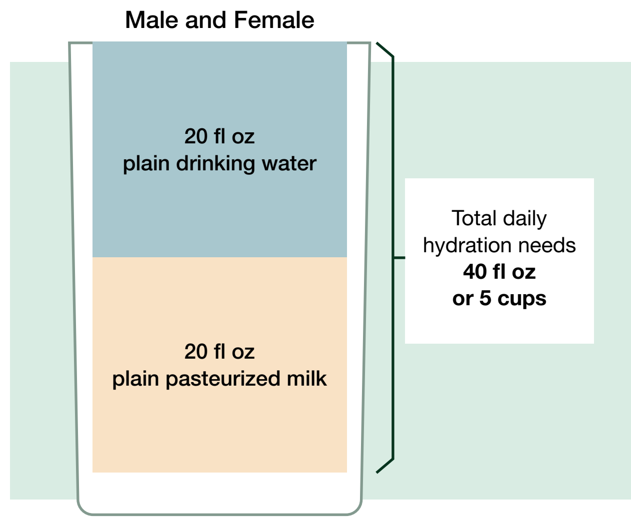
Scenario 1: Water only

If a child 5–8 years of age consumes **only water** as a beverage throughout the day, they will need to consume 40 fl oz to meet their total daily hydration needs (40 fl oz per day). This is the same for males and females.



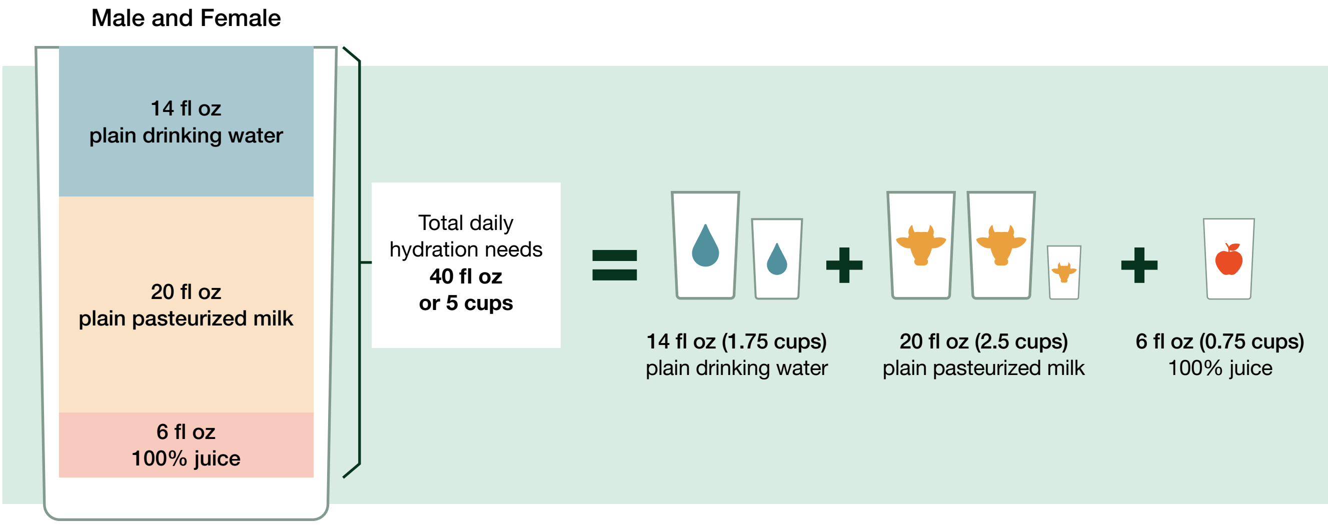
Scenario 2: Water and milk

If a child 5–8 years of age consumes the **maximum recommended quantity of milk (20 fl oz)** throughout the day, they will need to consume **20 fl oz of water** to meet their total daily hydration needs (40 fl oz per day). This is the same for males and females.



Scenario 3: Water, milk, and 100% juice

If a child 5–8 years of age consumes the **maximum recommended quantity of milk (20 fl oz) and the maximum quantity of 100% juice (6 fl oz)** throughout the day, they will need to consume **14 fl oz of water** to meet their total daily hydration needs (40 fl oz). This is the same for males and females.

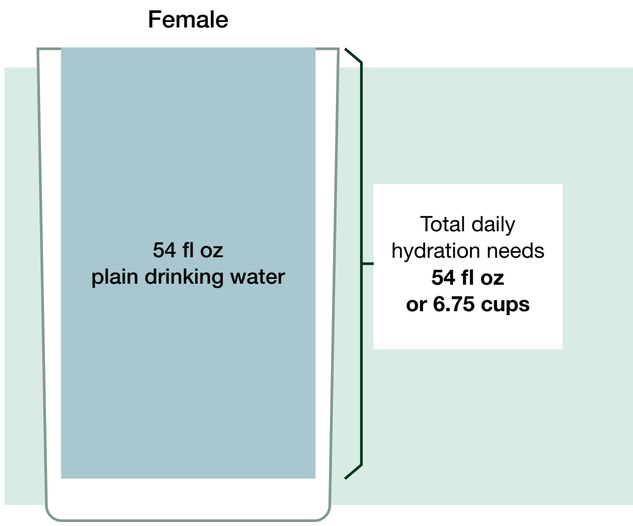


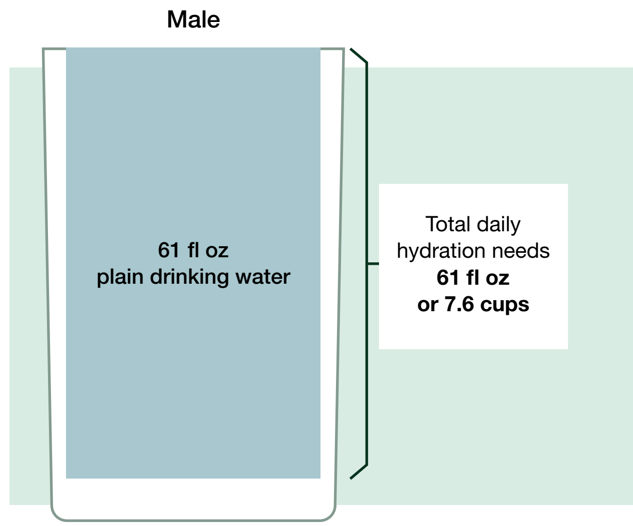
Adolescents ages 9 to 13 years old

For an adolescent 9–13 years of age, it is estimated that females need 71 fl oz (9 cups) of total water per day from both food and beverages, whereas males need 81 fl oz (10 cups) per day. The estimated proportion of total water needs consumed from foods is 24% (~17–20 fl oz) leaving approximately 70% of total daily water needs coming from beverages (~54 fl oz for females and 61 fl oz for males). The following scenarios are examples of how an adolescent 9–13 years of age might meet their total hydration needs from beverages (~54–61 fl oz) in a day.

Scenario 1: Water only

If an adolescent 9–13 years of age consumes **only water as a beverage** throughout the day, a female would need to consume **54 fl oz of water** and a male would need to consume **61 fl oz of water** to meet their total daily hydration needs.





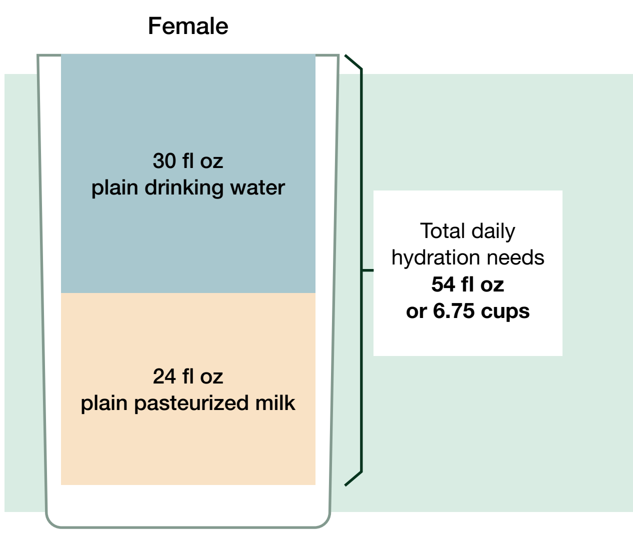
Scenario 2A: Water and the maximum recommended amount of dairy as milk

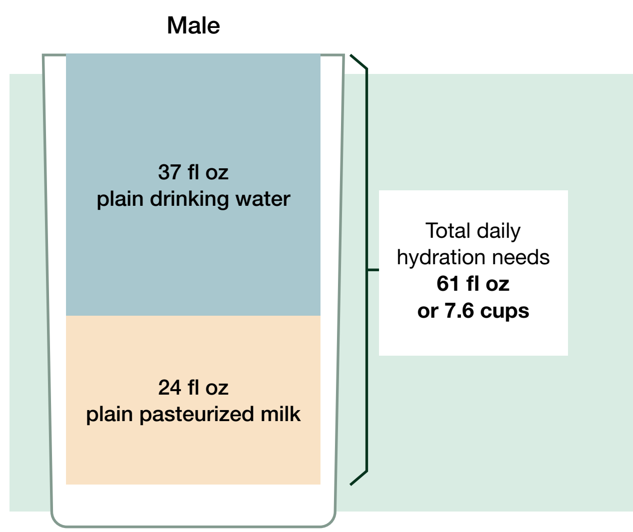
Female

If a female adolescent 9–13 years of age consumes the **maximum recommended quantity of milk (24 fl oz)** throughout the day, they will need to consume **30 fl oz of water** to meet daily hydration needs (54 fl oz per day).

Male

If a male adolescent 9–13 years of age consumes the **maximum recommended quantity of milk (24 fl oz)** throughout the day, they will need to consume **37 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).





Scenario 2B: Water and half of the recommended amount of dairy as milk

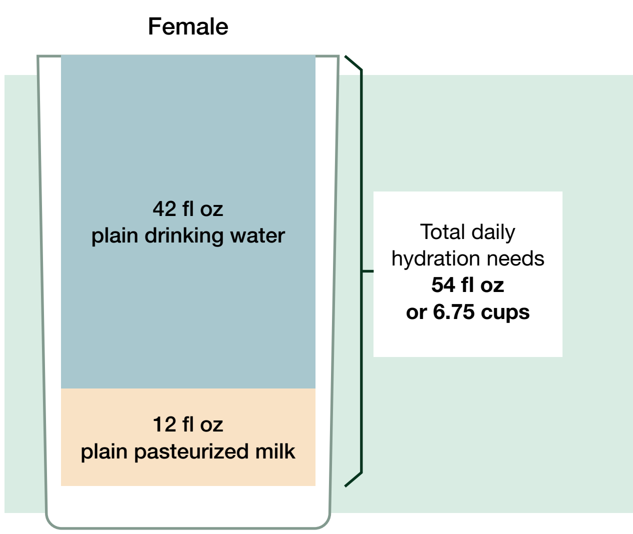
Research has shown that as children age, they drink less milk. Thus, the following scenarios only use half of the maximum recommended quantity of milk. The amount of water needed to meet daily hydration needs should be adjusted based on the amount of milk consumed.

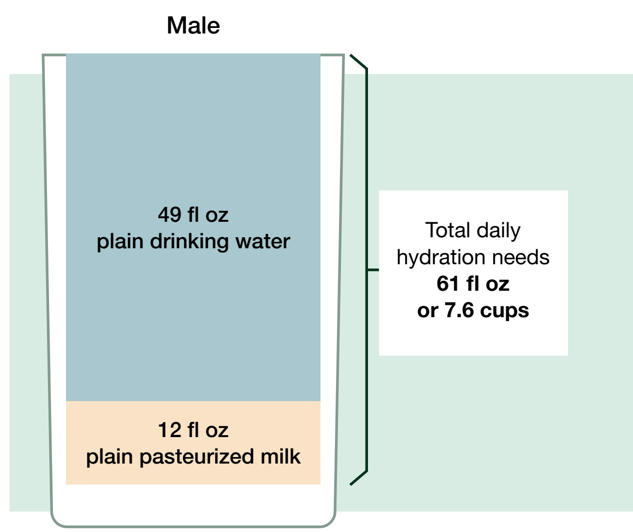
Female

If a female adolescent 9–13 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** throughout the day, they will need to consume **42 fl oz of water** to meet their total daily hydration needs (54 fl oz per day).

Male

If a male adolescent 9–13 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** throughout the day, they will need to consume **49 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).

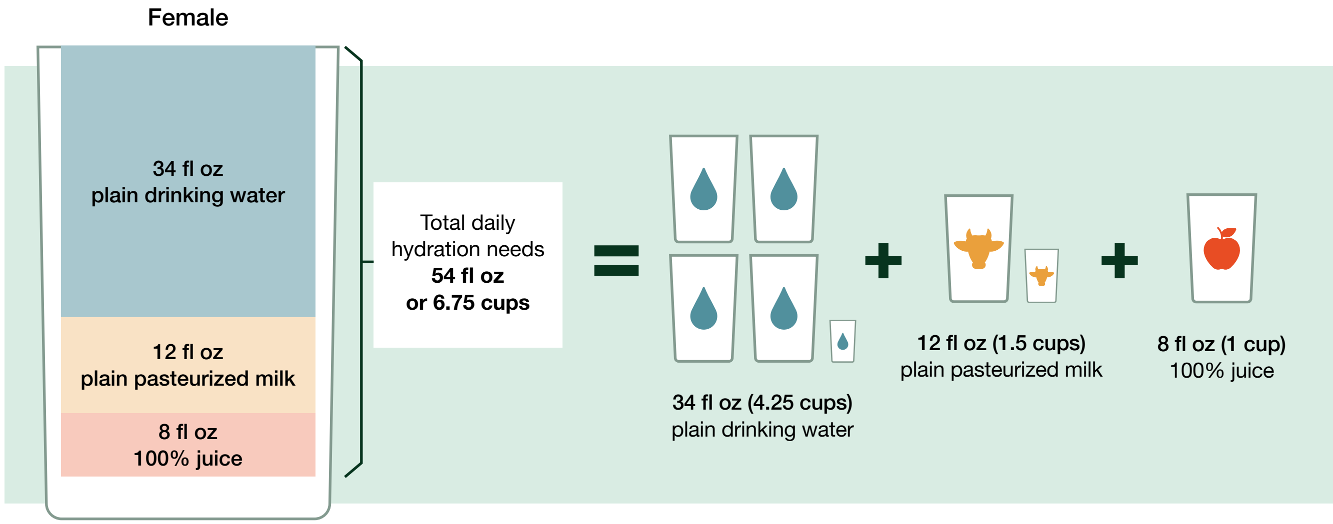




Scenario 3: Water, Milk, and 100% juice

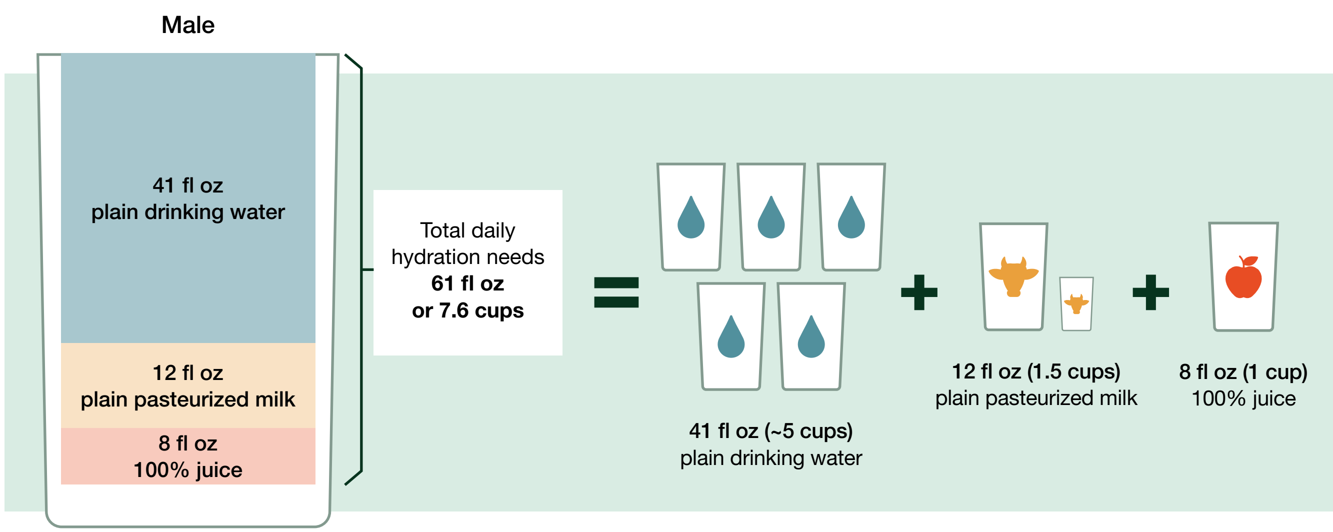
Female

If a female adolescent 9–13 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** and the **maximum quantity of 100% juice (8 fl oz)** throughout the day, they will need to consume **34 fl oz of water** to meet their total daily hydration needs (54 fl oz per day).



Male

If a male adolescent 9–13 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** and the **maximum quantity of 100% juice (8 fl oz)** throughout the day, they will need to consume **41 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).



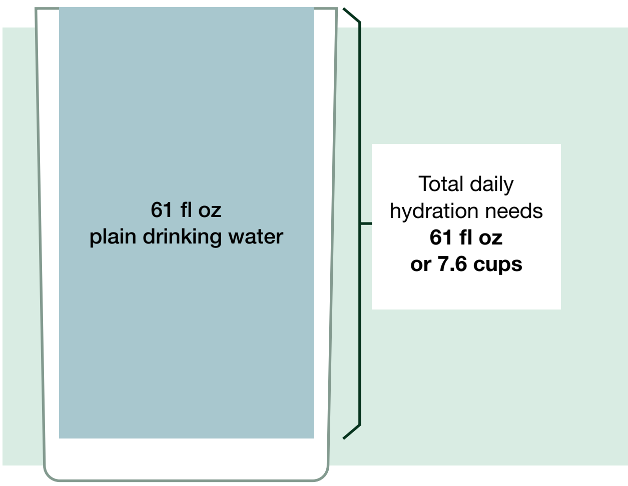
Adolescents ages 14 to 18 years old

For an adolescent 14–18 years of age, the estimated total daily water needs from both food and beverages is 78 fl oz (~10 cups) for females and 112 fl oz (14 cups) for males. The estimated proportion of total water needs consumed from foods is 20% (~17–22 fl oz) leaving approximately 80% of total daily water needs coming from beverages (~61 fl oz for females and 88 fl oz for males). The following scenarios are examples of how an adolescent 14–18 years of age might meet their total daily hydration needs from beverages (~61–88 fl oz).

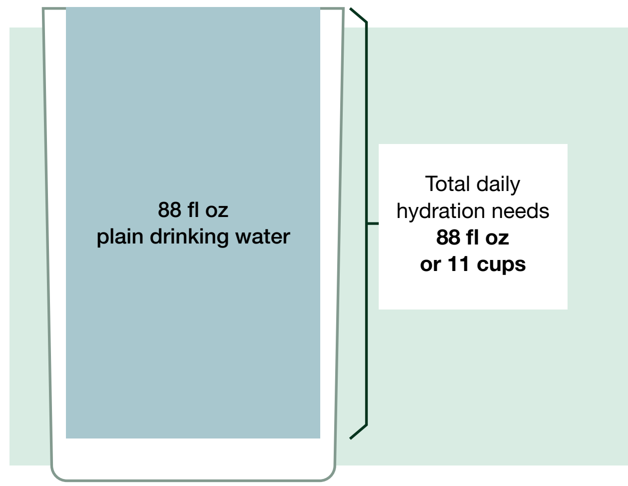
Scenario 1: Water only

If an adolescent 14–18 years of age consumes **only water as a beverage** throughout the day, a female would need to consume **61 fl oz of water** and a male would need to consume **88 fl oz of water** per day to meet their total daily hydration needs.

Female



Male



Scenario 2A: Water and the maximum recommended amount of dairy as milk

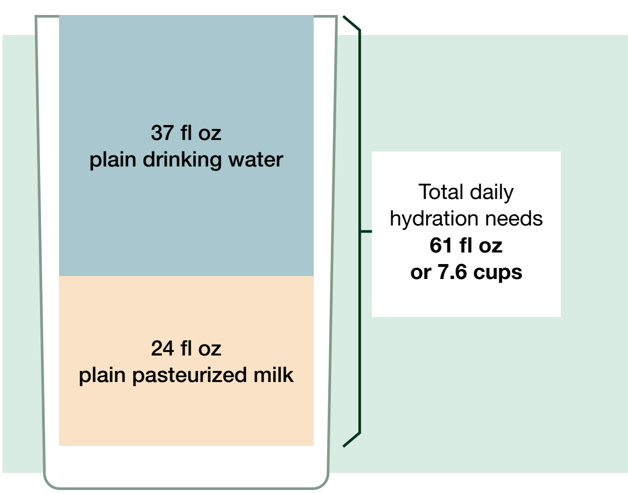
Female

If a female adolescent 14–18 years of age consumes the **maximum recommended quantity of milk (24 fl oz)** throughout the day, they will need to consume **37 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).

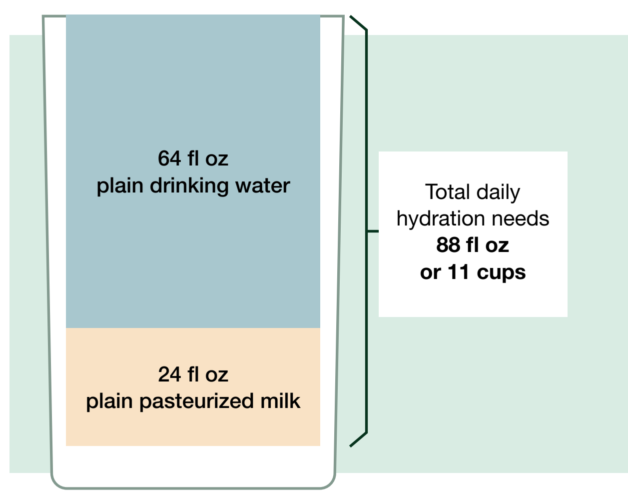
Male

If a male adolescent 14–18 years of age consumes the **maximum recommended quantity of milk (24 fl oz)** throughout the day, they will need to consume **64 fl oz of water** to meet their total daily hydration needs (88 fl oz per day).

Female



Male



Scenario 2B: Water and half of the recommended amount of dairy as milk

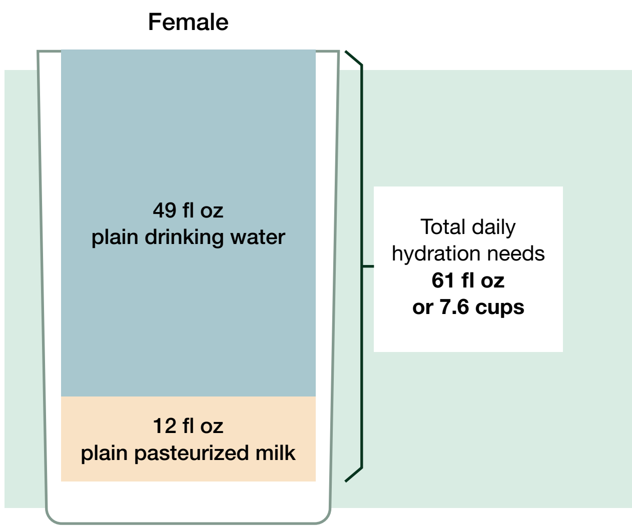
Research has shown that as children age, they drink less milk. Thus, the following scenarios only use half of the maximum recommended quantity of milk. The amount of water needed to meet daily hydration needs should be adjusted based on the amount of milk consumed.

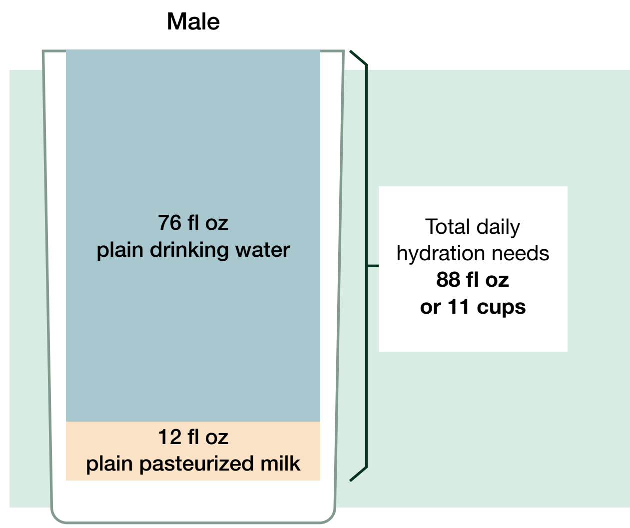
Female

If a female adolescent 14–18 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** throughout the day, they will need to consume **49 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).

Male

If a male adolescent 14–18 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** throughout the day, they will need to consume **76 fl oz of water** to meet their total daily hydration needs (88 fl oz per day).

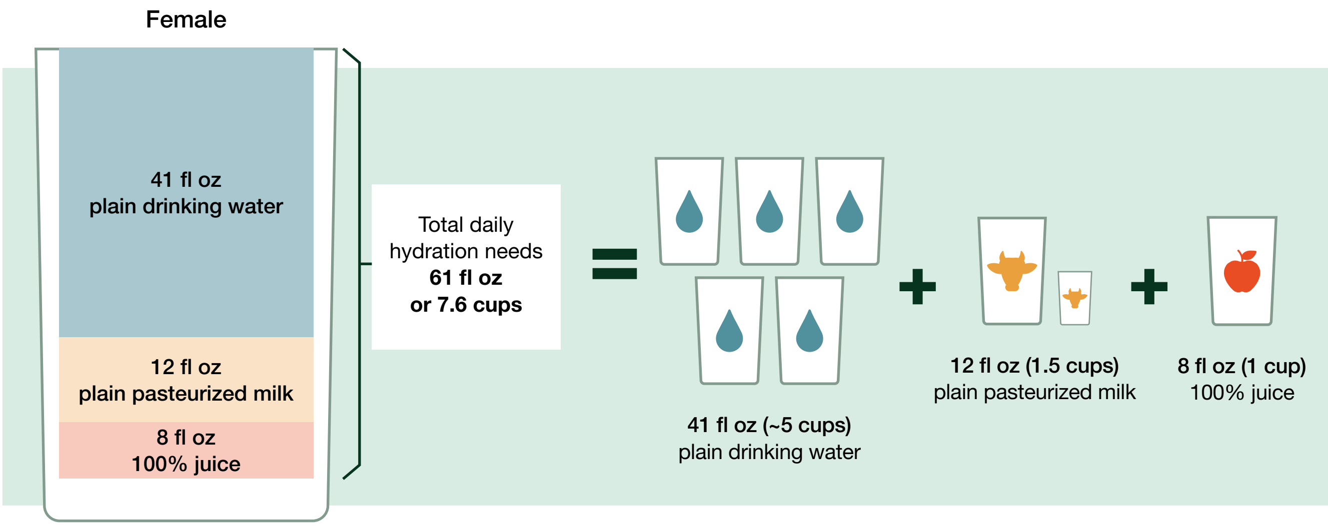




Scenario 3: Water, milk, and 100% juice

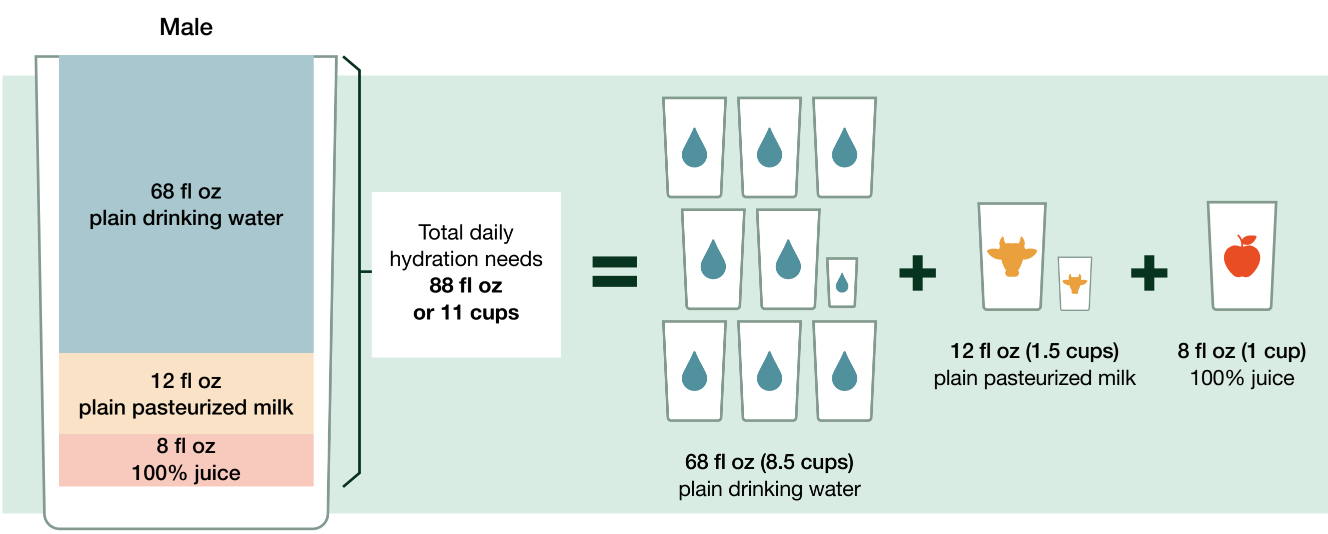
Female

If a female adolescent 14–18 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** and the **maximum quantity of 100% juice (8 fl oz)** throughout the day, they will need to consume **41 fl oz of water** to meet their total daily hydration needs (61 fl oz per day).



Male

If a male adolescent 14–18 years of age consumes **half of the maximum recommended quantity of milk (12 fl oz)** and the **maximum quantity of 100% juice (8 fl oz)** throughout the day, they will need to consume **68 fl oz of water** to meet their total daily hydration needs (88 fl oz per day).



APPENDIX G. COMPARISON OF THE DIFFERENT TYPES OF MILK IN THE MARKETPLACE

Today there are more types of fluid milk available to U.S. consumers than ever before. Confused consumers want to know how these products differ. This appendix compares the nutritional profile of many types of milk popular in the U.S., as well as describes their differences.

Organic Milk: Organic milk comes from cows that are raised according to organic farming practices, which are based on the principles of organic agriculture. For the term "organic" to be used on milk or milk products, livestock must be allowed to graze on pasture, be fed organic certified feed, and animals may not be treated with drugs, such as growth hormones or antibiotics.[1,2] According to the USDA, both conventional milk and organic milk provide essential nutrients, including protein, calcium, phosphorous, vitamin A, vitamin B12, and vitamin D;[3] however, some studies do demonstrate differences in micronutrient profiles, which can vary by farm location, soil content, and season.[4]

Other Mammal Milks:

- Goat milk is the milk produced by goats and is a commonly consumed cow's milk alternative that is thicker and creamier than regular cow's milk. While more commonly consumed in developing countries due to the lower cost of raising goats (compared to cows), goat milk is growing in popularity in the U.S. Goat milk has similar nutritional properties to cow's milk; however, the composition of the proteins is different, and they may be more easily digestible for those with cow's milk sensitivities.[5]
- Buffalo milk is the milk produced by water buffalo. Though not commonly consumed in the U.S., buffalo milk is produced widely in India and Pakistan. Buffalo milk is denser in nutrients and calories than regular cow's milk, with higher protein, fat, and lactose content.[6]
- When selecting other varieties of mammal milk, such as goat or buffalo, it is important to look for pasteurized products as raw milk from any animal carries a risk of contamination from bacteria that can leave children and immunocompromised adults at a higher risk of foodborne illness.

Lactose-Free Milk: Regular cow's milk that contains lactase, an enzyme that helps break down lactose (i.e., natural sugar found in milk) which eliminates lactose from the milk. Lactose-free milk is a good alternative for people who are lactose intolerant, as it has a similar taste, texture, and nutrients as regular milk.

A2 Milk: Regular cow's milk that is derived from cows who only produce A2 protein. The protein found in cow's milk comes from either casein (80%) or whey proteins (20%). Beta-casein, which is one of the most prevalent casein proteins (30%), largely comes in two types—A1 and A2, which have different amino acid profiles and thus are digested differently.[7] Dairy cow breeds show different patterns of B-casein in their milk, with some breeds having more A1 and some having more A2. Some studies have shown that A2 beta-casein may be easier to digest, and thus people who drink A2 only milk may be less likely to experience gastrointestinal symptoms;[8] however, the evidence is quite limited.[9]

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1 Organic Livestock Requirements. USDA. 2013. *https://www.ams.usda.gov/sites/default/files/media/Dairy%20-%20Guidelines.pdf*

2 Guidelines for Organic Certification of Dairy Livestock. Northeast Organic Farming Association of Vermont and USDA. *https://www.ams.usda.gov/sites/default/files/media/Organic%20Livestock%20Requirements.pdf*

3 U.S. Department of Agriculture. Dairy. Myplate.gov. Published 2020. *https://www.myplate.gov/eat-healthy/dairy*

4 Linehan K, Patangia DV, Ross RP, Stanton C. Production, Composition and Nutritional Properties of Organic Milk: A Critical Review. Foods. 2024; 13(4):550. *https://doi.org/10.3390/foods13040550*

5 ALKaisy QH, Al-Saadi JS, Al-Rikabi AKJ, Altemimi AB, Hesarinejad MA, Abedelmaksoud TG. Exploring the health benefits and functional properties of goat milk proteins. Food Sci Nutr. 2023;11(10):5641-5656. *https://doi.org/10.1002/fsn3.3531*

6 Buffalo Milk: Nutrition, Benefits, and How It Compares. Healthline. Published February 5, 2020. *https://www.healthline.com/nutrition/buffalo-milk*

7 Fernández-Rico S, Mondragón AdC, López-Santamarina A, Cardelle-Cobas A, Regal P, Lamas A, Ibarra IS, Cepeda A, Miranda JM. A2 Milk: New Perspectives for Food Technology and Human Health. Foods. 2022; 11(16):2387. *https://doi.org/10.3390/foods11162387*

8 Jianqin S, Leiming X, Lu X, Yelland GW, Ni J, Clarke AJ. Effects of milk containing only A2 beta casein versus milk containing both A1 and A2 beta casein proteins on gastrointestinal physiology, symptoms of discomfort, and cognitive behavior of people with self-reported intolerance to traditional cows' milk [published correction appears in Nutr J. 2016 Apr 29;15(1):45. doi: 10.1186/s12937-016-0164-y]. Nutr J. 2016;15:35. *https://doi.org/10.1186/s12937-016-0147-z*

9 A2 milk and A2 genetics. University of Minnesota Extension. Updated 2022. *https://extension.umn.edu/dairy-milking-cows/a2-milk-and-a2-genetics*

Ultra-Filtered Milk:[10] Cow's milk that has been strained through a membrane filtration device, leaving some components while removing others based on molecular weight. This allows for higher-molecular weight particles, such as milk protein solids, to be retained, while lower molecular weight particles, such as lactose, to be removed. Thus, ultra-filtered milk tends to be higher in protein and calcium, while having half the naturally-occurring sugar content and virtually no lactose. Generally, these products are more expensive than conventional milk, and sometimes have added non-sugar sweeteners.

Shelf-Stable Milk: Cow's milk that has been processed so that it can be stored for months without refrigeration. When stored properly, shelf-stable milk can be an excellent alternative to fresh milk as it keeps for long periods of time and has the same nutrients as fresh cow's milk. Examples include:

- UHT or Aseptic milk, which has been pasteurized at an ultra-high temperature (UHT) and put in sterile packaging. You can find these fluid milk products on most grocery shelves.
- Powdered milk, which has been removed of all water through the process of evaporation and the remaining dry solids can later be recombined with water to create fluid milk.
- Evaporated milk, which is milk that has been heated so that around 60% of the water content evaporates. The evaporated milk is then homogenized, canned, and put through a heat sterilization that is part of the canning process. Evaporated milk can be used in place of fluid milk by adding 1.5 cans of water for each can of evaporated milk; however, it is more commonly used in cooking.

Other Milk Drinks:

- Kefir is a beverage made by fermenting milk from a cow, goat, or sheep. Kefir is low in lactose and high in probiotics—also known as "good" bacteria—that assist in optimal gut health and function. Kefir can be used in place of milk, however, kefir has a more tangy or sour flavor similar to unsweetened yogurt.
- Yogurt-Based Smoothies are blended beverages combining yogurt with other foods such as fresh or frozen fruits and vegetables. Yogurt helps to boost the protein content of the smoothie as well as contribute probiotics to the diet; however, many of these products are also high in added sugars or non-sugar sweeteners.
- Whey-Based Protein Drinks are made through a process of isolating and drying whey protein which is found in cow's milk. Whey protein contains all the essential amino acids, making it a complete protein readily available for bodily absorption.[11] Some studies have shown whey protein to be associated with muscle growth and weight loss; however, fat and protein levels vary depending on the type of whey and the science supporting these claims is not strong.[12]

Other Dairy Equivalents:

This expert panel recommends consumption of plain pasteurized milk as part of a healthy diet for children and adolescents ages 5 through 18 years. The amounts provided in the recommendations are in alignment with recommendations from the DGA for daily servings of dairy; thus, these recommendations do not need to be met by milk alone. The dairy group includes all fluid, dry, or evaporated milk, including lactose-free and lactose-reduced products and nutritionally equivalent PBMA such as fortified soy beverages (soy milk). Both refrigerated and shelf-stable versions of these products are included in the dairy group, as well as non-beverage dairy products, such as yogurt and cheese. One cup-equivalent from the dairy group equals:

- one cup (or 8 fluid ounces) of milk or fortified soy milk
- one cup of unsweetened yogurt or kefir
- 1 ½ ounces of natural cheese, such as cheddar, mozzarella, swiss, parmesan
- 2 ounces of processed cheese, such as queso fresco or queso blanco
- 1/3 cup shredded cheese
- ½ cup ricotta cheese
- 2 cups cottage cheese

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10 What is an Ultra-Filtered Milk Product? South Dakota State University Extension. Updated October 24, 2022 *https://extension.sdstate.edu/what-ultra-filtered-milk-product*

11 Plant-Based Protein vs. Whey Protein: Which Is Better? Healthline. Published July 19, 2021. *https://www.healthline.com/nutrition/whey-vs-plant-protein#bottom-line*

12 Whey Protein: Uses, Side Effects, Interactions, Dosage, and Warning. WebMD. Published 2010. *https://www.webmd.com/vitamins/ai/ingredientmono-833/whey-protein*

According to MyPlate.gov, the dairy group does not include foods made from milk that have little calcium and a high fat content, such as cream, sour cream, cream cheese, and butter.

When making dietary choices, individuals should consider the most nutrient-dense options in the dairy group, such as unsweetened, plain pasteurized fat-free (skim) and low-fat (1%) milk, yogurt, and cheese, given the limited number of discretionary calories available in childhood and adolescence.

However, there may be situations when a higher fat content of milk (2% or whole) is appropriate, such as when a child is refusing lower-fat varieties or is having difficulty gaining weight. When counseling children and adolescents and their families, healthcare providers should recommend the milk type best suited to an individual's nutrient needs. The nutritional comparison table below provides more information on each type of milk discussed in this appendix.

Nutritional Comparison of Different Varieties of Milk (unflavored, unsweetened)[1]

	Cow's milk (whole)	2% milk	1% milk	Skim milk	Organic milk (skim)	Chocolate milk (lowfat)	Goat milk	Buffalo milk	Lactose-free milk (low-fat)	A2 milk (lowfat)	Ultra-filtered milk	Shelf-stable milk	Kefir
Calories	152	122	106	91	91	160	168	237	122	130	80	80	110
Protein (g)	8	8.2	8.3	8	8	8.7	8.7	9.2	8.4	9	13	9	10
Fat (g)	8	4.7	2.3	0	0	2.8	10	16.8	4.6	5	0	0	2
Added sugar (g)	0	0	0	0	0	12	0	0	0	0	0	0	0
Calcium (mg)	306	309	310	300	300	322	327	412	307	389	380	280	390
Vitamin D (mcg)	2.4	2.8	2.6	4.8	4.5	2.7	3.2	-	2.7	5	5	4.3	3.8
Potassium (mg)	374	390	391	430	430	430	498	434	388	389	400	370	380
Vitamin B12 (mcg)	1.3	1.4	1.5	1.4	1.3	0.6	0.2	0.9	1.3	-	1.1	-	-
Milk Variety Prices[2]													
$/gallon	3.19	3.19	3.19	3.19	6.99	3.99	21.20	51.98	9.38	10.83	12.28	7.99	17.96
$/8 fl oz serving	0.20	0.20	0.20	0.20	0.44	0.25	1.33	3.25	0.59	0.68	0.77	0.50	1.12

[1] Nutrition information is all for unsweetened, unflavored varieties, unless otherwise specified and is sourced from: https://fdc.nal.usda.gov. Specific products include: Whole, 2%, 1%, Skim, Chocolate - store brands (Harris Teeter, Food Lion), Organic milk (skim) - Good & Gather (Target), Goat milk - Meyenberg, Buffalo milk - Southwest Ranches Farmers Market, Lactose-free milk (low-fat) - Lactaid 2%, A2 milk (lowfat) - Snowville Creamery, Ultra-filtered milk - Fair Life, Shelf-stable milk - Carnation, Kefir - Lifeway 1%

[2] Pricing information sourced from grocery stores in Durham, NC, July 2024.

APPENDIX H. NUTRITIONAL COMPARISON OF PLANT-BASED MILK ALTERNATIVES

Plant-based milk alternatives (PBMA) are growing in popularity among consumers, but few understand that these products, except for fortified soy milk and some pea protein blends, are not nutritionally equivalent to cow's milk. Milk is often recommended as part of a healthy dietary pattern in the U.S. because it is an affordable and readily available source of many key nutrients like protein, fat, calcium, vitamin D, vitamin A, vitamin B12, potassium, phosphorous, riboflavin, and niacin. Importantly, milk is a good source of several key nutrients of concern that kids generally aren't getting enough of—**potassium, calcium, and vitamin D**.

Not all PBMA are the same, and none is a perfect substitute for the nutrients available in dairy milk. Thus, health care providers will need to work with families choosing to consume PBMA in place of dairy milk to ensure that the diets of children and adolescents provide adequate amounts of the key nutrients typically found in cow's milk, especially potassium, calcium, and vitamin D. PBMA are also more expensive (cup for cup) than dairy milk. This list of PBMA is ranked from best (green) to worst (red) when it comes to young children's nutritional needs.

Nutritional Comparison (unflavored, unsweetened varieties)[1]														
	Cow's Milk				Plant-Based Milk Alternatives									
	Whole	2% or reduced-fat	1% or low-fat	Skim or non-fat	Soy	Pea	Oat	Hazelnut	Hemp	Coconut	Cashew	Almond	Flax	Rice
Calories	152	122	106	91	80	80	40	90	60	40	25	30	25	120
Protein (g)	8	8.2	8.3	8	7	8	1	2	3	0	<1	1	0	0
Fat (g)	8	4.7	2.3	0	4.5	4.5	0.5	9	4.5	4	2	3	2.5	2.5
Added sugar (g)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Calcium (mg)	306	309	310	300	300	440	350	24	257	470	450	470	280	300
Vitamin D (mcg)	2.4	2.8	2.6	4.8	3	5	4	0	2	2	2.5	2	2.3	4.8
Potassium (mg)	374	390	391	430	300	405	350	105	100	310	0	170	0	40
Vitamin B12 (mcg)	1.3	1.4	1.5	1.4	2.5	2.5	0.2	-	-	0.9	-	-	1.4	1.1
Price Comparison[2]														
Avg price per gallon	3.39	3.39	3.39	3.39	8.19	14.64	9.45	21.20	23.88	8.19	11.94	6.29	31.92	19.96
Avg price per 8 fl oz serving	0.21	0.21	0.21	0.21	0.51	0.92	0.59	1.33	1.49	0.75	0.75	0.39	2.00	1.25

[1] Nutrition information is for unsweetened, unflavored varieties and is sourced from: *https://fdc.nal.usda.gov*. Specific products include: Cow's milk (all fat types) - store brands (Harris Teeter, Food Lion); Soy - Silk Organic Unsweet; Pea - Ripple Unsweetened Original; Oat - Planet Oat Original; Hazelnut - Elmhurst Unsweetened; Hemp - Pacific Foods Unsweetened Original; Coconut - Silk Unsweet; Cashew - Silk Unsweet; Almond - Silk Unsweet Original; Flax - Good Karma Unsweetened; Rice - Rice Dream Enriched Unsweetened.

[2] Pricing information sourced from grocery stores in Durham, NC, July 2024.

APPENDIX I. EXPERT PANEL MEMBERS AND SCIENTIFIC ADVISORS

Expert Panel Co-Chairs

Angie L. Cradock, ScD, MPE is a Principal Research Scientist and the Deputy Director of the Prevention Research Center on Nutrition and Physical Activity at the Harvard T.H. Chan School of Public Health (HPRC). The mission of the HPRC is to work with community partners to develop, implement, evaluate, and disseminate cost-effective strategies that will improve population nutrition and physical activity, prevent excess weight gain and chronic disease, and advance health equity. Dr. Cradock earned her Doctor of Science degree and a Master of Science degree in Health and Social Behavior from the Harvard T.H. Chan School of Public Health, a Master of Physical Education degree from Pacific Lutheran University, and a Bachelor of Arts degree in Biology from Vassar College.

Anisha I. Patel, MD, MSHS, MSPH is a Professor in the Division of General Pediatrics at Stanford University, Director of the Office of Community-Engaged Research in Stanford's Maternal and Child Health Research Institute, and an Associate Dean of Research in Stanford's School of Medicine. Dr. Patel also leads Partnerships for Research in Child Health where she partners with communities to co-design, implement, and evaluate research to reduce inequities in child health. Dr. Patel earned a medical degree at the University of North Carolina at Chapel Hill, completed a residency and chief residency in pediatrics at Stanford University, a fellowship in the Robert Wood Johnson Foundation Clinical Scholars Program at the University of California Los Angeles and a post-doctoral fellowship in the Philip R. Lee Institute for Health Policy Studies at the University of California San Francisco. Dr. Patel practices general pediatrics at the Gardner Packard Children's Health Center, a federally qualified health center affiliated with Stanford.

Expert Panel Members

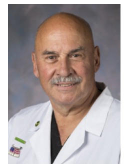
Academy of Nutrition and Dietetics

Alison Steiber, PhD, RDN is a Registered Dietitian Nutritionist and the Chief Mission, Impact and Strategy Officer at the Academy of Nutrition and Dietetics. In this role, Dr. Steiber leads the Research, International, and Scientific Affairs team in both research efforts, including conducting nutrition related research, systematic reviews, position statements, and Evidence Based Nutrition Practice Guidelines and the Dietitian Outcomes Registry. Additionally, Dr. Steiber oversees the Academy's international efforts, standardized language development and resources and supports the research fellowship program. Prior to the Academy, Dr. Steiber was Director of the Coordinated Dietetic Internship. She is an author on dozens of scientific research papers, represents the Academy at key research, scientific and/or policy conferences, is a member of the Board of Directors for the National Kidney Foundation, on the Scientific Advisory Panel for the American Council on Exercise and the Executive Committee for the International Society for Renal Nutrition and Metabolism. Dr. Steiber completed her Dietetic Internship and received her Master of Science in Dietetics at the University of Kansas Medical Center and her Doctorate in Human Nutrition from Michigan State University. In 2021, Dr. Steiber received the Distinguished Health Professions Alumna award from the University of Kansas Medical Center, Kansas City, KS.

Lori J. Bechard, PhD, MEd, RDN is a clinical nutrition researcher and educator currently serving as Associate Professor in the Department of Nutrition and Dietetics, College of Health and Wellness at Johnson & Wales University. Dr. Bechard has wide-ranging expertise in clinical pediatric nutrition research and specialized practice, and is the author of numerous publications in highly regarded peer-reviewed journals. She was previously the Director of Nutrition Research in the Critical Care Outcomes Center at Boston Children's Hospital, and co-directed the Pediatric International Nutrition Study (PINS), a cohort study of mechanically ventilated children in PICUs that has informed bedside nutrition practices around the world. Dr. Bechard is an active member of the Academy of Nutrition and Dietetics, currently serving as an advisor to the Pediatric Nutrition Practice Group, and is also a member of the American Society of Parenteral and Enteral Nutrition and the American Society for Nutrition.

American Academy of Pediatric Dentistry

Jenny Ison Stigers, DMD is a graduate of Morehead State University and obtained her dental degree from the University of Kentucky. She completed a two year General Practice Residency at UK and then a residency in pediatric dentistry at Indiana University and the James Whitcomb Riley Hospital for Children in Indianapolis. Dr. Stigers became certified by and is past-president of the American Board of Pediatric Dentistry. She spent her academic career with the University of Kentucky College of Dentistry, serving as clinic director and chief of dental services at Kosair Children's Hospital in Louisville, Kentucky and director of the West Kentucky Mobile Dental Clinics. She currently is Associate Editor of the American Academy of Pediatric Dentistry (AAPD) Reference Manual of Pediatric Dentistry. She chaired the AAPD's Task Force on Strengthening the Science in AAPD's Guidelines and Journals. She has authored multiple book chapters on pediatric dentistry and represented AAPD in multidisciplinary projects including the RWJ HER Healthy Beverage Consumption, Ages 0-5 Years.



Paul Casamassimo, DDS, MS received a DDS from Georgetown University and MS/Certificate in Pediatric Dentistry from the University of Iowa. He has taught at the University of Iowa and the University of Colorado. He is Professor Emeritus, Division of Pediatric Dentistry, the Ohio State University. He is former Editor-in-Chief of the American Academy of Pediatric Dentistry (AAPD) and its journal, Pediatric Dentistry, and past-president. Dr. Casamassimo is past-president of the Academy of Dentistry for the Handicapped and past editor of Journal of Dentistry for the Handicapped. He is a member of ADA, AAPD, and the Royal College of Surgeons of Edinburgh (UK) and is currently Chief Policy Officer of AAPD and past-Chair of the Dental Quality Alliance of the American Dental Association. He has over 500 publications including three books, in the areas of pediatric dentistry, special health care needs, health policy, and dental education. Dr. Casamassimo has received numerous leadership, humanitarian and teaching awards and is a board-certified pediatric dentist at Nationwide Children's Hospital and past-President of the medical staff.

American Academy of Pediatrics

Mark R. Corkins, MD is the Division Chief of Pediatric Gastroenterology and Professor at the University of Tennessee Health Science Center and Le Bonheur Children's, Memphis, TN and the St. Jude Endowed Chair of Excellence in Pediatric Gastroenterology. Dr. Corkins is a Fellow of the American Academy of Pediatrics, American Gastroenterological Association and the American Society for Parenteral and Enteral Nutrition and an honorary member of the Academy of Nutrition and Dietetics. Dr. Corkins has served on the ASPEN's Board of Directors and completed two terms on the AAP-Committee on Nutrition. He was ASPEN's 2007 Nutrition Support Physician of the year and the 2018 Excellence in Nutrition Support Education Award winner. He is head-editor of several nutrition textbooks, author of numerous journal articles and a member of the task force that created the new definition for pediatric malnutrition. Since July 2021, he is chair of the AAP's Committee on Nutrition.

Sarah E. Barlow, MD, MPH is a professor of pediatrics at University of Texas Southwestern Medical School, and director of the Children's Health Integrated Programs in Childhood Obesity. A pediatric gastroenterologist by training, she has focused her academic and clinical work in the field of childhood obesity. She established a pediatric weight management program at St. Louis University and was the medical director of the Texas Children's Hospital Center for Childhood Obesity. She was a co-investigator on the Texas Childhood Obesity Research Demonstration project, a CDC-sponsored study that examined healthcare, school, and early childhood education programs for obesity prevention and care in low-income neighborhoods. She has been the co-author on the three widely cited papers guiding pediatric obesity care: the 1998 recommendations, the 2007 recommendations, and the 2023 AAP Clinical Practice Guideline for the Evaluation and Treatment of Children and Adolescents with Obesity. She is currently on the executive council of the American Academy of Pediatrics Section on Obesity.

American Heart Association

Linda Van Horn, PhD, RDN is Professor and Chief, Nutrition Division, Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University in Chicago. She is a clinical nutrition epidemiologist focusing on primary prevention of cardiometabolic and other chronic diseases beginning in utero and throughout the life course. Dr. Van Horn was editor of the Journal of the Academy of Nutrition and Dietetics from 2003-2013. She chaired the 2010 US Dietary Guidelines Advisory Committee (DGAC) and served on the 2020 US DGAC. She chaired several NIH Task Forces and Workshops including the National Heart, Lung and Blood Institute Workshop on Medical Nutrition Education. She is an active member of the American Heart Association Nutrition Committee. She is a member of the NASEM Standing Committee on Evidence Synthesis and Communication in Diet and Chronic Disease Relationships. Her undergraduate training was in Nutrition and Dietetics at Purdue, her master's degree is in exercise physiology from the University of Pittsburgh and her doctoral work was completed at the University of Illinois, Chicago.

Sally S. Wong, PhD, RD, CDN, FAHA is the National Senior Director of Science & Medicine with the American Heart Association. She brings her expertise from the clinical, community, and academic settings to provide scientific guidance to the organization's impact goals and vision, and support research efforts across various research communities in epidemiology and prevention, lifestyle and cardiometabolic health, quality of care and outcomes research, and health equity. In her current, she provides consultation, guidance, and approval on science aspects to the organization on their public and professional programs, publications, press releases, corporate relations and marketing materials with health and science implications. Wong earned a PhD in Nutrition Epidemiology from New York University (NYU), she also is a Registered Dietitian and completed her dietetic internship training from NYU Langone Medical Center. Wong holds a MS in Clinical Nutrition from NYU and a BA in Biology from Hunter College, City University of New York. She has authored numerous research reports, peer-reviewed articles, and book chapters on nutrition and dietetics, dietary acculturation, and cardiovascular disease prevention. She was inducted as Fellow of the American Heart Association in 2015, and Fellow of the New York Academy of Medicine in 2020.

Scientific Advisory Committee Members

Allison Sylvetsky, PhD is an Associate Professor at the George Washington University Milken Institute School of Public Health and Vice Chair of the Department of Exercise and Nutrition Sciences. Dr. Sylvetsky received her doctorate in Nutrition and Health Science from Emory University and completed a post-doctoral fellowship in the Diabetes, Endocrinology, and Obesity Branch at the National Institutes of Health (NIH). Her primary research interests include studying the consumption and health effects of sugar-sweetened beverages and non-nutritive sweeteners, with a key focus on their consumption during childhood.

Emily A. Callahan, MPH, RDN is a Registered Dietitian Nutritionist and Founder and Principal of EAC Health and Nutrition, LLC, a consultancy that helps national health and science organizations evaluate and communicate research to educate stakeholders, shape environments, and advance policies to promote population health. In this capacity Emily supports the Food is Medicine Institute at the Friedman School of Nutrition Science and Policy at Tufts University, holding the role of Director of Policy Strategy; separately, she is also providing science writing and editing support for a major federal government nutrition effort. Emily was the lead research consultant for the 2019 Healthy Eating Research recommendations for beverage consumption among children ages 0-5 years. Previously, she held staff roles at the American Heart Association and the National Academies of Sciences, Engineering, and Medicine. She earned an MPH from the University of North Carolina at Chapel Hill and a BS, summa cum laude, from Miami University in Ohio.

Jim Krieger, MD, MPH is Executive Director of Healthy Food America and Clinical Professor Emeritus at the University of Washington School of Public Health. His work supports policy change to promote healthy eating and health equity through research, provision of technical assistance to policy makers and advocates, direct advocacy, and teaching. His policy work has led to implementation of the nation's second menu labeling regulation, adoption of sugary drink taxes, and launching sugary drink counter-marketing campaigns. His research has included evaluation of SSB taxes and warning labels. His work has been funded by NIH, CDC, and private foundations. He has served on Institute of Medicine Committees focused on obesity prevention. He has received numerous awards for his work, including the US Secretary of Health and Human Services Innovation in Prevention Award. He received his undergraduate degree at Harvard, MD at the University of California, San Francisco, and MPH at University of Washington.

Katrina Holt, MPH, MS, RD, FAND is a professor in the Department of Pediatrics at Georgetown University in Washington, DC. She is project director for the National Maternal and Child Oral Health Resource Center. In this capacity, she assists the federal Maternal and Child Health Bureau (MCHB), the Office of Head Start, and other federal agencies, professional associations, and experts to improve oral health care for pregnant women, children, and adolescents, including those with special health care needs, and their families. Katrina completed a Master of Public Health degree in maternal and child health from the University of Minnesota, a Master of Science degree in human nutrition from the University of Nebraska, and a Bachelor of Science degree in nutritional sciences and food from the University of Washington. She also completed a dietetic internship from the University of Nebraska and a MCHB-supported nutrition fellowship with the University of Minnesota, Adolescent Health Training Program.

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Stephen R. Daniels, MD, PhD is Professor and Chair of the Department of Pediatrics at the University of Colorado School of Medicine, and Pediatrician-in-Chief and L. Joseph Butterfield Chair in Pediatrics at Children's Hospital Colorado. He received his MD from the University of Chicago; MPH from Harvard University; and PhD in Epidemiology from the University of North Carolina. Dr. Daniels' area of expertise is preventive cardiology. His studies focus on understanding causes of blood pressure elevation and cholesterol abnormalities in children and adolescents, particularly the role of obesity. He has researched the development of structural and functional abnormalities in the heart and vascular system, including abnormalities in pediatric patients with diabetes mellitus, as well as the relationship of left ventricular hypertrophy to obesity and hypertension. Dr. Daniels has served on the Board of Childhood Obesity since 2010. He is co-author of Medical Epidemiology, an introductory textbook for medical students, and co-author and editor of Pediatric Prevention of Atherosclerotic Cardiovascular Disease. In 2015, he was awarded the Gold Heart Award by the American Heart Association—the AHA's highest volunteer honor. Dr. Daniels was inducted into the Association of American Physicians in 2021. He has been a member of the Society for Pediatric Research (SPR) and the American Pediatric Society (APS). He served on the APS Nominating Committee from 2015 to 2016, the APS Council from 2017 to 2022, and was voted APS President Elect in 2024.

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Temitope Erinosho, PhD is an Associate Professor in the Department of Applied Health Science at Indiana University-Bloomington, in Indiana. Her research focuses on the prevention of obesity in underserved children and families through interventions that promote healthy eating and physical activity behaviors. Environmental assessments of nutrition and physical activity practices and policies, and children's dietary and physical activity behaviors in child care settings are also important aspects of her research. Dr. Erinosho's research studies have been funded by the National Institutes of Health (NIH), Robert Wood Johnson Foundation's Healthy Eating Research Program, and university sources. Dr. Erinosho holds a doctorate degree in nutrition from New York University.