Part D. Chapter 3: Beverages

Introduction

Beverages such as water, milk, sugar-sweetened beverages (SSB), or juice may be consumed as part of meals or snacks, as a meal or snack, or sipped throughout the day and therefore not defined as a discrete ingestive event. Beverages are key contributors to hydration and to energy and nutrient intakes in U.S. dietary patterns. For example, among children and adolescents ages 2 through 19 years, beverages contribute 14 percent of mean daily energy intake, up to 42 percent of daily calcium intake, and up to 56 percent of daily vitamin D intake. Among adults ages 20 years and older, beverages contribute 17 percent of mean daily energy intake and approximately 25 percent of both daily vitamin D and calcium intakes.[1]

Box D.3.1: Data on U.S. Beverage Consumption

Part D. Chapter 1: Current Dietary Intakes and Prevalence of Nutrition-Related Chronic Health Conditions provides a summary of data analysis findings for beverage consumption in the United States and the Federal Data Analysis Report for the 2025 Dietary Guidelines Advisory Committee: Current Patterns of Food and Beverage Intake provides complete details.[1]

The substantive contribution of beverages to dietary patterns emphasizes the importance of understanding their impacts on health and including recommendations for beverage consumption within comprehensive dietary guidance. Although some beverages provide dietary and health benefits, consumption of higher quantities of certain beverages can contribute to excess intake of energy as well as certain nutrients that should be limited. Overall, total beverages contribute 43 percent and 54 percent of daily added sugars intake for children and adolescents ages 2 through 19 years and adults ages 20 years and older, respectively.[1] **Box D.3.1** provides information about where to learn more about this Committee's data analysis findings for beverage consumption in the United States.

The 2025 Committee's scientific questions about beverages were developed to focus on 1) common beverages that provide dietary benefit via their delivery of certain nutrients, such as vitamin C, vitamin D, and calcium (i.e., 100% juice and milk), and 2) beverages that do not provide dietary benefit but contribute added sugars and excess energy (i.e., SSB). Whereas low- and no-calorie sweetened beverages (LNCSB) are not generally considered to provide energy or essential nutrients in the diet, they were included because approximately 1 in 10 adults ages 20 years and older consume LNCSB at least once daily,[1] and uncertainty exists regarding their impact on growth, body composition, risk of obesity, and risk of type 2 diabetes.

This chapter provides key background information about the Committee's review of science related to beverages; presents evidence on the relationships between beverage consumption and growth, body composition, risk of obesity, and risk of type 2 diabetes across the lifespan resulting from this Committee's

systematic reviews; and provides the Committee's advice to the Departments for developing the *Dietary Guidelines for Americans, 2025-2030.*

Throughout this chapter, the term adults refers to individuals ages 19 years and older, including older adults. This is because the evidence for adults included studies that enrolled participants across the adult age span, including older adults, but did not allow for drawing separate conclusions for older adults in any of the questions reviewed. In addition to the 4 beverage questions in this chapter that included the populations of infants and young children through age 24 months, **Part D. Chapter 5: Complementary Feeding and Feeding Styles and Practices During Childhood** also addresses consumption of certain beverage types during complementary feeding.

Prioritizing the Systematic Reviews

Published systematic reviews and meta-analyses involving prospective cohort studies (PCS) and/or randomized controlled trials (RCT) have examined relationships between intakes of several types of beverages and chronic diseases. Within this literature base, however, bodies of evidence for PCS and RCT are often not integrated, the influence of differing types of the same beverage (e.g., milks of differing fat content) on health outcomes is often not examined, and outcomes are often not examined across the lifespan, particularly during pregnancy and the postpartum period. For example:

- PCS included in systematic reviews and meta-analyses have found relationships between consumption of SSB and LNCSB, when considered separately and together, and increased risk of outcomes including obesity, type 2 diabetes, cardiovascular disease, and all-cause mortality in adults.[2-4] However, when only RCT are examined and when LNCSB are used as a substitute for SSB, small improvements have been found in weight and cardiometabolic risk factors in adults.[5]
- An umbrella review of systematic reviews and meta-analyses of milk consumption in children and adults, which contained cross-sectional studies, PCS, and RCT, found beneficial associations between milk consumption and risk of cardiovascular disease, type 2 diabetes, and obesity.[6] However, the review did not examine the influence of the type of milk consumed, such as milk differing in fat content or sweet flavoring, on health outcomes.
- In a systematic review and meta-analysis of 100% fruit juice, when PCS were conducted with children, greater consumption of 100% fruit juice was associated with increases in body mass index (BMI), while RCTs in adults did not find a relationship between 100% fruit juice intake and body weight.[7]

Thus, given that beverages vary in energy content and nutrient composition—differences that may be associated with beverages' different impacts on health outcomes—various types of beverages were examined in separate questions. These beverages included dairy milk and milk alternatives, 100% juice, SSB, and LNCSB. The Committee also prioritized a question on beverage patterns, which had not been examined by prior Committees. Beverage patterns were defined as the quantities, proportions, variety, or combination of different beverages in diets, and the frequency of their habitual consumption. The

Committee considered it an important question because more than 1 beverage is consumed in the typical diet, so examining a single type of beverage in isolation to determine impacts on health does not represent how beverages are typically consumed. Beverages should instead be examined within a pattern of intake as is done for foods, an approach that was recommended by the 2020 Committee because it enables examination of relationships between overall beverage intake and health outcomes.[8] Finally, during the evidence synthesis, dairy milk and milk alternatives were organized into the categories of total milk, milk by fat content, sweetened milk, and non-dairy milk alternatives.

Setting the Review Criteria

The Committee distinguished favorable growth and body composition outcomes from unfavorable growth and body composition outcomes. Favorable growth and body composition outcomes were increases in or greater height (children and adolescents only) or lean body mass, and reductions in or lower weight-for-age, BMI-for-age, fat mass, or waist circumference. Unfavorable growth and body composition outcomes were increases in or greater weight-for-age, BMI-for-age, fat mass, or waist circumference, and lower height (for children and adolescents only) or reductions in lean body mass. Risk of obesity included changes in incidence of overweight and obesity or increases in weight or BMI. Weight loss in adults was considered a favorable outcome when studies used a reduced-energy diet, included only participants with overweight or obesity, or were designed to reduce weight. Sarcopenia was not included in this review as it was not considered within scope. For pregnancy and postpartum, adequacy of total gestational weight gain and postpartum weight change, respectively, were examined.

Several key covariates or confounders were examined when interpreting results from studies of beverage consumption. Total energy intake was not examined as a key confounder; however, the Committee considered whether study results accounted for total energy intake when synthesizing the evidence. This allowed the Committee to assess the effects of beverage consumption on health outcomes both dependent and independent of the energy provided by beverages to the total diet.

Expansion of Previous Reviews

The 2020 Dietary Guidelines Advisory Committee also conducted systematic reviews on consumption of milk, 100% juice, SSB, and LNCSB in relation to growth, size, body composition, and risk of overweight and obesity.[9] The 2025 Committee updated those reviews and expanded on the work by also examining overall beverage patterns in relation to growth, body composition, and risk of obesity. Additionally, type 2 diabetes was included as a health outcome when examining SSB and LNCSB consumption. For type 2 diabetes, the Committee considered both long-term observational studies with type 2 diabetes as the outcome and short-term interventions on surrogate/intermediate outcomes such as hemoglobin A1c. While randomized interventions can provide more direct evidence of a causal association, their generally short durations may miss mechanisms relevant to type 2 diabetes, a disease that develops over the course of years or decades.

The Committee also expanded on the previous work by conducting meta-analyses as part of their systematic reviews on SSB and growth, body composition, and risk of obesity from infancy through

adulthood, and on 100% juice and growth, body composition, and risk of obesity from infancy through adolescence (through age 19 years). The latter meta-analyses focused on infancy through adolescence due to the heightened interest in this population for guidance on 100% juice intake with regard to growth, body composition, and risk of obesity, as well as the significant differences in prevalence of 100% fruit juice consumption across age groups (i.e., 42 percent of children ages 2 through 5 years old, 28 percent of children ages 6 through 11 years old, and 16 percent of children and adolescents ages 12 through 19 years old consume 100% fruit juice daily).[1]

List of Questions

1. What is the relationship between beverage patterns consumed and growth, body composition, and risk of obesity?[10]
2. What is the relationship between dairy milk and milk alternative consumption and growth, body composition, and risk of obesity?[11]
3. What is the relationship between 100% juice consumption and growth, body composition, and risk of obesity?[12]
4. What is the relationship between sugar-sweetened beverage consumption and growth, body composition, and risk of obesity?[13]
5. What is the relationship between low- and no-calorie sweetened beverage consumption and growth, body composition, and risk of obesity?[14]
6. What is the relationship between sugar-sweetened beverage consumption and risk of type 2 diabetes?[15]
7. What is the relationship between low- and no-calorie sweetened beverage consumption and risk of type 2 diabetes?[16]

Conclusion Statements

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

Approach to Answering Question: Systematic Review

A conclusion statement cannot be drawn about the relationship between beverage pattern consumption and growth, body composition, and risk of obesity because there is not enough evidence available. (Grade: Grade Not Assignable)

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

Question 2. What is the relationship between dairy milk and milk alternative consumption and growth, body composition, and risk of obesity?

Approach to Answering Question: Systematic Review

Children and Adolescents

Total Milk

Total milk consumption by younger children may be associated with favorable growth and body composition, and lower risk of obesity during childhood. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

A conclusion statement cannot be drawn about the relationship between total milk consumption by older children and adolescents and growth, body composition, and risk of obesity because of substantial concerns with directness, consistency, and risk of bias in the body of evidence. (Grade: Grade Not Assignable)

Milk Fat Content

Consumption of higher-fat dairy milk compared to lower-fat dairy milk by younger children may be associated with favorable growth and body composition, and lower risk of obesity during childhood. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

A conclusion statement cannot be drawn about the relationship between consumption of milk with different fat content by older children and adolescents and growth, body composition, and risk of obesity because of substantial concerns with consistency, quantity, and risk of bias in the body of evidence. (Grade: Grade Not Assignable)

Milk Alternatives

A conclusion statement cannot be drawn about the relationship between consumption of milk alternatives by children and adolescents and growth, body composition, and risk of obesity because there is not enough evidence available. (Grade: Grade Not Assignable)

Sweetened Milk

A conclusion statement cannot be drawn about the relationship between consumption of sweetened milk by younger children and growth, body composition, and risk of obesity because there is no evidence available. (Grade: Grade Not Assignable)

There may not be a relationship between consumption of sweetened milk by older children and adolescents and growth, body composition, and risk of obesity. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

Adults and Older Adults

Total Milk

Total milk consumption by adults and older adults is not associated with measures of body composition or risk of obesity. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Milk Fat Content

A conclusion statement cannot be drawn about the relationship between consumption of milk with different fat content by adults and older adults and body composition and risk of obesity because of substantial concerns with directness, consistency, and an absence of trial data in the body of evidence. (Grade: Grade Not Assignable)

Milk Alternatives

A conclusion statement cannot be drawn about the relationship between consumption of milk alternatives by adults and older adults and body composition and risk of obesity because there is not enough evidence available. (Grade: Grade Not Assignable)

Sweetened Milk

A conclusion statement cannot be drawn about the relationship between consumption of sweetened milk by adults and older adults and body composition and risk of obesity because there is no evidence available. (Grade: Grade Not Assignable)

Pregnancy

A conclusion statement cannot be drawn about the relationship between milk consumption during pregnancy and adequacy of gestational weight gain because there is not enough evidence available. (Grade: Grade Not Assignable)

Postpartum

A conclusion statement cannot be drawn about the relationship between milk consumption during postpartum and postpartum weight change because there is no evidence available. (Grade: Grade Not Assignable)

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

Question 3. What is the relationship between 100% juice consumption and growth, body composition, and risk of obesity?

Approach to Answering Question: Systematic Review with Meta-Analysis

Infants, Children, and Adolescents

A conclusion statement cannot be drawn about the relationship between 100% juice consumption by infants and young children, up to age 24 months, and outcomes related to growth patterns, body composition, and risk of obesity during childhood because there are substantial concerns with consistency, precision, risk of bias, and generalizability in the body of evidence. (Grade: Grade Not Assignable)[a]

100% juice consumption by children and adolescents is not associated with growth, body composition, and risk of obesity. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Adults and Older Adults

100% juice consumption by adults and older adults is not associated with body composition. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

100% juice consumption by adults and older adults may not be associated with weight gain. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

Pregnancy

A conclusion statement cannot be drawn about the relationship between 100% juice consumption during pregnancy and adequacy of gestational weight gain because there is not enough evidence available. (Grade: Grade Not Assignable)

Postpartum

A conclusion statement cannot be drawn about the relationship between 100% juice consumption during postpartum and postpartum weight change because there is not enough evidence available. (Grade: Grade Not Assignable)

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

[a]This conclusion statement was developed as part of the systematic review on complementary feeding and growth, body composition, and risk of obesity. The conclusion statement relevant to infants and young children is presented here for reference. For more detail, see **Part D. Chapter 5: Complementary Feeding and Feeding Styles and Practices During Childhood**.

Question 4. What is the relationship between sugar-sweetened beverage consumption and growth, body composition, and risk of obesity?

Approach to Answering Question: Systematic Review with Meta-Analysis

Infants, Children, and Adolescents

Sugar-sweetened beverage consumption by infants, children, and adolescents is associated with unfavorable growth patterns and body composition, and higher risk of obesity in childhood up to early adulthood. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Adults and Older Adults

Sugar-sweetened beverage consumption by adults and older adults is associated with unfavorable body composition. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Sugar-sweetened beverage consumption by adults and older adults is associated with higher risk of obesity. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Pregnancy

A conclusion statement cannot be drawn about the relationship between sugar-sweetened beverage consumption during pregnancy and adequacy of gestational weight gain because there is not enough evidence available, and there are substantial concerns with consistency, precision, risk of bias, directness, and generalizability in the available body of evidence. (Grade: Grade Not Assignable)

Postpartum

A conclusion statement cannot be drawn about the relationship between sugar-sweetened beverage consumption during postpartum and postpartum weight change because there is not enough evidence available. (Grade: Grade Not Assignable)

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

Question 5. What is the relationship between low- and no-calorie sweetened beverage consumption and growth, body composition, and risk of obesity?

Approach to Answering Question: Systematic Review

Children and Adolescents

Low- and no-calorie sweetened beverage consumption by children and adolescents may not be associated with growth, body composition, and risk of obesity. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

Adults and Older Adults

Low- and no-calorie sweetened beverage consumption by adults and older adults, compared with water or lower amounts of low- and no-calorie sweetened beverages, is not associated with a change in body composition and risk of obesity. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

Pregnancy

A conclusion statement cannot be drawn about the relationship between low- and no-calorie sweetened beverage consumption during pregnancy and adequacy of gestational weight gain because there is no evidence available. (Grade: Grade Not Assignable)

Postpartum

A conclusion statement cannot be drawn about the relationship between low- and no-calorie sweetened beverage consumption during postpartum and postpartum weight change because there is not enough evidence available. (Grade: Grade Not Assignable)

View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/low-no-calorie-beverages_growth-obesity

Question 6. What is the relationship between sugar-sweetened beverage consumption and risk of type 2 diabetes?

Approach to Answering Question: Systematic Review

Infants and Young Children Up to Age 24 Months

A conclusion statement cannot be drawn about the relationship between sugar-sweetened beverage consumption by infants and young children up to age 24 months and risk of type 2 diabetes because there is no evidence available. (Grade: Grade Not Assignable)

Children and Adolescents

A conclusion statement cannot be drawn about the relationship between sugar-sweetened beverage consumption by children and adolescents and risk of type 2 diabetes because of substantial concerns with directness in the body of evidence. (Grade: Grade Not Assignable)

Adults and Older Adults

Sugar-sweetened beverage consumption by adults and older adults may be associated with higher risk of type 2 diabetes. This conclusion statement is based on evidence graded as moderate. (Grade: Moderate)

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

Question 7. What is the relationship between low- and no-calorie sweetened beverage consumption and risk of type 2 diabetes?

Approach to Answering Question: Systematic Review

Infants, Children, and Adolescents

A conclusion statement cannot be drawn about the relationship between low- and no-calorie sweetened beverage consumption by infants, children, and adolescents and risk of type 2 diabetes because there is not enough evidence available. (Grade: Grade Not Assignable)

Adults and Older Adults

Low- and no-calorie sweetened beverage consumption by adults and older adults may not be associated with risk of type 2 diabetes. This conclusion statement is based on evidence graded as limited. (Grade: Limited)

View the full systematic review, including details on the methodology and the evidence underlying these conclusion statements, at https://nesr.usda.gov/2025-dietary-guidelines-advisory-committee-systematic-reviews/low-no-calorie-beverages_type-2-diabetes

Integration

In this section the Committee integrates evidence across conclusion statements by organizing its findings by direction of association identified in its systematic reviews: favorable associations found between beverages and health outcomes, unfavorable associations found between beverages and health outcomes, no association found between beverages and health outcomes, and beverage-health outcome relationships for which a conclusion statement could not be drawn.

Favorable Associations Found Between Beverages and Health Outcomes

Two conclusion statements, both of which examined milk, identified associations between beverages and favorable health outcomes. These statements focused on 1) total milk and 2) higher-fat dairy milk in comparison to lower-fat dairy milk and the health outcomes of growth and body composition and lower risk of obesity during childhood. Both statements were for young children (ages 2 through 5 years) and were based on evidence graded as limited. These conclusion statements suggest that total milk, and higher-fat dairy milk compared to lower-fat dairy milk, may not provide excess energy for children ages 2 through 5 years. Both lower-fat and higher-fat dairy milk provide important nutrients such as protein, vitamin D, calcium, potassium, phosphorus, and magnesium.[1]

Unfavorable Associations Found Between Beverages and Health Outcomes

Four conclusion statements identified unfavorable associations between beverages and health outcomes, all of which examined SSB consumption. These conclusion statements included meta-analysis and were based on evidence graded as moderate. One statement focused on the life stages of infancy through adolescence and the association with unfavorable growth patterns and body composition and higher risk of obesity. Two conclusion statements in adults documented associations between SSB consumption and unfavorable body composition and higher risk of obesity, respectively. The fourth conclusion statement was for adults and the association of SSB consumption with higher risk of type 2 diabetes. All life stages except pregnancy and postpartum were represented in these 4 conclusion statements, which suggest that in general, SSB intake contributes to excess energy intake, which may contribute to unfavorable health outcomes. SSB also contribute to excess added sugars intake without providing beneficial nutrients. Among individuals ages 2 years and older, SSB and LNCSB contribute an average of 22 percent of daily added sugars intake for females and 27 percent for males.[17]

No Association Found Between Beverages and Health Outcomes

Eight conclusion statements identified no relationship between the beverages and health outcomes examined. Four of those statements were based on evidence graded as moderate and 4 were based on evidence graded as limited.

The statements supported by evidence graded as moderate examined relationships between 100% juice, total milk, or LNCSB with growth, body composition, and risk of obesity. Children and adolescents (100% juice) and adults (100% juice, total milk, and LCNSB) were represented in the statements based on evidence graded as moderate.

One of the conclusion statements based on evidence graded as moderate, which focused on 100% juice and growth, body composition, and risk of obesity in children and adolescents, reflected the overall evidence from this Committee's systematic review and meta-analysis of studies with populations ranging from ages 0 to 19 years. However, only 4 studies (1 included in the meta-analysis) included children from birth to 24 months, limiting applicability of this statement for young children. Furthermore, another conclusion statement developed as part of the systematic review on complementary feeding and growth, body composition, and risk of obesity determined that a conclusion could not be drawn about the relationship between 100% juice consumption by infants and young children, up to age 24 months, and outcomes related to growth patterns, body composition, and risk of obesity during childhood because there were substantial concerns with consistency, precision, risk of bias, and generalizability in the body of evidence. Current guidance in the *Dietary Guidelines for Americans, 2020-2025* states that 100% juice should not be given to children younger than 12 months and that nutrient-dense whole fruits and vegetables should be prioritized over 100% juice when feeding young children ages 12 to 24 months.

Besides this caveat, the evidence underlying these conclusion statements graded as moderate had consistent findings across the life stages examined, indicating that no association exists between consumption of these beverages (100% juice for children and adolescents; 100% juice, total milk, and

LNCSB for adults) and growth, body composition, and risk of obesity. Research that addresses methodological limitations and allows greater ability to generalize findings to the overall U.S. population would help strengthen the evidence underlying these conclusions.

The statements based on evidence graded as limited focused on 100% juice, sweetened milk, and LNCSB, and included the health outcomes of weight gain (100% juice); growth, body composition, risk of obesity (sweetened milk, LNCSB); and risk of type 2 diabetes (LNCSB). The life stages were children and adolescents (LNCSB: growth, body composition, and risk of obesity), older children and adolescents (sweetened milk: growth, body composition, and risk of obesity), and adults (100% juice: weight gain; LNCSB: risk of type 2 diabetes). The beverages included in these conclusion statements, except for sweetened milk, are generally seen as providing important nutrients or not contributing to excess added sugars or energy to the diet. As for life stage, only infants, young children ages 12 to 24 months, pregnancy, and postpartum life stages were not included in any of these statements. Given the lack of consistency in findings, small number of RCTs, and poor generalizability, more research is needed in this area.

Beverage-Health Outcome Relationships for Which a Conclusion Could Not Be Drawn

A conclusion could not be drawn for 19 of the beverage-health outcome relationships examined. All beverage types, life stages, and health outcomes examined had at least 1 conclusion statement that could not be drawn. Moreover, a conclusion statement could not be drawn regarding beverage patterns. Five of the conclusion statements indicated that no evidence was available, 9 indicated that not enough evidence was available, and 5 indicated concerns with the available evidence (e.g., quantity, directness, consistency, risk of bias). Pregnancy and postpartum were the life stages that were most represented in the conclusion statements that indicated no or not enough evidence was available.

Summary

When examined together, the conclusion statements indicate that total milk and higher-fat dairy milk may be associated with favorable health benefits for growth, body composition, and risk of obesity in children ages 2 through 5 years based on evidence graded as limited, and that SSB are associated with unfavorable health outcomes in infants, children, adolescents, and adults based on evidence graded as moderate. Despite concerns about consuming 100% juice and LNCSB and potential adverse health consequences such as excess weight gain and obesity, this Committee's systematic reviews suggest that a relationship does not exist (i.e., neither a beneficial nor an adverse relationship exists) between these beverages and growth, body composition, or risk of obesity in children, adolescents, or adults. Finally, no conclusion statements about beverages could be drawn for the life stages of pregnancy and postpartum, indicating that this area should be a research priority so that comprehensive guidance on beverage intake can be developed.

Discussion

Comparison to 2020 Dietary Guidelines Advisory Committee Findings

This Committee noted several differences when comparing its beverages conclusion statements with the 2020 Committee's beverage conclusion statements.[9] This Committee had a greater number of conclusion statements because conclusion statements were developed for additional life stages including infants and young children, pregnancy, and postpartum (the 2020 Committee was able to develop conclusion statements only for children and adults). In addition, differences in conclusion statements were found for each beverage type examined (for example, the evidence grades changed in some cases), and the Committee was also able to draw separate conclusion statements for types of milk (total milk, higher- vs. lower-fat content milk, and sweetened milk).

Milk was the beverage with the greatest change in conclusion statements. The ability to draw additional and different conclusion statements was most likely due to a larger body of evidence that enabled this Committee to more finely organize the evidence by life stage, as well as to separate the evidence for the different types of milk. For children, there was a change in directionality of associations with growth, body composition, and risk of obesity. This Committee found favorable growth and body composition and lower risk of obesity in younger children ages 2 through 5 years for total milk and higher-fat vs. lower-fat dairy milk, whereas the 2020 Committee found no relationship between total milk and adiposity in children and was unable to draw a conclusion for type of milk, including milk fat content, and adiposity in children. This Committee was also able to develop a conclusion statement for sweetened milk in older children and adolescents, which found no association with growth, body composition, or risk of obesity during childhood and was based on evidence graded as limited. The 2020 Committee determined that evidence was insufficient to draw a conclusion about the relationship between type of milk, including flavored milk, and adiposity in children. For adults, there was an increase in the strength of the evidence (from limited to moderate) for the conclusion statement of no association between total milk and growth, body composition, and risk of obesity. Finally, the life stages of pregnancy and postpartum were included in this Committee's conclusion statements, but not in the 2020 Committee's conclusion statements.

For 100% juice, the strength of the evidence underlying conclusion statements of no association with growth, body composition, and risk of obesity in children and adolescents and no association with body composition in adults increased from limited to moderate. The life stages of pregnancy and postpartum were included in this Committee's 100% juice conclusion statements, but not in the 2020 Committee's conclusion statements.

For SSB, the strength of the evidence underlying the conclusion statement for body composition and risk of obesity in adults increased from limited to moderate. Additionally, some of the observational evidence for SSB consumption by children and adolescents included longer follow-up periods (e.g., into participants' twenties or early thirties), which allowed this Committee's conclusion statement for growth, body composition, and risk of obesity to extend into outcomes measured through early adulthood. This Committee also developed a conclusion statement on SSB consumption and risk of type 2 diabetes. Unlike

the 2020 Committee, this Committee did not include a separate conclusion statement on the relationship of SSB compared with LNCSB on growth, body composition, and risk of obesity. This Committee noted that results were similar between studies comparing higher amounts of SSB consumption to lower amounts of SSB consumption, consumption of SSB to water, and consumption of SSB to LNCSB, on growth, body composition, and risk of obesity. Additionally, in PCS comparing differing levels of SSB consumption, it is not clear what other beverage(s) are consumed when SSB intake is lower. Thus, this Committee decided to integrate this evidence together in drawing a conclusion statement.

Finally, for LNCSB, there was both an increase in the strength of the evidence and a change in directionality for the conclusion statement for growth, body composition, and risk of obesity in adults: from limited evidence for an association with reduced adiposity to no association, based on evidence graded as moderate. In addition, this Committee included conclusion statements for the life stages of pregnancy and postpartum, and for risk of type 2 diabetes.

Comparisons to Other Systematic Reviews and Meta-Analyses

The relationship between SSB and risk of obesity has been examined in several published systematic reviews that include both PCS and RCT. Overall, results from these systematic reviews and meta-analyses support this Committee's findings that excess calories from SSB increase risk of obesity in both adults and children. In a systematic review and meta-analysis of controlled trials that lasted 2 or more weeks and were published through April 2022, excess energy from sugars (particularly when SSB contributed 20 percent or more of total energy intake or 100 g/d of sugars from SSB) increased adiposity, whereas removal of SSB decreased adiposity. A significant increase in body weight was observed when SSB were consumed as excess calories but not in substitution trials (energy-matched replacement of sugars).[18] In another systematic review and meta-analysis, each serving/day increase in SSB intake was associated with a 0.07-kg/m^2 higher BMI in children and a 0.42-kg higher body weight in adults. In addition, RCT in children indicated less BMI gain in the presence of SSB reduction interventions compared with control groups. In adults, randomization to addition of SSB to the diet led to greater body weight gain, and removal of SSB led to weight loss, compared with control groups. A positive linear dose-response association between SSB consumption and weight gain was found.[19] In a pooled analysis of 1.5 million adults, SSB intake was associated with an increased risk of obesity.[20] In another meta-analysis of PCS, SSB intake was associated with a higher risk of obesity in adults.[2] In a separate meta-analysis, substituting water for SSB did not result in a decrease in body weight, but this result was based on only 3 trials.[5] Overall, these findings were consistent with this Committee's conclusions that an association exists between SSB consumption and unfavorable growth patterns and body composition and increased risk of obesity across most life stages.

The association of SSB with type 2 diabetes risk has been examined in several systematic reviews of PCS. In 1 meta-analysis of PCS, each additional serving/day of SSB was associated with a 27 percent higher risk of type 2 diabetes.[3] Similar findings were observed in a pooled analysis of 1.5 million adults, in which higher SSB intake was associated with a 20 percent higher risk of type 2 diabetes.[20] In another meta-analysis, each 250-mL/day increase in SSB was associated with a 19 percent increase in risk of type

2 diabetes.[2] Collectively, these findings are consistent with this Committee's findings for adults, which indicated SSB consumption may be associated with higher risk of type 2 diabetes, based on evidence graded as moderate.

The relationship between LNCSB and risk of obesity has also been examined in several systematic reviews including PCS and RCT. In 1 meta-analysis of PCS, each 250-mL/day increase in LNCSB was associated with a 21 percent higher risk of obesity.[2] In another meta-analysis of RCT, substitution of LNCSB for SSB was associated with reduced body weight (-1.06 kg), body mass index (-0.32 kg/m^2), and percentage of body fat (-0.60 percent). Substituting LNCSB for water showed no effect on body weight, body mass index, or percentage of body fat.[5] In a systematic review and meta-analysis of PCS, an increase in LNCSB intake was associated with slightly lower weight, and substitution of LNCSB for SSB was associated with lower weight and lower incidence of obesity. Substitution of LNCSB in place of water showed no adverse associations.[21] In summary, although published meta-analyses of PCS examining LNCSB and risk of obesity indicated an increased risk, another meta-analysis based on substitution of LNCSB in place of SSB showed a decreased risk. The meta-analysis of RCT also showed a reduction in risk of obesity when SSB were substituted with LNCSB. Studies based on PCS could be prone to biases, which are difficult to rule out given that effect estimates were small and people consuming LNCSB may have experienced recent weight gain, leading to reverse causation. Overall, this Committee concluded that no association exists between LNCSB and growth, body composition, and risk of obesity across most life stages, which is compatible with the published findings from both PCS and RCT indicating that LNCSB might reduce weight compared to SSB.

With regard to risk of type 2 diabetes, meta-analysis of PCS showed that for each 250-mL/day increase in LNCSB intake, risk of type 2 diabetes was 15 percent higher.[2] Another meta-analysis of PCS indicated that each additional LNCSB serving per day was associated with a 13 percent increased risk of type 2 diabetes.[3] While these meta-analyses suggested that LNCSB might increase risk of type 2 diabetes, the magnitude of the effect was small, and this finding was based solely on PCS, which are prone to biases such as residual confounding by body mass and the inability of studies to determine if individuals diagnosed with pre-diabetes begin consuming LNCSB instead of SSB, leading to reverse causation. When developing its conclusion statements on LNCSB and risk of type 2 diabetes, the Committee noted similar limitations in the evidence, and ultimately developed a conclusion statement of no association between LNCSB and risk of type 2 diabetes in adults, based on evidence graded as limited.

Notable differences exist between this Committee's findings on milk consumption and growth, body composition, and risk of obesity when compared to other systematic reviews and meta-analyses. An umbrella review of systematic reviews and meta-analyses of milk consumption in children and adults containing cross-sectional studies, PCS, and RCT found beneficial associations between milk consumption and risk of cardiovascular disease, type 2 diabetes, and obesity. However, this review did not examine the influence of the types of milk consumed and included studies published only up to April 2019. In a linear dose-response meta-analysis of PCS published up to April 2021, the risk of overweight/obesity in adults decreased 12 percent per 200-g/day increase in total milk.[22] In a meta-analysis of PCS of children and adolescents that included studies published up to October 2021, total milk consumption was marginally

associated with increased prevalence and incidence of overweight. The number of studies were limited, however, especially for low- and high-fat milk.[23] In contrast, when considering types of dairy products by fat content, this Committee's conclusion statements suggest that total milk and higher-fat dairy milk compared to lower-fat dairy milk may not contribute excessive energy for younger children ages 2 through 5 years.

In a systematic review and meta-analysis of PCS examining 100% fruit juice intake by children, greater consumption of 100% fruit juice was associated with increases in body mass index.[7] In comparison, this Committee found no association between 100% juice consumption and risk of obesity in children and adolescents, supported by evidence graded as moderate. These differences could be explained by this Committee examining outcomes in addition to BMI, and differences in the inclusion criteria between the 2 reviews. Further, the other systematic review with meta-analysis found that the increase in BMI was small, only 5 of 23 studies reported a significant positive association, and heterogeneity was high. No RCT evidence in children was reported. Additionally, authors reported that RCT in adults did not find a relationship between 100% fruit juice intake and body weight. Yet, PCS in adults found a significant association among studies unadjusted for total energy, suggesting potential mediation by calories. The results were highly heterogenous; of 8 studies, 4 reported a significant positive association, 2 reported a significant inverse association, and 2 reported a non-significant association.[7] In comparison, largely because of the inconsistency in the direction of the results from the PCS and a null RCT, this Committee concluded there was no association between 100% juice consumption and body composition and weight gain in adults and graded the evidence for weight gain as limited.

Committee's Advice to the Departments

Findings from the systematic reviews support existing general recommendations for beverage consumption provided in the *Dietary Guidelines for Americans, 2020-2025*, emphasizing water and beverages that contribute beneficial nutrients, such as fat-free and low-fat milk and 100% juices; and that intake of beverages (e.g., SSB) that contain calories while contributing limited or no beneficial nutrients, or that contribute to intakes of added sugars and saturated fat, should be reduced.

While this Committee did not specifically examine coffee and tea in its systematic reviews, data from the Committee's data analyses support existing recommendations that coffee, tea, and flavored waters are also options, but that the most nutrient-dense options include little, if any, sweeteners or cream. Coffee and tea without sweeteners or cream contain relatively few calories and contribute to nutrient intakes. For example, coffee and tea contribute 9 to 11 percent of potassium intakes for adults ages 19 years and older. However, coffee and tea also contribute 13 to 14 percent of added sugars intakes for adults ages 19 years and older,[17] reinforcing the importance of consuming coffee and tea with minimal or no sweeteners.

It is also important to note that coffee and tea often contain caffeine. The *Dietary Guidelines for Americans, 2020-2025* provides information about safe levels of caffeine consumption and this Committee recommends carrying that information forward in the next edition of the *Dietary Guidelines for Americans*.

The Committee suggests enhancements to these existing recommendations for the *Dietary Guidelines for Americans, 2025-2030*:

- The *Dietary Guidelines for Americans, 2020-2025* states that the primary beverages consumed should be calorie-free beverages (especially water) and beverages that contribute beneficial nutrients; however, it is unclear what is meant by "calorie-free beverages." The Committee suggests that the 2025-2030 edition specifically recommend plain drinking water as the primary beverage for people to consume. Water beverages flavored with a small amount of 100% fruit juice may also be suggested as a healthy option.
- Recommended milk consumption should be specified as unsweetened fat-free and low-fat dairy milk and unsweetened fortified soy beverages. For younger children ages 2 through 5 years, the Committee found that higher-fat dairy milk (in comparison to lower-fat dairy milk) may be associated with favorable growth and body composition, and lower risk of obesity during childhood, based on evidence graded as limited. The Committee could not draw a conclusion about the relationship between consumption of milk with different fat content by older children, adolescents, adults, or older adults and growth, body composition, or risk of obesity because of substantial concerns with the body of evidence. Additionally, for older children and adolescents, the Committee found that there may not be a relationship between consumption of sweetened milk and growth, body composition, and risk of obesity, based on evidence graded as limited. The Committee was not able to draw a conclusion for the relationship between consumption of sweetened milk by younger children, adults, or older adults and growth, body composition, or risk of obesity because there was no evidence available. Sweetened dairy milk and fortified soy beverages contain beneficial nutrients, and they also contain added sugars, which should be limited as illustrated in **Part D. Chapter 10: Food Group and Subgroup Analyses**. The Committee decided that evidence is not sufficient to advise changing the *Dietary Guidelines for Americans, 2020-2025* recommendations for primary consumption of unsweetened fat-free and low-fat milk across the lifespan.
- The *Dietary Guidelines for Americans, 2020-2025* does not recommend consumption of cow milk or fortified soy beverages in place of human milk or infant formula before age 12 months. This Committee concurs with this guidance. Whole-fat unsweetened dairy milk or fortified unsweetened soy beverages can be offered to children ages 12 through 23 months, with transition to fat-free and low-fat unsweetened dairy milks starting at age 24 months. This is consistent with a consensus statement from the Academy of Nutrition and Dietetics (AND), the American Academy of Pediatric Dentistry (AAPD), the American Academy of Pediatrics (AAP), and the American Heart Association (AHA) on healthy beverage consumption in early childhood.[24]
- With regard to products that are added to beverages, this Committee recommends that products containing high amounts of calories and saturated fat and/or added sugars (such as half & half, cream, non-dairy creamers, and flavorings with added sugars such as syrups) should be replaced with versions lower in saturated fat and added sugars.

- For SSB and other beverages that contain added sugars with minimal or no beneficial nutrients, recommendations should state to limit intakes rather than to reduce/decrease them. The conclusion statements that found an association between SSB and unfavorable growth patterns and body composition, and higher risk of obesity, in childhood through early adulthood; and with unfavorable body composition, higher risk of obesity, and increased risk of type 2 diabetes in adults were based on evidence graded as moderate. The *Dietary Guidelines for Americans, 2020-2025* states that these beverages are not necessary in the diets of children and adolescents and recommends decreasing consumption. These recommendations should be strengthened to state that children and adolescents should limit SSB. Similarly, an AHA scientific statement recommends that children and adolescents limit intake of SSB to 1 or fewer 8-oz beverages per week,[25] and a consensus statement from AND, AAPD, AAP, and AHA recommends SSB and flavored milk not be consumed by children younger than age 5 years.[24] Similarly for adults, recommendations should continue to emphasize limiting consumption of beverages that contain added sugars.

The Committee also highlights other considerations for beverage consumption guidance:

- The *Dietary Guidelines for Americans, 2020-2025* states that replacement of added sugars with low- and no-calorie sweeteners in beverages may aid in short-term weight management, but questions remain about their long-term effectiveness. The Committee found that LNCSB may not be associated with growth, body composition, and risk of obesity in children and adolescents (supported by evidence graded as limited), and that they may not be associated with change in body composition and risk of obesity (supported by evidence graded as moderate) and risk of type 2 diabetes (supported by evidence graded as limited) in adults. Given continuing questions and uncertainty about the long-term effectiveness of LNCSB for weight management, emphasis should be on consumption of water and nutrient-dense beverages. This is particularly important for children; a consensus statement from AND, AAPD, AAP, and AHA recommends that children younger than 5 years not consume LNCSB.[24]
- Though the Committee found insufficient evidence to generate conclusion statements for associations of beverage consumption with gestational weight gain and postpartum weight change, general beverage recommendations still apply to pregnant and postpartum populations. The *Dietary Guidelines for Americans, 2020-2025* only mentions moderation of caffeine intakes during pregnancy and lactation; however, increased hydration and nutrient intakes are critical during these time periods.[26] The next edition of the *Dietary Guidelines for Americans* should clearly state that water and nutrient-dense beverages should be the primary beverages consumed during pregnancy and lactation.

References

1. Cruz CM, DeSilva D, Beckman K, et al. Federal Data Analysis Report for the 2025 Dietary Guidelines Advisory Committee: Current Patterns of Food and Beverage Intake. 2024;doi:https://doi.org/10.52570/DA.DGAC2025.DA01
2. Qin P, Li Q, Zhao Y, et al. Sugar and artificially sweetened beverages and risk of obesity, type 2 diabetes mellitus, hypertension, and all-cause mortality: a dose-response meta-analysis of prospective cohort studies. *Eur J Epidemiol*. Jul 2020;35(7):655-671. doi:https://doi.org/10.1007/s10654-020-00655-y
3. Meng Y, Li S, Khan J, et al. Sugar- and Artificially Sweetened Beverages Consumption Linked to Type 2 Diabetes, Cardiovascular Diseases, and All-Cause Mortality: A Systematic Review and Dose-Response Meta-Analysis of Prospective Cohort Studies. *Nutrients*. Jul 30 2021;13(8)doi:https://doi.org/10.3390/nu13082636
4. Pan B, Ge L, Lai H, et al. Association of soft drink and 100% fruit juice consumption with all-cause mortality, cardiovascular diseases mortality, and cancer mortality: A systematic review and dose-response meta-analysis of prospective cohort studies. *Crit Rev Food Sci Nutr*. 2022;62(32):8908-8919. doi:https://doi.org/10.1080/10408398.2021.1937040
5. McGlynn ND, Khan TA, Wang L, et al. Association of Low- and No-Calorie Sweetened Beverages as a Replacement for Sugar-Sweetened Beverages With Body Weight and Cardiometabolic Risk: A Systematic Review and Meta-analysis. *JAMA Netw Open*. Mar 1 2022;5(3):e222092. doi:https://doi.org/10.1001/jamanetworkopen.2022.2092
6. Zhang X, Chen X, Xu Y, et al. Milk consumption and multiple health outcomes: umbrella review of systematic reviews and meta-analyses in humans. *Nutr Metab (Lond)*. Jan 7 2021;18(1):7. doi:https://doi.org/10.1186/s12986-020-00527-y
7. 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*. Mar 1 2024;178(3):237-246. doi:https://doi.org/10.1001/jamapediatrics.2023.6124
8. Dietary Guidelines Advisory Committee. *Scientific Report of the 2020 Dietary Guidelines Advisory Committee: Advisory Report to the Secretary of Agriculture and the Secretary of Health and Human Services*. 2020. https://doi.org/10.52570/DGAC2020
9. 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. 2020;USDA Nutrition Evidence Systematic Reviews. doi:https://doi.org/10.52570/nesr.dgac2020.sr0401
10. Raynor HA, Deierlein AL, Gardner CD, et al. *Beverage Patterns and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR02
11. Raynor HA, Deierlein AL, Gardner CD, et al. *Dairy Milk and Milk Alternatives and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR03
12. Deierlein AL, Raynor HA, Andres A, et al. *100% Juice and Growth, Body Composition, and Risk of Obesity: A Systematic Review with Meta-Analysis*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR05
13. Deierlein AL, Raynor HA, Andres A, et al. *Sugar-Sweetened Beverages and Growth, Body Composition, and Risk of Obesity: A Systematic Review with Meta-Analysis*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR23
14. Raynor HA, Deierlein AL, Gardner CD, et al. *Low- and No-Calorie Sweetened Beverages and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR04
15. Giovannucci E, Taylor C, Deierlein A, et al. *Sugar-Sweetened Beverages and Risk of Type 2 Diabetes: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service,

Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR14

16. Giovannucci E, Taylor C, Deierlein A, et al. *Low- and No-Calorie Sweetened Beverages and Risk of Type 2 Diabetes: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review; 2024. https://doi.org/10.52570/NESR.DGAC2025.SR15
17. Cruz CM, DeSilva D, Beckman K, et al. Federal Data Analysis Report for the 2025 Dietary Guidelines Advisory Committee: Current Intakes of Nutrients and Dietary Components. 2024;doi:https://doi.org/10.52570/DA.DGAC2025.DA03
18. Chiavaroli L, Cheung A, Ayoub-Charette S, et al. Important food sources of fructose-containing sugars and adiposity: A systematic review and meta-analysis of controlled feeding trials. *Am J Clin Nutr*. Apr 2023;117(4):741-765. doi:https://doi.org/10.1016/j.ajcnut.2023.01.023
19. Nguyen M, Jarvis SE, Tinajero MG, et al. Sugar-sweetened beverage consumption and weight gain in children and adults: a systematic review and meta-analysis of prospective cohort studies and randomized controlled trials. *Am J Clin Nutr*. Jan 2023;117(1):160-174. doi:https://doi.org/10.1016/j.ajcnut.2022.11.008
20. Santos LP, Gigante DP, Delpino FM, Maciel AP, Bielemann RM. Sugar sweetened beverages intake and risk of obesity and cardiometabolic diseases in longitudinal studies: A systematic review and meta-analysis with 1.5 million individuals. *Clin Nutr ESPEN*. Oct 2022;51:128-142. doi:https://doi.org/10.1016/j.clnesp.2022.08.021
21. Lee JJ, Khan TA, McGlynn N, et al. Relation of Change or Substitution of Low- and No-Calorie Sweetened Beverages With Cardiometabolic Outcomes: A Systematic Review and Meta-analysis of Prospective Cohort Studies. *Diabetes Care*. Aug 1 2022;45(8):1917-1930. doi:https://doi.org/10.2337/dc21-2130
22. Feng Y, Zhao Y, Liu J, et al. Consumption of Dairy Products and the Risk of Overweight or Obesity, Hypertension, and Type 2 Diabetes Mellitus: A Dose-Response Meta-Analysis and Systematic Review of Cohort Studies. *Adv Nutr*. Dec 22 2022;13(6):2165-2179. doi:https://doi.org/10.1093/advances/nmac096
23. Babio N, Becerra-Tomas 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*. Jan 2022;23 Suppl 1:e13400. doi:https://doi.org/10.1111/obr.13400
24. Lott M CE, Welker Duffy E, Story M, Daniels S. *Healthy Beverage Consumption in Early Childhood: Recommendations from Key National Health and Nutrition Organizations.* 2019. https://healthyeatingresearch.org/wp-content/uploads/2019/09/HER-HealthyBeverageTechnicalReport.pdf.
25. Vos MB, Kaar JL, Welsh JA, et al. Added Sugars and Cardiovascular Disease Risk in Children: A Scientific Statement From the American Heart Association. *Circulation*. May 9 2017;135(19):e1017-e1034. doi:https://doi.org/10.1161/cir.0000000000000439
26. Bardosono S, Morin C, Guelinckx I, Pohan R. Pregnant and Breastfeeding Women: Drinking for Two? *Ann Nutr Metab*. 2017;70 Suppl 1:13-17. doi:https://doi.org/10.1159/000462998