

2020 Dietary Guidelines Advisory Committee: Beverages and Added Sugars Subcommittee

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Topics and Questions Under Review

- Presented at previous meeting:
 - Beverages during pregnancy and birth weight
- To be discussed today:
 - Beverages and growth, size, and body composition
 - Added sugars and cardiovascular disease
 - Alcohol and all-cause mortality

Approaches to Examine the Evidence

The Committee is answering scientific questions by reviewing the evidence using different approaches.



Data Analysis



**Food Pattern
Modeling**



**NESR
Systematic Reviews**

Today we will present findings from new NESR systematic reviews and related reviews from the 2015 DGAC, but all evidence sources for each question will be considered in the report.

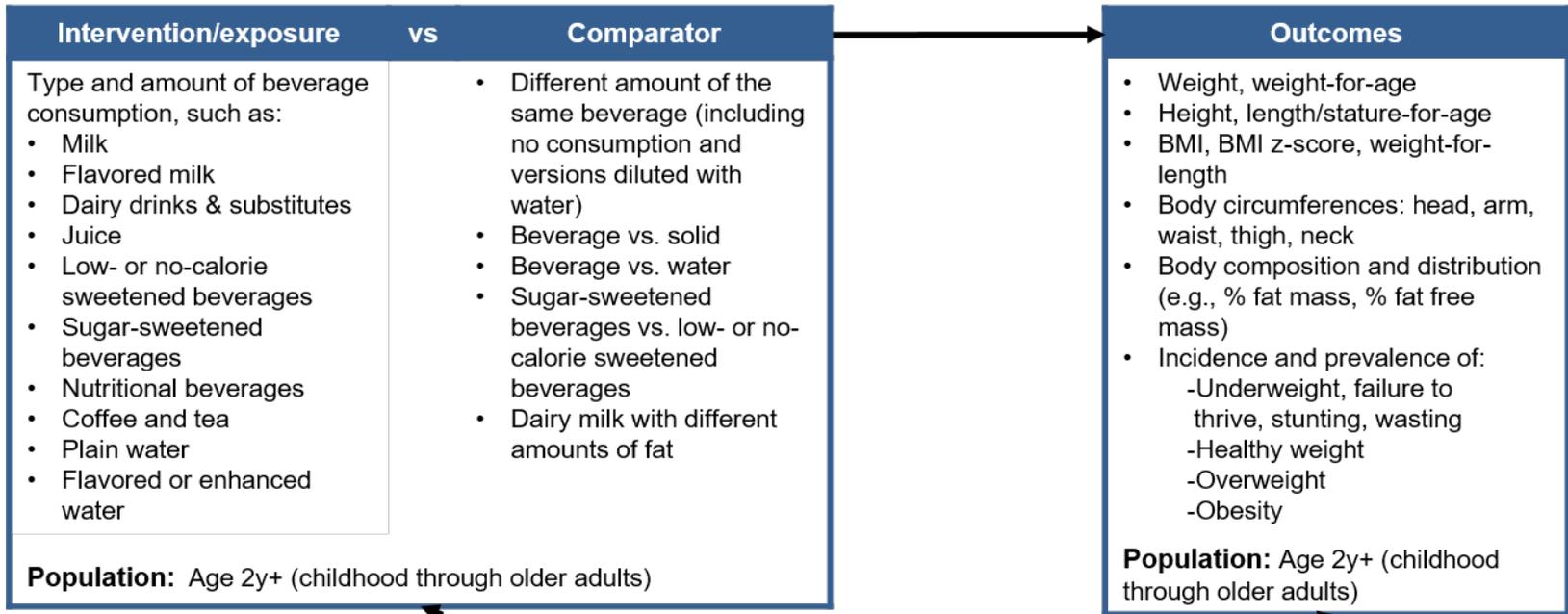
Question: Non-alcoholic beverage consumption

What is the relationship between **beverage consumption** and growth, size, body composition and risk of overweight and obesity?

Approach to Answer Question: NESR Systematic Review

Analytic Framework: Beverages and growth, size and body composition

Systematic review question: What is the relationship between beverage consumption and growth, size, body composition, and risk of overweight and obesity?



Key confounders: Sex, age, race/ethnicity, socioeconomic status, anthropometry at baseline, physical activity, smoking
Other factors to be considered: Total energy intake, timing, temporal use, sugar, protein, fiber, energy density, alcohol, medications, supplements, study duration

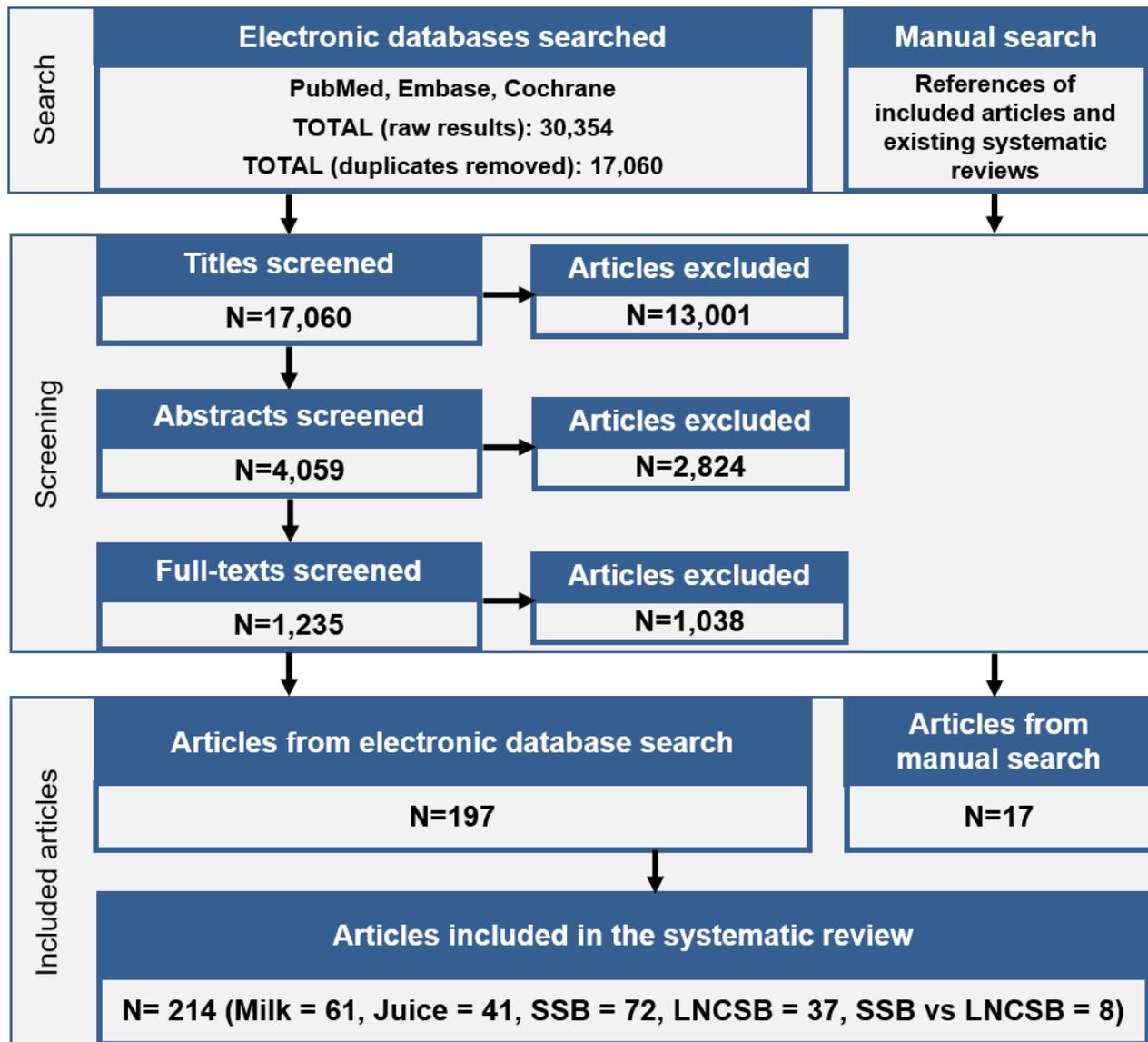
Inclusion and Exclusion Criteria: Beverages and growth, size and body composition

Sugar-sweetened beverages

- The 2015 Dietary Guidelines included articles published up to December 2011
- 2020 work included articles published since January 2012 instead of January 2000 (the date for all other beverage types)

Category	Inclusion Criteria	Exclusion Criteria
Date of publication	<ul style="list-style-type: none">• January 2012 – June 2019	<ul style="list-style-type: none">• Articles published prior to 2012

Literature Search and Screening Results: Beverages and growth, size and body composition



Today:

- Milk
- Juice
- SSB
- LNCSB
- SSB vs LNCSB

Summary of the Evidence: Beverages and growth, size and body composition

Beverages: Children

- To discern ‘healthy growth’ from ‘excessive growth’ in children, weight status (prevalence or incidence of overweight or obesity), BMI for age and sex and BMI z-scores, and body composition measures such as waist circumference and body fat, were considered to reflect “adiposity”.
- To assess ‘healthy growth’ in children, outcomes such as height and lean mass were considered.

Beverages: Adults

- Weight status (prevalence or incidence of overweight or obesity), BMI, and body composition measures such as waist circumference, body fat, and abdominal adiposity were considered to reflect “adiposity”.

Description of the Evidence: Beverages and growth, size and body composition

Milk

- 61 articles were reviewed:
 - **Children:** 29 articles (ages 2-14 years)
 - 25 prospective cohort studies and
 - 4 randomized controlled trials;
 - Analytic sample sizes ranging from 49 to 13,514.
 - **Adults:** 32 articles
 - 24 prospective cohort studies,
 - 7 randomized controlled trials and;
 - 1 Mendelian Randomization study;
 - Analytic sample sizes ranging from 31 to 52,987.

Summary of the Evidence Synthesis: Beverages and growth, size and body composition

Milk: Children

- The majority of the findings for adiposity outcomes were not significant. The few findings that were significant were not consistent in direction.
- 4 studies reported height
 - 1 RCT found no effect of milk intake on height compared to drinking water; study duration was only 12 weeks
 - 3 cohort studies reported a significant positive association between milk intake and height in children.
- 7 cohort studies looked specifically at types of milk (i.e. milk fat levels, flavored milk) and adiposity outcomes in children, but the results were not consistent.

Summary of the Evidence Synthesis: Beverages and growth, size and body composition (milk)

Milk: Adults

- The majority of the studies in adults found no significant association between milk intake and adiposity; however, there were some significant associations which were inconsistent in direction.
- The body of evidence from children and adults has several significant limitations including lack of specificity and consistency in definition of the exposure, the use of non-validated methods for assessing beverage intake, uncontrolled confounding, and inconsistencies in findings.

DRAFT Conclusion Statement and Grade: Beverages and growth, size and body composition

Milk

Conclusion statements – children

- Limited evidence suggests that milk intake is not associated with adiposity in *children*.
- Limited evidence suggests that higher milk intake is associated with a greater increase in height compared to lower intake in *children*.
- 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*.

Grade: Limited - Milk intake and adiposity, milk intake and height; Insufficient - milk type and adiposity.

Conclusion statement – adults

- Limited evidence suggests that milk intake is not associated with adiposity in *adults*.

Grade: Limited - Milk intake and adiposity

Description of the Evidence: Beverages and growth, size and body composition (juice)

Juice

The body of evidence includes 41 articles:

- **Children:** 22 articles (ages 3-18 years)
 - 21 prospective cohort studies;
 - 1 randomized controlled trial;
 - Analytic sample sizes ranging from 21 to 15,418.
- **Adults:** 19 articles
 - 14 prospective cohort studies;
 - 4 randomized controlled trials and;
 - 1 non-randomized controlled trial;
 - Analytic sample sizes ranging from 26 to 50,422.

Summary of the Evidence Synthesis: Beverages and growth, size and body composition

Juice

- **Children**

- Higher quality studies found little or no effect
- Overall: Inconsistent findings
- Limitations: inadequate adjustment for confounders, self-reported height and weight, inconsistent measures of consumption, inconsistent measures of growth, size and body composition across studies

- **Adults**

- RCTs: short duration and small sample size
- Cohort studies: large samples and consistent findings
- Limitations: self-report height and weight data, inadequate adjustment for confounders, poorly defined exposure

DRAFT Conclusion Statement and Grade: Beverages and growth, size and body composition

Juice

Conclusion statement – children

- Limited evidence suggests 100% juice intake in children is not associated with growth, size, body composition, or risk of overweight or obesity in *children*.

Grade: Limited

Conclusion statement – adults

- Limited evidence suggests 100% juice consumption is not associated with measures of adiposity in *adults*.

Grade: Limited

Description of the Evidence: Beverages and growth, size and body composition (SSBs)

Sugar-sweetened beverages

72 articles were reviewed:

- **Children:** 46 articles (ages 2-15 years):
 - 43 prospective cohort studies,
 - 2 randomized controlled trials and
 - 1 non-randomized controlled trial;
 - Analytic sample sizes ranged from 40 to 15,418.
- **Adults:** 26 articles
 - 23 prospective cohort studies,
 - 3 randomized controlled trials and
 - 1 non-randomized controlled trial;
 - Analytic sample sizes ranged from 47 to 49,106.
- The articles examined different amounts of sugar-sweetened beverage intake or sugar-sweetened beverage intake compared to water.

Summary of the Evidence Synthesis: Beverages and growth, size and body composition (SSBs)

Sugar-sweetened beverages

Children:

- Randomized controlled trials showed a relationship between a decrease in sugar-sweetened beverages and a decrease in BMI
- Prospective cohort studies showed a positive relationship between sugar-sweetened beverage intake and adiposity
- Limitations: inconsistencies across subgroups, inconsistency in methods (particularly, differences in definition of exposure), and differences in the age of children assessed and the duration of follow-up, and high attrition

Adults:

- Experimental studies had inconsistent results and limitations related to sample size, definition of the exposure and generalizability
- Prospective cohort studies showed a positive relationship between sugar-sweetened beverage consumption and at least one measure of adiposity
 - This relationship was not consistent across all measured markers of adiposity.

DRAFT Conclusion Statement and Grade: Beverages and growth, size and body composition (SSBs)

Sugar-sweetened beverages

Conclusion statement – children

- Moderate evidence suggests that higher sugar-sweetened beverage intake is associated with greater adiposity in *children*.

Grade: Moderate – sugar-sweetened beverages and adiposity

Conclusion statement – adults

- Limited evidence suggests that higher sugar-sweetened beverage intake is associated with greater adiposity in *adults*.

Grade: Limited – sugar-sweetened beverages and adiposity

Description of the Evidence: Beverages and growth, size and body composition (LNC SBs)

Low- and no-calorie sweetened beverages

37 articles were reviewed:

- **Children:** 17 articles (ages 2-16 years)
 - All prospective cohort studies
 - Varied duration (6 months to 12 years)
 - Analytic sample sizes ranging from 49 to 11,654.
- **Adults:** 20 articles
 - 14 articles from prospective cohort studies
 - 6 articles from randomized controlled trials
 - Analytic sample sizes ranged from 50 to 51,603.

Summary of the Evidence Synthesis: Beverages and growth, size and body composition (LNCSEBs)

Low- and no-calorie sweetened beverages

- **Children**

- In children, the majority found no association for the main outcome measure(s) among the study population.
- Limitations: inadequate adjustment for confounders, inconsistency in methods, short study duration, high attrition

- **Adults**

- In adults, a well-designed RCT and large prospective cohort studies found associations between low- and no- calorie sweetened beverages and reduced adiposity.
- Limitations in experimental studies: study duration, no assessment of compliance, difference in comparators
- Limitations in cohort studies: high attrition, difference in assessment methods, confounding, poor generalizability

DRAFT Conclusion Statement and Grade: Beverages and growth, size and body composition (LNCSBs)

Low- and no- calorie sweetened beverages

Conclusion statement – children

Limited evidence suggests no association between low- and no- calorie sweetened beverage consumption and adiposity in *children*.

Grade: Limited

Conclusion statement – adults

Limited evidence suggests that low- and no- calorie sweetened beverage consumption is associated with reduced adiposity in *adults*.

Grade: Limited

Description of the Evidence: Beverages and growth, size and body composition (LNCSBs vs SSBs)

Low- and no- calorie sweetened beverages vs. sugar-sweetened beverages

8 articles were reviewed:

- **Children:** 2 articles
 - Both from same randomized controlled trial
- **Adults:** 6 articles
 - 5 randomized controlled trials
 - 1 prospective cohort study

Summary of the Evidence Synthesis: Beverages and growth, size and body composition (LNCSB vs SSB)

Low- and no- calorie sweetened beverages vs. sugar-sweetened beverages

- **Children:** Evidence in children was too limited to draw a conclusion about a relationship between low- and no- calorie sweetened beverage consumption versus sugar-sweetened beverage consumption and measures of adiposity.
- **Adults:** Evidence in adults was relatively consistent suggesting no association between SSB compared with low/no-calorie sweetened beverages on adiposity outcomes; however, studies had small sample sizes, little evidence of adherence, short follow-up times, limited generalizability

DRAFT Conclusion Statement and Grade: Beverages and growth, size and body composition (LNCSB vs SSB)

Low- and no-calorie sweetened beverages vs. sugar-sweetened beverages

Conclusion statement – children

Insufficient evidence is available to determine the relationship between sugar-sweetened beverages compared with low- and no- calorie sweetened beverages on adiposity in *children*.

Grade: Grade not assignable

Conclusion statement – adults

Limited evidence suggests no association between sugar-sweetened beverages compared with low- and no- calorie sweetened beverages on adiposity in *adults*

Grade: Limited

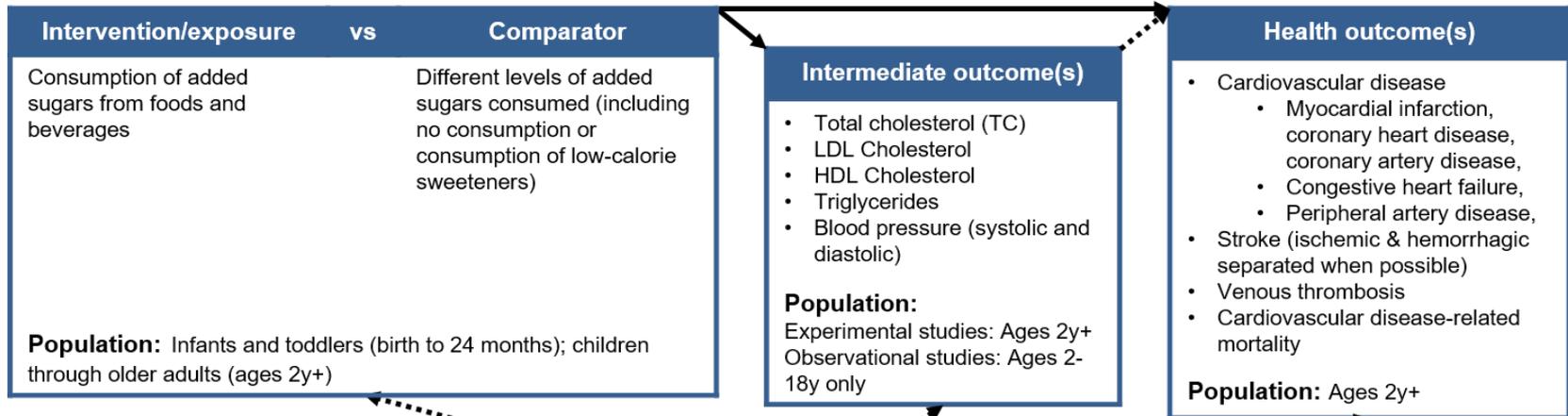
Question: Added sugars consumption

What is the relationship between **added sugars consumption** and risk of cardiovascular disease?

Approach to Answer Question: NESR Systematic Review

Analytic Framework: Added sugars consumption and risk of cardiovascular disease

Systematic review question: What is the relationship between added sugars consumption and risk of cardiovascular disease?



Key confounders (2y+): Sex, age, race/ethnicity, SES, alcohol intake (in adults), physical activity, anthropometry (intermediate outcomes only), smoking, naturally occurring sugar intake

Other factors to be considered (2y+): Total energy intake, anthropometry (health outcomes), menopausal status, medications, supplements, sodium, protein, fiber, fat, energy density, family history of CVD, food form (solid/beverage)

Key confounders (B-24 only): Gestational age, maternal age, sex, race/ethnicity, SES (parent), parental education, feeding practices (e.g., human milk/infant formula history), anthropometry at birth or baseline

Other factors to be considered (B-24 only): Smoking (maternal), maternal diet, maternal anthropometry, parity, participation in a supplemental food program, family history of CVD, complementary feeding practices

Key definitions

Added sugars: Sugars that are either added during the processing of foods, or are packaged as such (e.g., a bag of sugar). Added sugars include sugars (free, mono- and disaccharides), sugars from syrups and honey, and sugars from concentrated fruit or vegetable juices that are in excess of what would be expected from the same volume of 100 percent fruit or vegetable juice of the same type (FDA, 2016). (Studies that use a different definition of added sugars will also be considered.)

Legend

- The relationship of interest in the systematic review
- Factors that may impact the relationship of interest in the systematic review

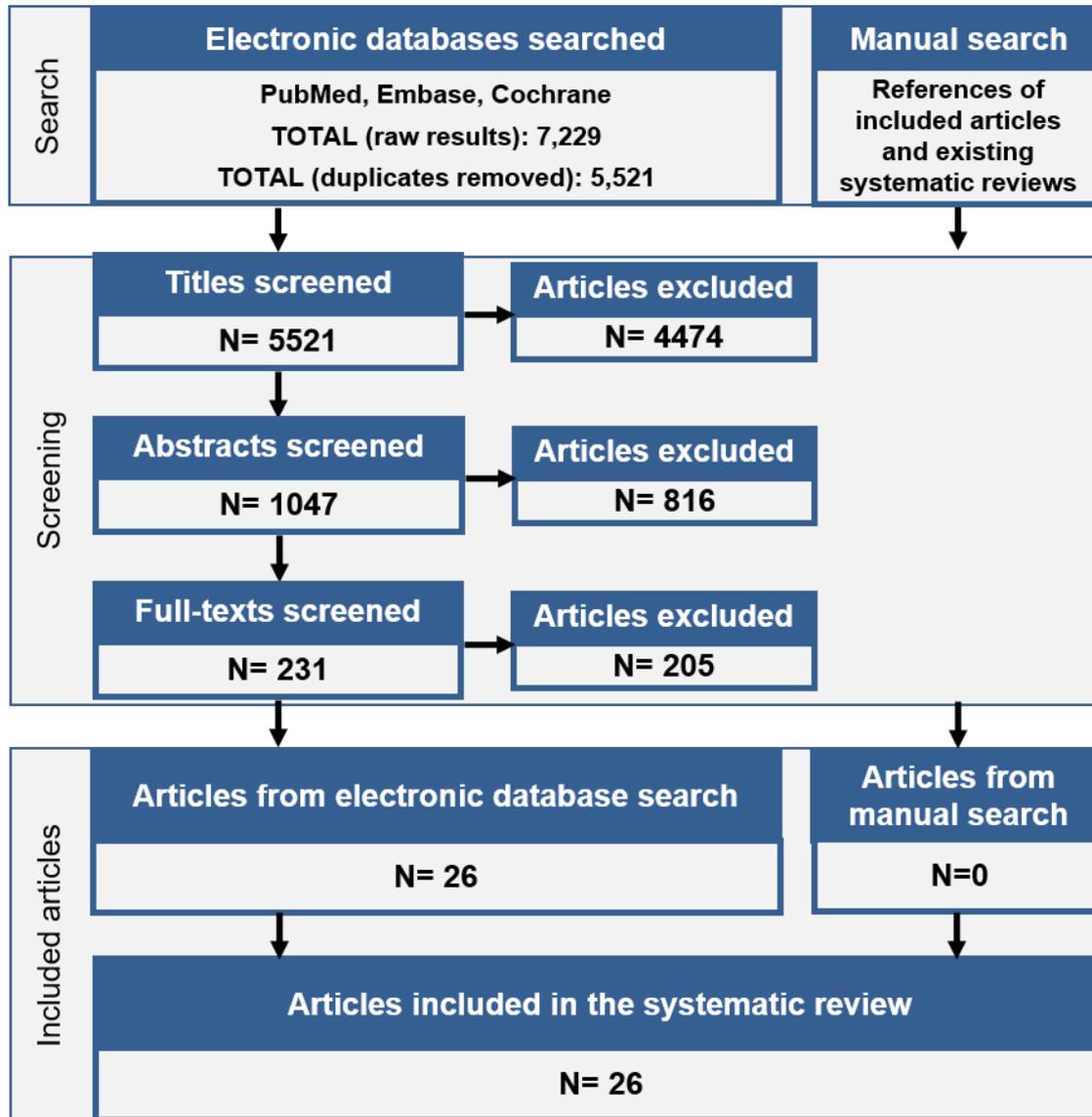
Inclusion and Exclusion Criteria: Added sugars consumption and risk cardiovascular disease

- Study duration and sample size criteria were added
- The intervention/exposure criteria were clarified to focus on studies measuring a majority of total added sugars intake

Category	Inclusion Criteria	Exclusion Criteria
Study duration	<ul style="list-style-type: none"> • 4-week minimum for experimental studies • No duration cutoff for observational studies 	<ul style="list-style-type: none"> • Experimental studies <4 weeks in duration
Sample size	<ul style="list-style-type: none"> • Observational studies enrolling >1,000 participants 	<ul style="list-style-type: none"> • Observational studies enrolling <1,000 participants
Intervention/exposure	Consumption of added sugars, particularly added sugars from the overall diet or from a food or beverage group that represent a large portion of overall added sugars intake, such as SSBs	Consumption of: <ul style="list-style-type: none"> • Low- or no-calorie sweeteners • Sugar alcohols Added: <ul style="list-style-type: none"> • Individual types of added sugars (e.g., overall honey intake, which likely does not represent overall added sugars intake) • Experimentally-manipulated foods or beverages

Literature Search and Screening Results: Added sugars consumption and risk of cardiovascular disease

Publication date range:
Sept 2014 – Sept 2019



Added sugars consumption

2020 Dietary Guidelines Advisory Committee: Meeting 5

Description of the Evidence: Added sugars consumption and risk of cardiovascular disease

26 articles were reviewed:

- **Children:** 3 articles (ages 13mo-11 years)
 - 1 randomized controlled trial;
 - 2 prospective cohort studies,
 - Analytic sample sizes ranged from 478 to 2,333.
- **Adults:** 23 articles
 - 6 randomized controlled trials (including 2 cross-over RCTs)
 - 17 prospective cohort studies;
 - Analytic sample sizes ranged from 47 to 353,751.
- **Exposure:**
 - Several stronger studies measured the exposure at multiple time points
 - Many studies only assessed added sugars intake once
- **Outcomes:**
 - Children: only intermediate outcomes (e.g. blood lipids)
 - Adults: CVD/CHD mortality was the most commonly assessed outcome

Summary of the Evidence Synthesis

- **Children**

- One RCT and one high quality prospective cohort study showed detrimental effects of added sugars intake on blood lipids (total and HDL cholesterol).
- One weaker prospective cohort study found no effect of added sugars intake on blood lipids, but had significant limitations (sample size, only assessed added sugar intake at baseline).

- **Adults**

- RCTs: Mixed results, but multiple limitations including small sample sizes, behavioral intervention with no difference in SSB intake between intervention and control, and improper adjustment for confounders.
- PCSs: Mixed findings, but studies with multiple measures of added sugars intake over time showed an association with CVD mortality.

DRAFT Conclusion Statement and Grade

Conclusion statement – children

Limited evidence suggests that higher intake of added sugars is associated with a worse lipid profile in children.

Grade: Limited

Conclusion statements – adults

Limited evidence suggests that higher intake of added sugars in adulthood is associated with increased risk for CVD mortality.

Grade: Limited

DRAFT Conclusion Statement and Grade (continued)

Conclusion statements – adults (continued)

Insufficient evidence is available to determine the association between added sugars intake in adulthood and cardiovascular disease risk profile. (2 studies)

Insufficient evidence is available to determine the association between added sugars intake in adulthood and risk of stroke. (2 studies)

Insufficient evidence is available to determine the association between added sugars intake in adulthood and incident ischemic CVD events. (2 studies)

Insufficient evidence is available to determine the relationship between added sugar intake in adulthood and risk of peripheral artery disease. (2 studies)

Insufficient evidence is available to determine the relationship between added sugars intake in adulthood and risk of heart failure. (1 study)

Grade: Grade not assignable – adults and CVD risk profile and stroke, incident ischemic CVD events, PAD, and heart failure

Additional questions:

What is the relationship between **added sugars consumption** and **growth, size, body composition and risk of overweight and obesity?**

Approach: Not reviewed (partially addressed by review of sugar-sweetened beverages and this outcome)

What is the relationship between **added sugars consumption** and **risk of type 2 diabetes?**

Approach: Not reviewed

Added sugars and growth, size and body composition

2015 DGAC:

Strong and consistent evidence shows that intake of added sugars from food and/or sugar-sweetened beverages are associated with excess body weight in children and adults. The reduction of added sugars and sugar-sweetened beverages in the diet reduces body mass index (BMI) in both children and adults. Comparison groups with the highest versus the lowest intakes of added sugars in cohort studies were compatible with a recommendation to keep added sugars intake below 10 percent of total energy intake. (Includes literature up to 2012)

2020 DGAC:

- The 2020 DGAC evidence base includes literature from 2012 - 2019 and focuses on SSBs as a key source of added sugars.
- The Subcommittee's review of evidence on sugar-sweetened beverages and growth, size, body composition outcomes aligns, in part, with the 2015 conclusion.

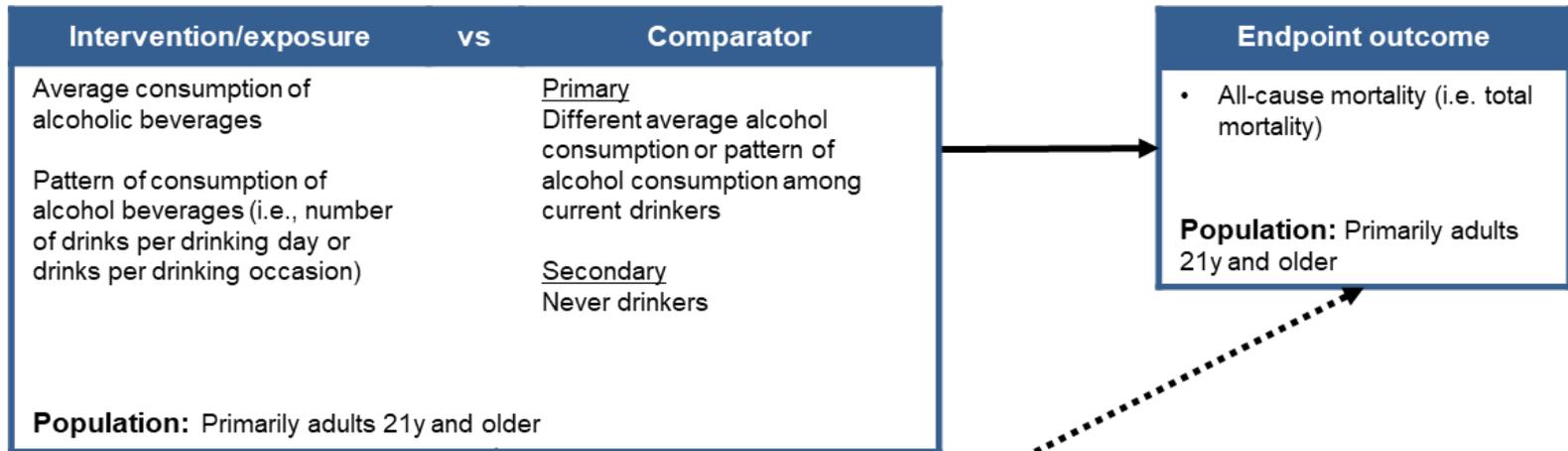
Question

What is the relationship between **alcohol consumption** and all-cause mortality?

Approach to Answer Question: NESR Systematic Review

Analytic Framework

Systematic review question: What is the relationship between alcohol consumption and all-cause mortality?



Key confounders: Sex, age, race/ethnicity, SES (income, education, health insurance, preventive health care access), eating pattern or diet quality, physical activity, smoking

Exposure-specific key confounders:

Key confounder for average consumption exposure: Pattern of consumption

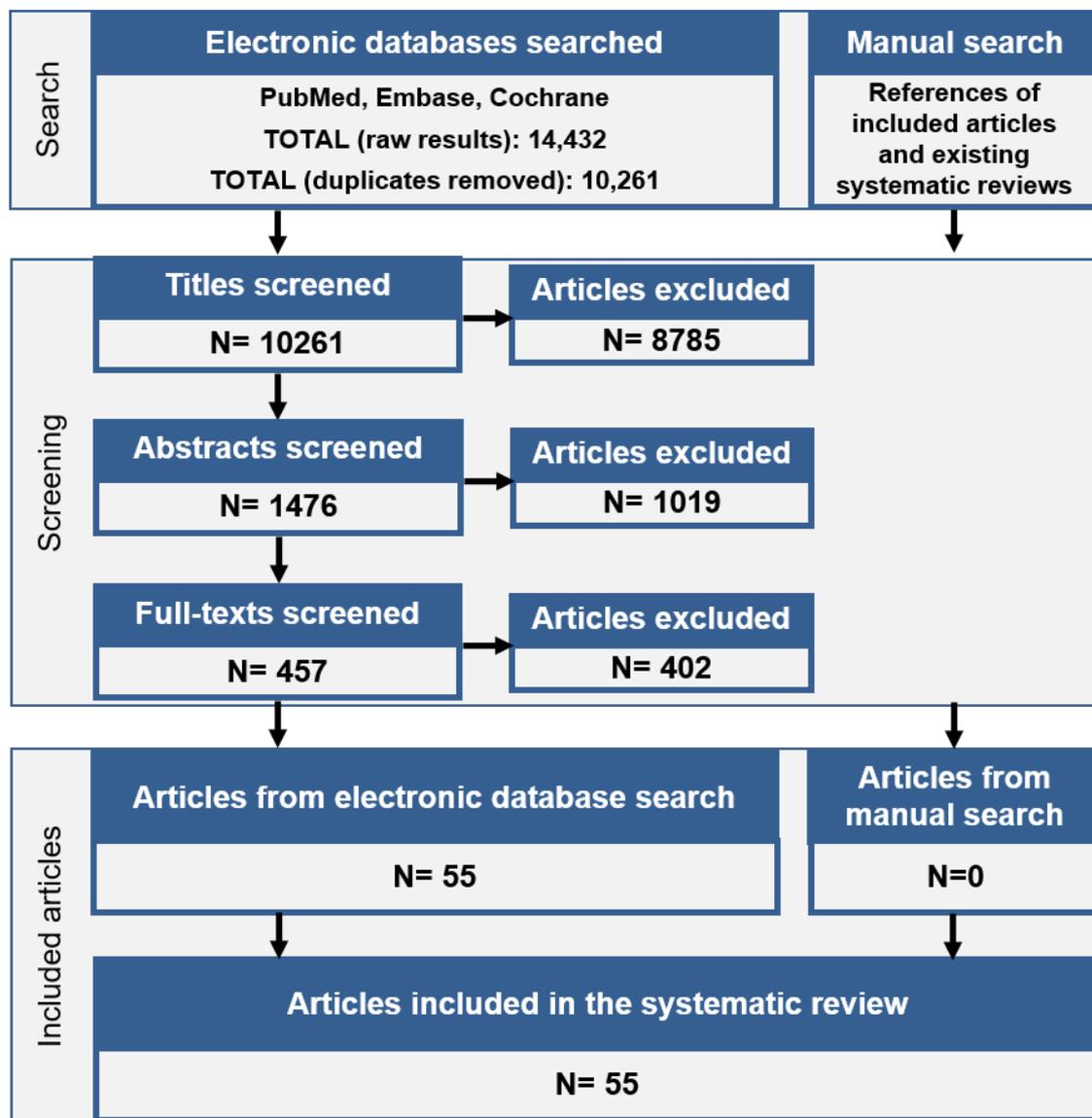
Key confounder for pattern of consumption exposure: Average consumption

Other factors to be considered: Total energy intake (ideally without alcohol), age distribution of the study sample, anthropometry, hypertension, blood pressure, diabetes, glucose, lipids, medications, family history of chronic disease, beverage type (e.g., beer, wine, spirits)

Inclusion and Exclusion Criteria

Category	Inclusion Criteria	Exclusion Criteria
Sample size	Observational studies enrolling >1,000 participants	Observational studies enrolling <1,000 participants
Date of publication	January 2010 – March 2020	Articles published prior to January 2010

Literature Search and Screening Results



Description of the Evidence

- 55 articles addressed alcohol consumption and all-cause mortality
 - No randomized control trials
 - 1 Mendelian randomization study
 - 54 prospective cohort studies
 - Most studies had large sample sizes (> 10,000 participants)
- Most studies examined average alcohol consumption, but some assessed patterns of consumption (e.g. binge drinking)
 - Few studies assessed or controlled for both
 - Most studies only assessed consumption at one point in time
 - Challenges in measuring amount of alcohol consumed
- Most studies included middle-aged and older participants, but some studies included younger participants (18+)
- Focused on data for current drinkers, as literature on “non-drinkers” (never and former) has substantial limitations in terms of confounding, generalizability, misclassification

Summary of the Evidence Synthesis: Alcohol and all-cause mortality

- Mendelian Randomization: 1 article
 - Lower mortality among those with lower genetically-predicted alcohol consumption,
 - Small sample size; too small to distinguish between drinking levels
- Cohort studies:
 - Most studies found higher mortality among those consuming high volumes of alcohol compared to those consuming low volumes, with generally consistent dose-response relationships.
 - Among drinkers, studies consistently found that binge drinking was associated with increased mortality risk compared to not binge drinking, and that more frequent binge drinking was associated with increased risk compared with less frequent binge drinking.
 - Binge drinking typically defined as consuming 5+ drinks for men or 4+ drinks for women during a drinking occasion
- Mendelian Randomization studies addressing alcohol and CVD and cancer will be identified and used to provide context

DRAFT Conclusion Statement and Grade: Alcohol and all-cause mortality

Conclusion statements

Moderate evidence finds that high average alcohol consumption is associated with an increased risk of all-cause mortality compared with low average alcohol consumption among drinkers.

Moderate evidence finds that binge drinking (consuming 5+ drinks for men or 4+ drinks per women during a drinking occasion) is associated with increased risk of mortality, and that more frequent binge drinking is associated with increased mortality risk compared with less frequent or no binge drinking among drinkers.

Grade: Moderate

Next Steps

- Conclusion statements and grading will be finalized
- Systematic reviews will be peer-reviewed
- Collaboration with data analysis and food pattern modeling working group will continue for each of our 3 question areas: beverages, added sugars, and alcohol
- The scientific report of this Dietary Guidelines Advisory Committee will be drafted

Beverages and Added Sugars Subcommittee: Members and Staff



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