

Appendix E2.45: Evidence Portfolio

Part D. Chapter 6: Cross-Cutting Topics of Public Health Importance

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

Conclusion Statement: Strong evidence shows that higher consumption of added sugars, especially sugar-sweetened beverages, increases the risk of type 2 diabetes among adults and this relationship is not fully explained by body weight.

DGAC Grade: Strong

Review of Evidence

Evidence for this question and conclusion came from five SRs and MA published between January 2010 and August 2014.¹⁻⁵ Four of the reviews focused on sugar-sweetened beverages^{1-3,5} and one review examined sugar intake.⁴ Combined, a total of 17 articles were considered in these reviews, of which nine were included in two or more reviews. Increased consumption of sugar-sweetened beverages was consistently associated with increased risk of type 2 diabetes. Pooled estimated relative risks ranged from 1.20 to 1.28, and included 1.20 (95% CI = 1.12 to 1.29)/330 ml/day of sugar-sweetened soft drinks;¹ 1.26 (95% CI = 1.12 to 1.41) for sugar-sweetened beverages,³ and 1.28 (95% CI = 1.04 to 1.59) for sugar-sweetened fruit juices.⁵ Comparably, a hazard ratio of 1.29 (1.02, 1.63) was identified for sugar-sweetened beverages.² These consistently positive associations between sugar-sweetened beverages and type 2 diabetes were attenuated, but still existed, after adjustment for BMI, suggesting that body weight only partly explains the deleterious effects of sugar-sweetened beverages on type 2 diabetes. Although the studies were highly heterogeneous, findings from the MA by Malik et al. tentatively showed that consumption of more than one 12-ounce serving per day of sugar-sweetened beverage increased the risk of developing type 2 diabetes by 26 percent, compared to consuming less than one serving per month. Insufficient high-quality data are available to determine a dose-response line or curve between sugar-sweetened beverage consumption and type 2 diabetes risk.

The issue of generalizability, whether the participants included in this body of evidence are representative of the general U.S. population, was not specifically addressed in the literature reviewed, but the large sample sizes of the pooled data (several hundred thousand subjects from different populations) are noteworthy.

Table 1. Summary of existing reports, systematic reviews, and meta-analyses examining the relationship between the intake of added sugars and risk of type 2 diabetes?

Author, Year Publication Type AMSTAR Rating*	Added Sugars Definition Outcomes Considered	Date Range Searched Criteria Used	Included Studies** (Number and Design)	Recommendations, Evidence/Conclusion Statements, and/or Main Results from Existing Report/ SR/ MA
Greenwood, 2014 Systematic Review and Meta-Analysis AMSTAR: 8/11	Sugar-sweetened beverages (carbonated, sugar-sweetened colas and soft drinks, total fruit punch, non-diet soda, full-energy sweetened soft drinks) Incidence of T2D	1990 to Nov 2009, with an update in June 2013 PCs; English language; original research article; at least 3 yr duration; differentiated between sugar and artificially sweetened beverages; participants from a generally healthy population	11 publications from 9 cohorts (5 publications from 6 cohorts used in meta-analysis of SSBs)	Conclusion: The included studies were observational, so their results should be interpreted cautiously, but findings indicate a positive association between sugar-sweetened soft drink intake and T2D risk, attenuated by adjustment for BMI. Main Results: The summary relative risk for sugar-sweetened soft drinks was 1.20/330 ml per d. The association with sugar-sweetened soft drinks was slightly lower in studies adjusting for BMI, consistent with BMI being involved in the causal pathway.
Romaguera, 2013 (Note: Included in Greenwood, 2014) Meta-Analysis of eight cohorts from the EPIC study AMSTAR: N/A	Sweet beverages (juices [either from 100% fruit and vegetables or concentrates], nectars [juices with up to 20% added sugar], and total soft drinks [sugar-sweetened and artificially sweetened]) Incidence of T2D	N/A Excluded those with evidence of T2D and those within the lowest and highest 1% of the cohort distribution of the ratio of reported total energy intake: energy requirement and those with missing information on diet, physical activity, level of education, smoking status, or BMI	Eight cohorts of the EPIC study	Conclusion: This study corroborates the association between increased incidence of T2D and high consumption of sugar-sweetened soft drinks in European adults. Main Results: In adjusted models, one 336 g (12 oz) daily increment in sugar-sweetened soft drink consumption was associated with HR for T2D of 1.22 (95% CI: 1.09 to 1.38). After further adjustment for energy intake and BMI, the association of sugar-sweetened soft drinks with T2D persisted (HR 1.18, 95% CI: 1.06 to 1.32). Juice and nectar consumption was not associated with T2D incidence.
Malik, 2010 Meta-Analysis AMSTAR: 8/11	Sugar-sweetened beverages (soft drinks, carbonated soft drinks, fruitades, fruit drinks, sports drinks, energy and vitamin water drinks, sweetened iced tea, punch, cordials,	1966 to May 2010 PCs; English language; presentation of relative risk and associated measure of variance; definition and metric for SSB intake; adults	8 PCs	Conclusion: Higher consumption of SSBs is associated with development of T2D. Main Results: Individuals in the highest quantile of SSB intake (most often 1–2, 12-oz servings/day) had a 26% greater risk of developing T2D than those in the lowest quantile (none or <1 serving/month) (RR=1.26).

	squashes, and lemonade) Incidence of T2D			
Sonestedt, 2012 Systematic Review AMSTAR: 9/11	Sugar intake (intrinsic, added, and total sugar intake from sugar-sweetened beverages, sugars, sucrose, and fructose) Incidence of T2D (also searched for impaired glucose tolerance and insulin sensitivity)	2000 to 2010, with update through Dec 2011 PCs with 4 or more yrs of follow-up; RCTs with at least 4 wks duration, drop-out rate <50%, and replacement of sugars with corresponding amount of CHO; English or Nordic language; generally healthy populations	9 PCs (4 on total sugars, sucrose, or fructose and 6 reported on SSBs)	Conclusion: Data from PCs suggest that SSBs probably increase the risk of T2D. The results were limited or inconsistent on the adverse effect of intake of total sugars, glucose, or fructose on the incidence of T2D. Main Results: The results from the 4 studies on the association between intake of total sugars, sucrose, or fructose and T2D were inconclusive, with studies showing positive, negative, and no association. The 6 studies reporting on SSBs were more conclusive, with 4 reporting a positive association, and a fifth reporting a positive association in the model not adjusting for BMI.
Xi, 2014 Systematic Review and Meta-Analysis AMSTAR: 10/11	Sugar-sweetened fruit juice and 100% fruit juice Incidence of T2D	Up to Dec 2013 PCs; English language; reported covariate adjusted RRs or HRs with 95% CIs for highest vs. lowest category of fruit juice intake; for multiple articles from same cohort, selected only the study with the largest sample size	4 PCs examined sugar-sweetened fruit juice and 4 PCs examined 100% fruit juice	Conclusion: The findings support dietary recommendations to limit SSBs, such as fruit juice with added sugar, to prevent the development of T2D. Main Results: A higher intake of sugar-sweetened fruit juice was significantly associated with risk of T2D (RR = 1.28), while intake of 100% fruit juice was not associated with risk of developing T2D (RR = 1.03).

* A measurement tool for the 'assessment of multiple systematic reviews' (AMSTAR)

**Reference overlap: Of the 17 articles included in total across the reviews, 9 were included in two or more reviews.

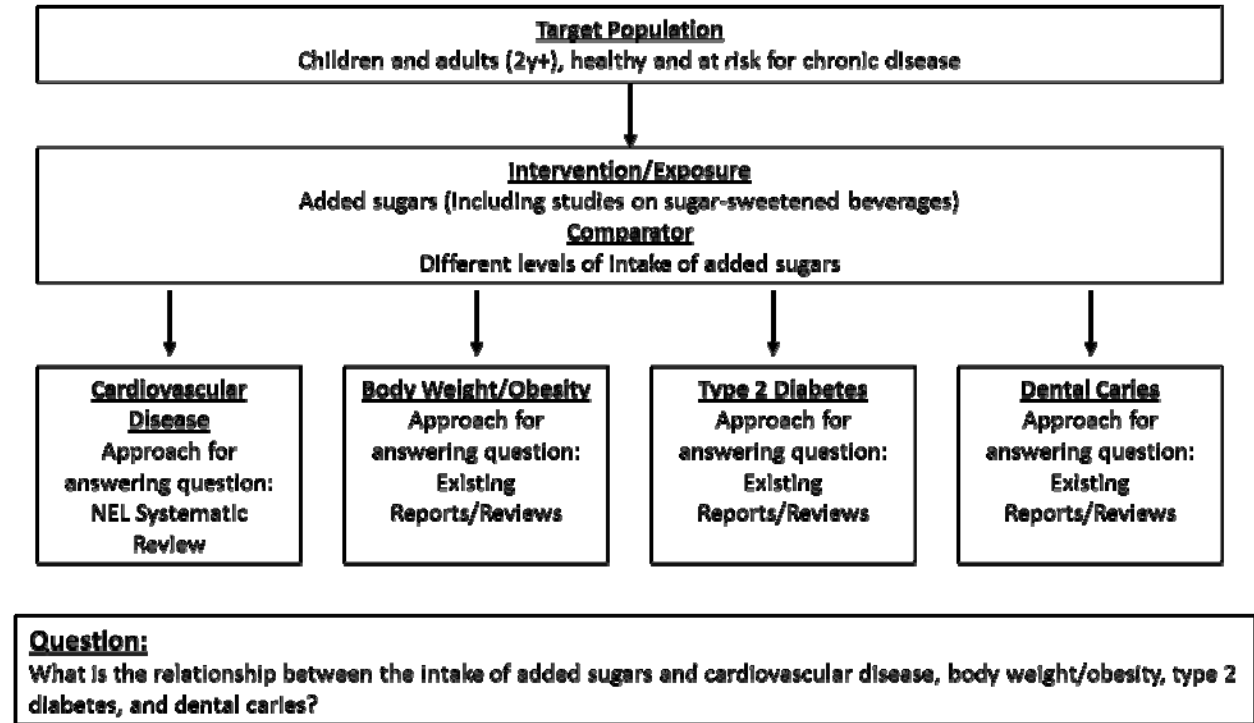
References Included in Review

1. Greenwood DC, Threapleton DE, Evans CE, Cleghorn CL, Nykjaer C, Woodhead C, et al. Association between sugar-sweetened and artificially sweetened soft drinks and type 2 diabetes: systematic review and dose-response meta-analysis of prospective studies. *Br J Nutr.* 2014;1-10. PMID: 24932880. <http://www.ncbi.nlm.nih.gov/pubmed/24932880>
2. Romaguera D, Norat T, Wark PA, Vergnaud AC, Schulze MB, van Woudenberg GJ, et al. Consumption of sweet beverages and type 2 diabetes incidence in European adults: results from EPIC-InterAct. *Diabetologia.* 2013;56(7):1520-30. PMID: 23620057. <http://www.ncbi.nlm.nih.gov/pubmed/23620057>

3. Malik VS, Popkin BM, Bray GA, Despres JP, Willett WC, Hu FB. Sugar-sweetened beverages and risk of metabolic syndrome and type 2 diabetes: a meta-analysis. *Diabetes Care*. 2010;33(11):2477-83. PMID: 20693348. <http://www.ncbi.nlm.nih.gov/pubmed/20693348>
4. Sonestedt E, Overby NC, Laaksonen DE, Birgisdottir BE. Does high sugar consumption exacerbate cardiometabolic risk factors and increase the risk of type 2 diabetes and cardiovascular disease? *Food Nutr Res*. 2012;56. PMID: 22855643. <http://www.ncbi.nlm.nih.gov/pubmed/22855643>
5. Xi B, Li S, Liu Z, Tian H, Yin X, Huai P, et al. Intake of fruit juice and incidence of type 2 diabetes: a systematic review and meta-analysis. *PLoS One*. 2014;9(3):e93471. PMID: 24682091. <http://www.ncbi.nlm.nih.gov/pubmed/24682091>

Supplementary Information:

Analytical Framework



Methodology

The Committee relied on existing SRs/MA published since January 2010 to address the intake of added sugars and risk of type 2 diabetes.

Search Strategy for Existing Systematic Reviews/Meta-Analyses

PubMed:

Added Sugar* OR brown sugar*[tiab] OR white sugar*[tiab] OR raw sugar* OR syrup*[tiab] OR dextrose OR fructose OR fruit juice concentrate* OR glucose OR honey[mh] OR honey[tiab] OR jam[tiab] OR invert sugar* OR malt sugar* OR maltose[tiab] OR maltodextrin OR molasses OR turbinado sugar* OR cane sugar*[tiab] OR cane juice*[tiab] OR "sugar cane"[tiab] OR sugar beet*[tiab] OR trehalose[tiab] OR sucrose[tiab] OR sweetene* OR table sugar*[tiab] OR "Monosaccharides"[Mesh] OR Monosaccharide*[tiab] OR disaccharide*[tiab] OR "Disaccharides"[Mesh] OR "Sweetening Agents"[Mesh:noexp] OR "Nutritive Sweeteners"[Mesh] OR "Dietary Sucrose"[tiab] OR sugar based* OR sugar-based* OR HFCS OR candy[tiab] OR "Candy"[Mesh] OR "Carbonated beverages"[mh] OR Soft drink* OR Liquid sugar* OR Soda pop* OR soda[tiab] OR Carbonated drink*[tiab] OR dessert*[tiab] OR pastries[tiab] OR ice cream*[tiab] OR cookies[tiab] OR cake*[tiab] OR pie[tiab] OR pies[tiab] OR gelatin*[tiab] OR jello[tiab] OR fruit punch*[tiab] OR fruitade*[tiab] OR sugary[tiab] OR sweets[tiab] OR sugar-sweetene*[tiab] OR caramel OR "malt barley" OR "barley malt" OR "Sweetening Agents" [Pharmacological Action] (done; w/ food/diet terms 30; none selected; 8/7/2014) OR sugar-

coated[tiab] OR sugar coated*[tiab] OR sugar*[ti] OR sugar sweeten*[tiab] OR dietary sugar*[tiab] OR confectioner*[tiab] OR fizzy drink*[tiab] OR chewing gum*[tiab]
AND

("insulin resistance"[mh] OR "insulin"[ti] OR inflammation[ti] OR glucose intoleran*[tiab] OR "Glucose Intolerance"[Mesh] OR diabetes[tiab] OR "Diabetes Mellitus, Type 2"[Mesh] OR "Hemoglobin A, Glycosylated"[Mesh] OR "hemoglobin A1c "[tiab] OR ("impaired fasting" AND (glucose OR glycemi*)) OR "onset diabetes" OR "impaired glucose" OR "insulin sensitivity" OR insulin-resist*[tiab] OR insulin resist*[tiab])

Embase:

(added NEXT/1 sugar*):ti,ab OR (raw NEXT/1 sugar*):ti,ab OR (white NEXT/1 sugar*):ti,ab OR (brown NEXT/1 sugar*):ti,ab OR 'sugar intake'/exp OR 'sucrose'/exp OR 'sweetening agent'/de OR 'fructose'/exp OR 'monosaccharide'/exp OR 'sugarcane'/exp OR 'lactose'/exp OR (milk NEXT/2 sugar*):ti,ab OR 'sugar beet'/exp OR 'sugar'/exp/mj OR (sugar NEXT/1 beet*):ti,ab OR sugarcane:ti,ab OR (sugar NEXT/1 cane):ti,ab OR dextrose:ti,ab OR 'glucose'/exp OR (corn NEXT/1 syrup*):ti,ab OR (maple NEXT/1 syrup*):ti,ab OR 'honey'/exp OR 'invert sugar'/exp OR (invert NEXT/1 sugar*):ti,ab OR 'maltose'/exp OR (malt NEXT/1 sugar*):ti,ab OR 'maltodextrin'/exp OR 'molasses'/exp OR (turbinado NEXT/1 sugar*):ti,ab OR 'disaccharide'/exp OR disaccharide*:ti,ab OR trehalose*:ti,ab OR (sugar NEXT/1 based*):ti,ab OR HFCS*:ti,ab OR candy:ti,ab OR candies:ti,ab OR 'carbonated beverage'/exp OR (carbonated NEXT/1 beverage*):ti,ab OR (Soft NEXT/1 drink*):ti,ab OR (Liquid NEXT/1 sugar*):ti,ab OR (Soda NEXT/1 pop*):ti,ab OR popsicle*:ti,ab OR (soda NEAR/10 (drink* OR beverage*)) OR (Carbonated NEXT/1 drink*):ti,ab OR 'soft drink'/exp OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEXT/1 cream*):ti,ab OR 'ice cream'/exp OR cookies:ti,ab OR cake*:ti OR pie:ti,ab OR pies:ti,ab OR gelatin*:ti,ab OR jello:ti,ab OR (fruit NEXT/1 punch*):ti,ab OR fruitade*:ti,ab OR (('fruit juice'/exp OR (fruit NEXT/1 juice*)) AND concentrate) OR sweets:ti,ab OR caramel:ti,ab OR (malt* NEAR/1 barley) OR ('syrup'/exp OR syrup*:ti,ab) OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab OR 'chewing gum'/exp
('food'/exp OR 'beverage'/exp OR diet/exp OR 'dietetics'/exp OR nutrition/exp OR cane OR rice OR sorghum OR malt OR golden OR 'food additive'/exp)
AND

("insulin":ti OR inflammation:ti,ab OR (glucose NEXT/1 intoleran*):ti,ab OR diabetes:ti,ab OR "hemoglobin A1c":ti,ab OR ("impaired fasting" AND (glucose OR glycemi*)) OR "onset diabetes" OR "impaired glucose" OR 'insulin resistance'/exp OR (insulin NEXT/1 resistan*):ti,ab OR 'glucose intolerance'/exp OR 'non insulin dependent diabetes mellitus'/exp OR 'glycosylated hemoglobin'/exp OR 'impaired glucose tolerance'/exp OR 'maturity onset diabetes mellitus'/exp OR 'systematic review'/exp OR 'meta analysis'/exp

Cochrane:

"insulin resistance":ti,ab OR "insulin":ti OR inflammation:ti OR (glucose NEXT intoleran*):ti,ab OR diabetes:ti OR ("Hemoglobin A":ti AND Glycosylated:ti) OR "hemoglobin A1c ":ti OR ("impaired fasting":ti AND (glucose:ti OR glycemi*:ti)) OR "onset diabetes":ti OR "impaired glucose":ti

(Added NEXT Sugar*) OR (brown NEXT sugar*) OR (white NEXT sugar*) OR (raw NEXT sugar*) OR syrup*:ti,kw OR dextrose:ti OR fructose:ti OR (fruit NEXT juice NEXT concentrate*) OR glucose:ti OR honey:ti OR jam:ti OR (invert NEXT sugar*) OR (malt NEXT sugar*) OR

maltose:ti OR maltodextrin:ti OR molasses OR (turbinado NEXT sugar*) OR (cane NEXT sugar*) OR (cane NEXT juice*) OR "sugar cane":ti,ab OR (sugar NEXT beet*):ti,ab OR trehalose:ti OR sucrose:ti OR sweetene* OR (table NEXT sugar*) OR Monosaccharide*:ti OR disaccharide*:ti OR "Dietary Sucrose":ti,ab OR (sugar NEXT based*) OR sugar-based* OR HFCS OR candy:ti,ab OR candies:ti,ab OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEXT drink*) OR (Liquid NEXT sugar*) OR (Soda NEXT pop*) OR popsicle* OR soda:ti OR dessert*:ti,ab OR pastries:ti,ab OR (ice NEAR/1 cream*) OR cookies:ti,ab OR cake*:ti OR pie:ti OR pies:ti OR gelatin*:ti OR jello:ti OR "fruit punch":ti,ab OR fruitade*:ti,ab OR sugar*:ti OR sweets:ti OR (sugar-sweetene*:ti,kw,ab) OR caramel:ti,ab OR (malt* NEAR/1 barley) OR 'syrup':ti,ab,kw OR (dietary NEXT sugar*):ti,ab OR sugary:ti,ab OR sugar*:ti OR (sugar NEAR/3 sweet*):ti,ab OR (sugar NEAR/3 coat*):ti,ab OR (dietary NEXT/1 sugar*):ti,ab OR confectioner*:ti,ab OR (fizzy NEXT/1 drink*):ti,ab OR chewing gum*:ti,ab ("body weight" OR obesity:ti,kw,ab OR overweight:ti,kw,ab OR "body fat":ti,kw,ab OR adipos*:ti,kw,ab OR weight:ti,kw,ab OR waist:ti,kw,ab OR "body mass":ti,kw,ab OR bmi:ti,kw,ab OR "Metabolic syndrome":ti,kw,ab)

Navigator:

((Added NEXT Sugar*) OR (brown NEAR/1 sugar*) OR (white NEAR/1 sugar*) OR (raw NEAR/1 sugar*) OR title:syrup* OR title:dextrose OR title:fructose OR (fruit NEAR/1 juice NEAR/1 concentrate*) OR title:glucose OR title:honey OR title:jam OR (invert NEAR/1 sugar*) OR (malt NEAR/1 sugar*) OR title:maltose OR title:maltodextrin OR title:molasses OR (turbinado NEAR/1 sugar*) OR (cane NEAR/1 sugar*) OR (cane NEAR/1 juice*) OR "sugar cane" OR (sugar NEAR/1 beet*) OR title:trehalose OR title:sucrose OR title:sweetene* OR (table NEAR/1 sugar*) OR title:Monosaccharide* OR title:disaccharide* OR "Dietary Sucrose" OR (sugar NEAR/1 based*) OR sugar-based* OR HFCS OR title:candy OR title:candie* OR (Carbonated NEAR beverage*) OR (Carbonated NEAR drink*) OR (Soft NEAR/1 drink*) OR (Liquid NEAR/1 sugar*) OR (Soda NEAR/1 pop*) OR popsicle* OR title:soda OR title:dessert* OR title:pastries OR (ice NEAR/1 cream*) OR title:cookies OR title:cake* OR title:pie OR pies:ti OR title:gelatin* OR title:jello OR "fruit punch" OR title:fruitade* OR title:sweets OR (sugar-sweetene*) OR title:caramel OR (malt* NEAR/1 barley) OR (dietary NEAR/1 sugar*) OR title:sugar* OR (sugar NEAR/3 sweet*) OR (sugar NEAR/3 coat*) OR (dietary NEAR/1/1 sugar*) OR title:confectioner* OR (fizzy NEAR/1 drink*) OR chewing NEAR/1 gum*)

Inclusion Criteria

Date Range:

- Published between December 2011 and August 2014 (in English in a peer-reviewed journal)

Study Design:

- Systematic review and/or meta-analysis that included randomized controlled trials and/or prospective cohort studies

Study Subjects:

- Reviews that included studies from high or very high human development (2012 Human Development Index)
- Healthy or at elevated chronic disease risk

Intervention/Exposure:

- Added sugars, including sugar-sweetened beverages

- Added sugars are sugars that are either added during the processing of foods, or are packaged as such, and include sugars (free, mono- and disaccharides), syrups, naturally occurring sugars that are isolated from a whole food and concentrated so that sugar is the primary component (e.g., fruit juice concentrates), and other caloric sweeteners.²⁸

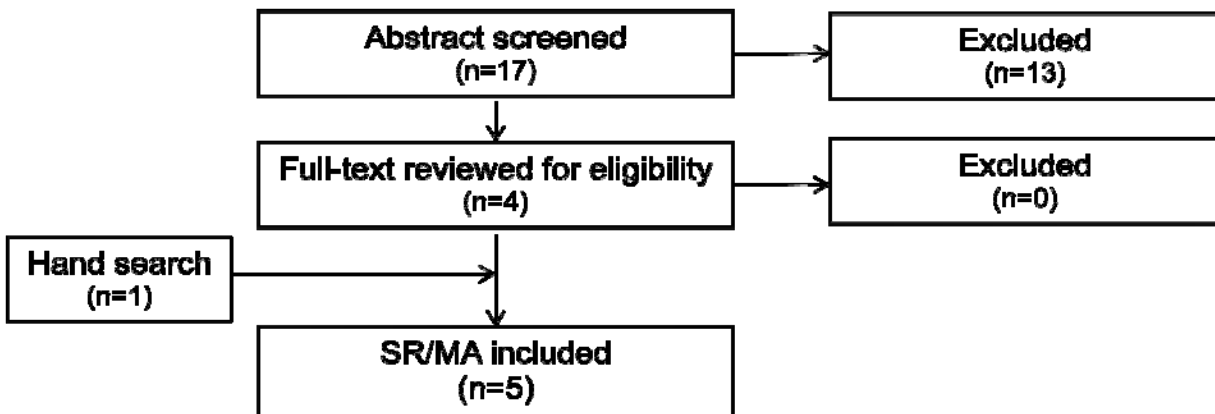
Outcome:

- Glucose intolerance, insulin resistance, or incidence of type 2 diabetes

Quality:

- Reviews rated 8-11 on AMSTAR (A measurement tool for the ‘assessment of multiple systematic reviews’)

Search Results



Excluded Articles with Reason for Exclusion

6. Esposito K, Kastorini CM, Panagiotakos DB, Giugliano D. Prevention of type 2 diabetes by dietary patterns: a systematic review of prospective studies and meta-analysis. *Metab Syndr Relat Disord.* 2010;8(6):471-6. PMID: 20958207. <http://www.ncbi.nlm.nih.gov/pubmed/20958207>. EXCLUDE: Focused on dietary patterns, not added sugars
7. Ha V, Jayalath VH, Cozma AI, Mirrahimi A, de Souza RJ, Sievenpiper JL. Fructose-containing sugars, blood pressure, and cardiometabolic risk: a critical review. *Curr Hypertens Rep.* 2013;15(4):281-97. PMID: 23793849. <http://www.ncbi.nlm.nih.gov/pubmed/23793849>. EXCLUDE: Narrative review
8. Hu FB. Resolved: there is sufficient scientific evidence that decreasing sugar-sweetened beverage consumption will reduce the prevalence of obesity and obesity-related diseases. *Obes Rev.* 2013;14(8):606-19. PMID: 23763695. <http://www.ncbi.nlm.nih.gov/pubmed/23763695>. EXCLUDE: Narrative review
9. Kelishadi R, Mansourian M, Heidari-Beni M. Association of fructose consumption and components of metabolic syndrome in human studies: a systematic review and meta-analysis. *Nutrition.* 2014;30(5):503-10. PMID: 24698343. <http://www.ncbi.nlm.nih.gov/pubmed/24698343>. EXCLUDE: Did not include incidence of type 2 diabetes as an outcome

10. Liu K, Zhou R, Wang B, Mi MT. Effect of resveratrol on glucose control and insulin sensitivity: a meta-analysis of 11 randomized controlled trials. *Am J Clin Nutr.* 2014;99(6):1510-9. PMID: 24695890. <http://www.ncbi.nlm.nih.gov/pubmed/24695890>. EXCLUDE: Examine resveratrol, not added sugars
11. Nettleton JA, Hivert MF, Lemaitre RN, McKeown NM, Mozaffarian D, Tanaka T, et al. Meta-analysis investigating associations between healthy diet and fasting glucose and insulin levels and modification by loci associated with glucose homeostasis in data from 15 cohorts. *Am J Epidemiol.* 2013;177(2):103-15. PMID: 23255780. <http://www.ncbi.nlm.nih.gov/pubmed/23255780>. EXCLUDE: Did not examine relationship between added sugars and type 2 diabetes
12. Pereira M, Carreira H, Lunet N, Azevedo A. Trends in prevalence of diabetes mellitus and mean fasting glucose in Portugal (1987-2009): a systematic review. *Public Health.* 2014;128(3):214-21. PMID: 24559769. <http://www.ncbi.nlm.nih.gov/pubmed/24559769>. EXCLUDE: Did not examine added sugars
13. Pereira MA. Diet beverages and the risk of obesity, diabetes, and cardiovascular disease: a review of the evidence. *Nutr Rev.* 2013;71(7):433-40. PMID: 23815142. <http://www.ncbi.nlm.nih.gov/pubmed/23815142>. EXCLUDE: Focused on diet beverages
14. Quinn TJ, Dawson J, Walters MR. Sugar and stroke: cerebrovascular disease and blood glucose control. *Cardiovasc Ther.* 2011;29(6):e31-42. PMID: 20491782. <http://www.ncbi.nlm.nih.gov/pubmed/20491782>. EXCLUDE: Narrative review
15. Ruxton CH, Gardner EJ, McNulty HM. Is sugar consumption detrimental to health? A review of the evidence 1995-2006. *Crit Rev Food Sci Nutr.* 2010;50(1):1-19. PMID: 20047137. <http://www.ncbi.nlm.nih.gov/pubmed/20047137>. EXCLUDE: Did not examine incidence of type 2 diabetes
16. Schwingshackl L, Hoffmann G. Comparison of the long-term effects of high-fat v. low-fat diet consumption on cardiometabolic risk factors in subjects with abnormal glucose metabolism: a systematic review and meta-analysis. *Br J Nutr.* 2014;111(12):2047-58. PMID: 24666665. <http://www.ncbi.nlm.nih.gov/pubmed/24666665>. EXCLUDE: Focused on high-fat versus low-fat diet
17. Weed DL, Althuis MD, Mink PJ. Quality of reviews on sugar-sweetened beverages and health outcomes: a systematic review. *Am J Clin Nutr.* 2011;94(5):1340-7. PMID: 21918218. <http://www.ncbi.nlm.nih.gov/pubmed/21918218>. EXCLUDE: Reviews quality of existing reviews
18. Wiebe N, Padwal R, Field C, Marks S, Jacobs R, Tonelli M. A systematic review on the effect of sweeteners on glycemic response and clinically relevant outcomes. *BMC Med.* 2011;9:123. PMID: 22093544. <http://www.ncbi.nlm.nih.gov/pubmed/22093544>. EXCLUDE: Did not incidence of type 2 diabetes as an outcome