**Impact of unhealthy food and beverage consumption in children on risk of dental caries: a systematic review**

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**Supplementary Tables and Figures**

**Table S1** Database searches for the effects of unhealthy food and beverage consumption among children aged ≤10 years on risk of dental caries

**Search Name: Cochrane searches**

ID Search Hits

#1 (infant):ti,ab,kw 49857

#2 (infants):ti,ab,kw 32907

#3 (infancy):ti,ab,kw 3763

#4 MeSH descriptor: [Infant] this term only 21560

#5 (toddler\*):ti,ab,kw 1748

#6 (baby):ti,ab,kw 5083

#7 (babies):ti,ab,kw 4875

#8 MeSH descriptor: [Child] this term only 48734

#9 ("Child"):ti,ab,kw 146976

#10 (school child\*):ti,ab,kw 20996

#11 (boy):ti,ab,kw 711

#12 (boys):ti,ab,kw 6378

#13 (girl):ti,ab,kw 1470

#14 (girls):ti,ab,kw 7051

#15 ("pre-school\*"):ti,ab,kw 614

#16 ("kindergar\*"):ti,ab,kw 0

#17 ("elementary school"):ti,ab,kw 1021

#18 (primary school):ti,ab,kw 9832

#19 #1 OR # 2 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #13 OR #15 OR #16 OR #17 OR #18 1068829

#20 MeSH descriptor: [Snacks] explode all trees 282

#21 (snack):ti,ab,kw 1519

#22 #20 OR #21 1611

#23 MeSH descriptor: [Candy] explode all trees 792

#24 (candy):ti,ab,kw 369

#25 (candies):ti,ab,kw 64

#26 (sweets):ti,ab,kw 293

#27 (confection\*):ti,ab,kw 103

#28 (sweet food):ti,ab,kw 525

#29 MeSH descriptor: [Chocolate] explode all trees 60

#30 (chocolat\*):ti,ab,kw 1077

#31 (salt\*):ti,ab,kw 7071

#32 (salty food):ti,ab,kw 125

#33 (savoury):ti,ab,kw 158

#34 #23 OR #24 OR #25 OR #26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33 9795

#35 MeSH descriptor: [Fast Foods] explode all trees 105

#36 ("fast-food"):ti,ab,kw 601

#37 (street food):ti,ab,kw 29

#38 (junk food\*):ti,ab,kw 77

#39 (convenience food\*):ti,ab,kw 264

#40 (ready-prepared food\*):ti,ab,kw 2

#41 (ready to eat meal\*):ti,ab,kw 58

#42 (takeaway food\*):ti,ab,kw 23

#43 (take-away food\*):ti,ab,kw 17

#44 (takeout food\*):ti,ab,kw 5

#45 (take-out food\*):ti,ab,kw 8

#46 (fried food\*):ti,ab,kw 158

#47 (ultra-processed food\*):ti,ab,kw 32

#48 (ultraprocessed food\*):ti,ab,kw 36

#49 (processed food\*):ti,ab,kw 650

#50 (processed meat):ti,ab,kw 205

#51 (fatty food\*):ti,ab,kw 3259

#52 #35 OR #36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42 OR #43 OR #44 OR #45 OR #46 OR #47 OR #48 OR #49 OR #50 OR #51 4984

#53 MeSH descriptor: [Dietary Sucrose] explode all trees 305

#54 (sugar):ti,ab,kw 8085

#55 (sugars):ti,ab,kw 961

#56 (sugary):ti,ab,kw 213

#57 MeSH descriptor: [Sweetening Agents] explode all trees 736

#58 (sweetener\*):ti,ab,kw 550

#59 #53 OR #54 OR #55 OR #56 OR #57 OR #58 9425

#60 ("unhealthy"):ti,ab,kw 1513

#61 (inappropriate food\*):ti,ab,kw 103

#62 (non-nutritive):ti,ab,kw 300

#63 (nonnutritive):ti,ab,kw 383

#64 (nutrient poor):ti,ab,kw 301

#65 (energy dense food\*):ti,ab,kw 463

#66 (less healthy meal\*):ti,ab,kw 941

#67 (less healthy food\*):ti,ab,kw 1705

#68 (low nutrient):ti,ab,kw 1512

#69 (nutritive value):ti,ab,kw 496

#70 (energy-dense):ti,ab,kw 436

#71 #60 OR #61 OR #62 OR #63 OR #64 OR #65 OR #66 OR #67 OR #68 OR #69 OR #70 6356

#72 (complementary food\*):ti,ab,kw 808

#73 (complementary diet):ti,ab,kw 644

#74 (complementary meal\*):ti,ab,kw 191

#75 #72 OR #73 OR #74 1175

#76 MeSH descriptor: [Beverages] explode all trees 6029

#77 (beverage\*):ti,ab,kw 6631

#78 (soda):ti,ab,kw 413

#79 (sodas):ti,ab,kw 47

#80 (carbonated drink):ti,ab,kw 147

#81 (sweet drink\*):ti,ab,kw 172

#82 (sweetened drink\*):ti,ab,kw 407

#83 (soft drink\*):ti,ab,kw 559

#84 #76 OR #77 OR #78 OR #79 OR #80 OR #81 OR #82 OR #83 11157

#85 #22 OR #34 OR #52 OR #59 OR #71 OR #75 OR #84 37956

#86 ("intake"):ti,ab,kw 54242

#87 (intakes):ti,ab,kw 4651

#88 (consum\*):ti,ab,kw 70753

#89 (feeding):ti,ab,kw 22133

#90 (eating):ti,ab,kw 14676

#91 (drinking):ti,ab,kw 11635

#92 (eat):ti,ab,kw 3672

#93 (drink):ti,ab,kw 6818

#94 #86 OR #87 OR #88 OR #89 OR #90 OR #91 OR #92 OR #93 139621

#95 MeSH descriptor: [Animals] this term only 9792

#96 MeSH descriptor: [Humans] this term only 591274

#97 (#19 AND #85 and #94) NOT (#95 NOT #96) 16629

#98 ("randomized-controlled trial"):pt 498138

#99 (controlled clinical trial):pt 323841

#100 (randomized):ti,ab,kw 901454

#101 (trial):ti,ab,kw 825752

#102 (groups):ti,ab,kw 475952

#103 (comparative study):pt 166014

#104 MeSH descriptor: [Control Groups] explode all trees 111

#105 MeSH descriptor: [Follow-Up Studies] explode all trees 59090

#106 (follow-up stud\*):ti,ab,kw 219260

#107 (follow-up assessment):ti,ab,kw 58334

#108 MeSH descriptor: [Prospective Studies] explode all trees 91786

#109 (prospective stud\*):ti,ab,kw 206021

#110 MeSH descriptor: [Evaluation Studies as Topic] explode all trees 50832

#111 (evaluat\*):ti,ab,kw 492538

#112 (quasi experiment\*):ti,ab,kw 5115

#113 (quasiexperiment\*):ti,ab,kw 4452

#114 MeSH descriptor: [Interrupted Time Series Analysis] explode all trees 51

#115 (ITS stud\*):ti,ab,kw 108192

#116 (time series):ti,ab,kw 7967

#117 (time point\*):ti,ab,kw 69107

#118 MeSH descriptor: [Controlled Before-After Studies] explode all trees 71

#119 (controlled):ti,ab,kw 744775

#120 (CBA stud\*):ti,ab,kw 267

#121 (pre test):ti,ab,kw 26376

#122 (pretest):ti,ab,kw 10268

#123 (post test):ti,ab,kw 41465

#124 (posttest):ti,ab,kw 11946

#125 (pre intervention):ti,ab,kw 36566

#126 (post intervention):ti,ab,kw 61277

#127 (before-after stud\*):ti,ab,kw 1459

#128 ("before and after"):ti,ab,kw 59238

#129 (nonrandom):ti,ab,kw 283

#130 (non-random\*):ti,ab,kw 5626

#131 MeSH descriptor: [Cohort Studies] explode all trees 148452

#132 (cohort stud\*):ti,ab,kw 49549

#133 (longitudinal stud\*):ti,ab,kw 18887

#134 #98 OR #99 OR #100 OR #101 OR #102 OR #103 OR #104 OR #105 OR #106 OR #107 OR #108 OR #109 OR #110 OR #111 OR #112 OR #113 OR #114 OR #115 OR #116 OR #117 OR #118 OR #119 OR #120 OR #121 OR #122 OR #123 OR #124 OR #125 OR #126 OR #127 OR #128 OR #129 OR #130 OR #131 OR #132 OR #133 1418750

#135 #97 AND #134 with Publication Year from 1971 to 2020, with Cochrane Library publication date Between Jan 1971 and Dec 2020, in Trials 15393

#136 ("editorial"):pt 2752

#137 (comment):pt 1882

#138 (news):pt 334

#139 ("Letter"):pt 12061

#140 (review):pt 17935

#141 ("systematic review"):pt 59

#142 ("meta-analysis"):pt 530

#143 ("meta-analysis"):ti,ab,kw 17978

#144 ("meta analyses"):ti,ab,kw 17978

#145 (retracted publication):pt 485

#146 (retraction of publication):pt 58

#147 (retraction of publication):ti,ab,kw 42

#148 (retraction of publication):pt 58

#149 #136 OR #137 OR #138 OR #139 OR #140 OR #141 OR #142 OR #143 OR #144 OR #145 OR #146 OR #147 OR #148 48859

#150 #135 NOT #149 with Cochrane Library publication date Between Jan 1971 and Dec 2020 15224

**Database: EMBASE**

| Search | Query | Results |
| --- | --- | --- |
| #12 | #10 not #11 | 6982 |
| #11 | Limit #10 to conference abstracts | 2414 |
| #10 | #8 NOT #9 | 9396 |
| #9 | Search: editorial.pt OR comment.pt OR news.pt OR letter.pt OR review.pt OR "systematic review".pt OR "systematic review".tw OR "meta-analysis".pt OR "meta-analysis".tw OR "meta-analyses".tw OR "retracted publication".pt OR "retraction of publication".pt OR "retraction of publication".tw OR "retraction notice".tw | 4726267 |
| #8 | Search: #6 and #7 | 10108 |
| #7 | Search: randomized controlled trial.pt OR controlled clinical trial.pt OR randomized.tw OR trial.tw OR groups.tw OR comparative study.pt OR control groups.mp OR follow-up studies.mp OR follow-up stud\*.tw OR follow-up assessment.tw OR prospective studies.mp OR prospective stud\*.tw OR "evaluation studies as topic".mp OR evaluat\*.tw OR quasi experiment\*.tw OR quasiexperiment\*.tw OR interrupted time series analysis.mp OR ITS stud\*.tw OR time series.tw OR time point\*.tw OR controlled before-after studies.mp OR controlled.tw OR CBA stud\*.tw OR pre test.tw OR pretest.tw OR post test.tw OR posttest.tw OR pre intervention.tw OR post intervention.tw OR before-after stud\*.tw OR "before and after".tw OR nonrandom\*.tw OR non-random\*.tw OR cohort studies.mp OR cohort stud\*.tw OR longitudinal stud\*.tw | 9040729 |
| #6 | Search: #4 NOT #5 | 21571 |
| #5 | Search: (animals.mp NOT humans.mp) | 767206 |
| #4 | 1 and 2 and 3 | 21724 |
| #3 | Search: intake.tw OR intakes.tw OR consum\*.tw OR feeding.tw OR eating.tw OR drinking.tw OR eat.tw OR drink.tw | 1281552 |
| #2 | Search: beverages.mp OR beverage\*.tw OR soda.tw OR sodas.tw OR carbonated drink\*.tw OR sweet drink\*.tw OR sweetened drink\*.tw OR soft drink\*.tw OR complementary food\*.tw OR complementary diet.tw OR complementary meal\*.tw OR unhealthy.tw OR inappropriate food.tw OR inappropriate foods.tw OR non-nutritive.tw OR nonnutritive.tw OR nutrient poor.tw OR less healthy meal\*.tw OR less healthy food\*.tw OR low nutrient.tw OR nutritive value.tw OR energy-dense.tw OR dietary sucrose.mp OR sugar.tw OR sugars.tw OR sugary.tw OR sweetening agents.mp OR sweetener.tw OR sweeteners.tw OR fast foods.mp OR fast food\*.tw OR street food\*.tw OR junk food\*.tw OR convenience food\*.tw OR ready-prepared food\*.tw OR ready to eat meal\*.tw OR takeaway food\*.tw OR take-away food\*.tw OR takeout food\*.tw OR take-out food\*.tw OR fried food\*.tw OR ultra-processed food\*.tw OR ultraprocessed food\*.tw OR processed food\*.tw OR processed meat\*.tw OR fatty food\*.tw OR candy.mp OR candy.tw OR candies.tw OR sweets.tw OR confection\*.tw OR sweet food\*.tw OR chocolate.mp OR chocolat\*.tw OR salt\*.tw OR savoury.tw OR Snacks.mp OR snack\*.tw | 450238 |
| #1 | Search: infant.mp OR infant.tw OR infants.tw OR infancy.tw OR toddler\*.tw OR baby.tw OR babies.tw OR child.mp OR child\*.tw OR schoolchild\*.tw OR boy.tw OR boys.tw OR girl.tw OR girls.tw OR pre school\*.tw OR kindergar\*.tw OR elementary school\*.tw OR primary school\*.tw | 3169372 |

**Database: PubMed**

| Search | Query | Results |
| --- | --- | --- |
| #16 | #14 NOT #15 | 13,060 |
| #15 | Search: editorial[Publication Type] OR comment[Publication Type] OR news[Publication Type] OR letter[Publication Type] OR review[Publication Type] OR "systematic review"[Publication Type] OR "systematic review"[tiab] OR "meta-analysis"[Publication Type] OR "meta-analysis"[tiab] OR "meta-analyses"[tiab] OR "retracted publication"[Publication Type] OR "retraction of publication"[Publication Type] OR "retraction of publication"[tiab] OR "retraction notice"[tiab] Filters: from 1971/1/1 - 2020/11/27 | 4,922,701 |
| #14 | Search: #13 AND #14 Filters: from 1971/1/1 - 2020/11/30 Sort by: Publication Date | 14,355 |
| #13 | Search: #11 AND #12 | 14,380 |
| #12 | Search: randomized controlled trial[pt] OR controlled clinical trial[pt] OR randomized[tiab] OR trial[tiab] OR groups[tiab] OR comparative study[pt] OR control groups[mh] OR follow-up studies[mh] OR follow-up stud\*[tiab] OR follow-up assessment[tiab] OR prospective studies[mh] OR prospective stud\*[tiab] OR "evaluation studies as topic"[mh] OR evaluat\*[tiab] OR quasi experiment\*[tiab] OR quasiexperiment\*[tiab] OR interrupted time series analysis[mh] OR ITS stud\*[tiab] OR time series[tiab] OR time point\*[tiab] OR controlled before-after studies[mh] OR controlled[tiab] OR CBA stud\*[tiab] OR pre test[tiab] OR pretest[tiab] OR post test[tiab] OR posttest[tiab] OR pre intervention[tiab] OR post intervention[tiab] OR before-after stud\*[tiab] OR "before and after"[tiab] OR nonrandom\*[tiab] OR non-random\*[tiab] OR cohort studies[mh] OR cohort stud\*[tiab] OR longitudinal stud\*[tiab] | 9,144,658 |
| #11 | Search: (#1 AND #9 AND #10) NOT (animals[mh] NOT humans[mh]) | 26,811 |
| #10 | Search: intake[tiab] OR intakes[tiab] OR consum\*[tiab] OR feeding[tiab] OR eating[tiab] OR drinking[tiab] OR eat[tiab] OR drink[tiab] | 1,008,423 |
| #9 | Search: #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 | 523,824 |
| #8 | Search: beverages[mh] OR beverage\*[tiab] OR soda[tiab] OR sodas[tiab] OR carbonated drink\*[tiab] OR sweet drink\*[tiab] OR sweetened drink\*[tiab] OR soft drink\*[tiab] | 162,087 |
| #7 | Search: complementary food\*[tiab] OR complementary diet[tiab] OR complementary meal\*[tiab] | 1486 |
| #6 | Search: unhealthy[tiab] OR inappropriate food[tiab] OR inappropriate foods[tiab] OR non-nutritive[tiab] OR nonnutritive[tiab] OR nutrient poor[tiab] OR less healthy meal\*[tiab] OR less healthy food\*[tiab] OR low nutrient[tiab] OR nutritive value[tiab] OR energy-dense[tiab] | 23,532 |
| #5 | Search: dietary sucrose[mh] OR sugar[tiab] OR sugars[tiab] OR sugary[tiab] OR sweetening agents[mh] OR sweetener[tiab] OR sweeteners[tiab] | [133,115](https://pubmed.ncbi.nlm.nih.gov/?term=dietary+sucrose%5Bmh%5D+OR+sugar%5Btiab%5D+OR+sugars%5Btiab%5D+OR+sugary%5Btiab%5D+OR+sweetening+agents%5Bmh%5D+OR+sweetener%5Btiab%5D+OR+sweeteners%5Btiab%5D&sort=relevance&size=200&ac=no) |
| #4 | Search: fast foods[mh] OR fast food\*[tiab] OR street food\*[tiab] OR junk food\*[tiab] OR convenience food\*[tiab] OR ready-prepared food\*[tiab] OR ready to eat meal\*[tiab] OR takeaway food\*[tiab] OR take-away food\*[tiab] OR takeout food\*[tiab] OR take-out food\*[tiab] OR fried food\*[tiab] OR ultra-processed food\*[tiab] OR ultraprocessed food\*[tiab] OR processed food\*[tiab] OR processed meat\*[tiab] OR fatty food\*[tiab] | 12,955 |
| #3 | Search: candy[mh] OR candy[tiab] OR candies[tiab] OR sweets[tiab] OR confection\*[tiab] OR sweet food\*[tiab] OR chocolate[mh] OR chocolat\*[tiab] OR salt\*[tiab] OR savoury[tiab] | 215,735 |
| #2 | Search: Snacks[mh] OR snack\*[tiab] | 8,453 |
| #1 | Search: infant[mh] OR infant[tiab] OR infants[tiab] OR infancy[tiab] OR toddler\*[tiab] OR baby[tiab] OR babies[tiab] OR child[mh] OR child\*[tiab] OR schoolchild\*[tiab] OR boy[tiab] OR boys[tiab] OR girl[tiab] OR girls[tiab] OR pre school\*[tiab] OR kindergar\*[tiab] OR elementary school\*[tiab] OR primary school\*[tiab] | 3,071,122 |

**Table S2** Assessment criteria for overall risk of bias for non-randomized studies of interventions

|  |  |
| --- | --- |
| **Overall risk of bias assessment for ROBINS-I\*** | **Criteria** |
| Low | Study is judged to be at low risk of bias for all domains |
| Moderate | Study is judged to be a low or moderate risk of bias for all domains |
| Serious | Study is judged to be a serious risk of bias in at least one domain-but not at critical risk of bias in any domain |
| Critical | The study is judged to be at critical risk of bias in at least one domain |
| No information | No indication that the study is a serious or critical risk of bias *and* there is a lack of information in one or more key domains of bias |

\* From Sterne et al 2016. 1

We followed the signaling questions provided in the detailed guidance notes for each domain and also defined the major confounding variables to be considered for the intervention (i.e. exposure to (consumption of) unhealthy foods and beverages) under consideration in included studies (Domain 1). 1

**Table S3** Synthesis of results of studies on the effect of unhealthy food and beverage consumption ondental caries outcomes in children aged ≤10 years†

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Study ID** | **Baseline age (mean or range)** | | **Length of follow-up** | | **N‡** | | **DAT** | **Exposure** | | **Intake unit** | | **Comparator** | | **Indicator** | | **Outcome** | **Estimate\*** | | | **Overall RoB** |
| **Exposure: SSB** |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| 0–<2 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| Anderson 2021 2 | 1 y | | 6 y | | 2400 | | Questionnaire completed by parents with examiner | Sugar-containing beverages | | Frequency/d | | Not consumed vs consumed ≥ 1/day at 1, 2 and 3 y old | | ICDAS | | Dental caries (defs 0 vs >0) at 1, 2, 3, 5 and 7 y. | OR = 1.2 (95% CI = 1.02, 1.60) (1 y), OR = 1.44 (95% CI = 1.05, 1.99) (2 y), OR = 2.01 (95% CI = 1.60, 2.55) (3 y), OR = 1.36 (95% CI = 1.08, 1.80) (5 y), OR = 1.38 (95% CI = 1.09, 1.74) (7 y) | | | Serious |
| Bernabe 2020 3 | 12.8 mo | | 36 mo | | 1111 | | FFQ | Sugar containing beverages | | Frequency/d | | Initial intake (continuous); Deviations from initial intake (continuous) | | dmfs | | Dental caries trajectory | Baseline intake: β = -0.1 95% CI = -0.17, -0.03, P = 0.006; Change in intake: β = -0.14 (95% CI = -0.22, -0.05) P = 0.001 | | | Serious |
| Echeverria 2022 4 | 3-48 mo | | 3 y 9 mo | | 2806 | | Questionnaire completed by caregiver | Sugar-containing beverages | | Trajectory of sugar consumption from 3 to 48 m (always low, always intermediate, growing, and always high) | | Low vs high median sugar consumption | | ICDAS | | Dental caries at 48 mo; cavitated dental caries at 48 mo | Prevalence ratio (adjusted) dental caries = 1.42 (95% CI = 1.17, 1.73); Prevalence ratio cavitated caries = 1.51 (95% CI = 1.19, 1.92), P < 0.001 | | | Serious |
| Jordan 2020 5 | 8-18 mo | | 5 y | | 93 | | FFQ | SSB | | Frequency/d | | Consumed vs. not consumed | | dmfs | | Incident caries dichotomized outcome of caries-free (incidence = 0) vs caries (incidence >0) | OR = 2 (95% CI = 1.0, 4.2) | | | Serious |
| Marshall 2003 6,7 | 6 wk | | 5 y | | 291 | | 3-d diet diaries at 1, 2, 3, 4, 5 y | SSB | | g/d | | Pop/sports drink consumption 12-24 mo; Pop/sports drink and 36-48 mo; Sugar beverages at 12-24 mo | | d1 lesions; d2-3 lesions | | Caries at 12-36 mo | 12-36 mo: OR = 1.34, P = 0.12; 36-48 mo: OR = 1.33, P = 0.12 | | | Serious |
|  | 1 y | | 3-6 y | | 396 | | 3-d diet diaries at 1, 2, 3, 4, 5 y | SSB | | g/d | | Continuous | | d1 lesions; d2-3 lesions | | Caries at 4 and 7 y | Soda pop: OR = 2.2 (95% CI = 1.4, 3.6) P < 0.05; Drinks from powder: OR = 2.0 (95% CI = 1.2, 3.4) P < 0.05 | | | Serious |
| Park 2015 8 | 10-12 mo | | 62 mo | | 1269 | | 7-d recall questionnaire | SSB | | Frequency/d | | SSB <1 times/wk vs. none; SSB 1-<3 times/wk vs. none, SSB ≥ 3 times/wk vs. none | | Number of reported caries | | Caries number at 6 y | OR = 1.15 (95% CI = 0.61, 2.18) | | | Serious |
| Sakuma 2007 9 | 1.5 y | | 1.5 y | | 5107 | | FFQ | SSB | | Frequency/d | | Continuous | | Change in caries | | Number of teeth with caries | Four cities/districts: β = 0.34, OR = 1.4 (95% CI = 1.2, 1.7) P < 0.001; β = 0.39, OR = 1.5 (95% CI = 1.3, 1.7) P < 0001; β = 0.19, OR = 1.2 (95% CI = 1.0, 1.4) P < 0.05; Other β = 0.28, OR = 1.3 (95% CI = 1.2, 1.5) P < 0.001 | | | Serious |
| Warren 2009 10 | 6-24 mo | | 18 mo | | 128 | | Questionnaire completed by study coordinator | SSB | | Consumed/not consumed in a week | | Regular consumption vs. not consumed | | Cavitated and non-cavitated dental lesions | | Cavitated (d2-3) and non cavitated (d1 lesions) | OR = 5.20, (95% CI = 2.0, 13.3) P = 0.001 | | | Serious |
| Watanabe 2014 11 | 1.5 y | | ~21 mo | | 31202 | | FFQ | SSB | | Frequency/d | | Daily consumed vs. not consumed | | Dental caries present or absent | | Dichotomous (0, 1) | OR = 1.56 (95% CI = 1.46, 1.65), P < 0.001 | | | Serious |
| Wigen 2015 12 | 1.5 y | | 3.5 y | | 1095 | | FFQ | SSB | | Frequency/wk | | ≥ once/wk vs.< once/wk | | Sum of dmft | | Dichotomous (0, 1) | OR = 1.9, (95% CI = 1.2, 2.9) | | | Serious |
| 2–<5 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| Grindefjord 1996 13 | 30 mo | | 12 mo | | 692 | | Questionnaire completed by parents at 1, 2.5 and 3.5 y | Sugar-containing beverages | | Times/d | | >2/day vs. <2/day | | Initial/manifest dental caries  (Koch, 1967) at 2.5 & 3.5yr | | Present or absent | OR = 1.79 (CI = 1.00, 3.15), P = 0.045 | | | Serious |
| Hooley 2012 14 | 4.79 y | | 2.05 y | | 4149 | | 24-h dietary recall | Sweet drinks | | Frequency/d | | Continuous | | Dental caries (reported by primary caregiver) at 6-7 y and 8-9 y | | Yes or No to cavities, extractions or fillings since last survey | 2 y: OR = 1.02 (SE = 0.03), P = 0.56; 4 y OR = 1.10 (SE = 0.04) P = 0.01 | | | Serious |
| Ismail 2008 15 | 30 mo | | 12 mo | | 692 | | Questionnaire completed by parents at 1, 2.5 and 3.5 y | Soda beverages | | Frequency/d | | ≥2 vs.<2/d | | Initial/manifest dental caries | | Present or absent | OR = 1.79 (CI = 1.00, 3.15), P = 0.045 | | | Serious |
|  | 0-5 y | | 2 y | | 788 | | FFQ | Soda beverages | | Frequency/wk | | Continuous | | ECC; Severe ECC | | Present or absent | Caries: OR = 1.27 (SD = 0.20) P = 0.14; Severe caries OR = 0.13 (SD = 0.13), P = 0.04 | | | Serious |
| Mei 202116 | 3-4 y | | 2 y | | 549 | | Parental questionnaire on dietary intake | Carbonated beverages; Sugary drinks/snacks at night | | Frequency/d | | 1 vs <1 time/day and >1 vs <1 time/day; Never vs sometimes; never vs always | | dmft and dmfs (WHO, 1997) | | dmft; ECC | SSB: dmft (univariable) 1/day: b=0.21 [−0.71, 1.14]; p=0.651; >1 /day: b=0.45 (−0.89, 1.79) vs <1 /day P=0.510; ECC (univariable) 1/day: OR=1.19 [0.70, 2.02]; P=0.523; >1 /day: OR=1.77 (0.81, 3.89) vs <1 /day p=0.155; Sugary drinks/snacks at night: dmft: Sometimes vs never: b = 0.88 (95% CI = 0.20, 1.56), P = 0.011; always vs never: b = 1.19 (95% CI = 0.13, 2.25). P = 0.028; ECC: sometime vs never: OR = 1.29, (95% CI = 0.90, 1.84), P = 0.163, always vs never: OR = 1.42, (95% CI = 0.86, 2.36), P = 0.168 | | | Serious |
| Pang 2015 17 | 3-6 y | | 2 y | | 887 | | Questionnaire completed by parents | SSB | | Frequency/d | | ≥ 1/d vs.< 1/d; ≥ 1/d vs.< 1/d | | DMFT/dmft caries | | New cases of caries | OR = 3.73 (95% = 1.55, 8.97) | | | Serious |
| Skafida 2018 18 | 2 y | | 3 y | | 3770 | | FFQ | SSB | | Frequency/mo | | Several times/mo vs.< once/mo or never | | Decayed, extracted or filled teeth | | Dichotomous (0, 1) | OR = 1.26 (95% CI = 1.01, 1.55), P < 0.05 | | | Serious |
| Tamaki 2009 19 | 5 or 6 y | | 2.5 y | | 500 | | FFQ | SSB | | Frequency/d | | Continuous | | Incident caries | | Change from baseline to follow-up | OR = 1.355, (95% CI = 0.963, 1.908), P = 0.08 | | | Critical |
| Thornley 2021 20 | 2 y | | 5 y | | 4111 | | FFQ | SSB | | Frequency/mo | | Four groups | | dmft | | Category based on dmft score | Univariate analysis: P < 0.001 | | | Critical |
| 5-<10 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| Lin 2021 21 | 8-9 y | | 1 y | | 494 | | Parental questionnaire | Carbonated drinks; Handmade drinks | | Frequency/week; sweetness | | Often vs seldom; Sugar rich vs non-sugary | | Incidence caries | | Incidence from baseline to 1 y follow up | Carbonated drinks: OR = 1.9 (95% CI = 1.0, 3.7) P < 0.01;  Handmade: OR = 1.7 (95% CI = 1.1, 2.9), P < 0.05; OR = 0.8 (95% CI = 0.7, 1.0), P > 0.05 | | | Serious |
| **Exposure: Unhealthy foods** | |  | |  | |  | | |  | |  | |  |  |  | | |  |
| 0–<2 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| Anderson 2021 2 | 1 y | | 6 y | |  | | Questionnaire completed by parents with examiner | Sweets | | Frequency/week | | Not consumed vs consumed ≥ 1/day at 1,2 and 3 y old | | ICDAS | | Dental caries (defs 0 vs >0)\_at 1, 2, 3, 5 and 7 y. | OR=1.65 (95% CI = 1.14, 2.38) (2 y); OR=2.06 (95% CI = 1.63, 2.60 (3 y); OR = 1.98 (95% CI = 1.54, 2.55) (5 yr); OR=1.88 (95% CI = 1.46, 2.41) (7 y) | | | Serious |
| Chaffee 2015 22 | 6 mo | | 32 mo | | 458 | | Parent interview on age of introduction of child foods | 6 mo sweet index; 12 mo sweet index | | Time of introduction | | 6 mo sweet index Tertile 3 vs.1; 12 mo sweet index Tertile 3 vs. Tertile 1 | | Severe ECC; dmft | | ≥1 affected maxillary anterior teeth or ≥4 decayed, missing due to caries, or restored tooth surfaces | Upper vs. lowest tertile for: severe ECC at 6 mo: RR = 1.46 (95% CI = 0.97, 2.04) at 12 mo: RR = 1.55 (95% CI = 1.17, 2.23) (cumulative incidence ratio); dmft at 6 mo: RR = 1.62 (95% CI = 0.91, 2.70), dmft at 12 mo RR = 1.78 (95% CI = 1.20, 2.90) | | | Serious |
| Devenish 2020 23 | 3 mo | | 26 mo | | 965 | | 24-h recall, 2-d food diary at 1 y; FFQ at 2 y | Energy as free sugars | | %EI | | > 10% EI free sugar vs. <5%EI free sugar at 1 and 2 y; > 10% EI as free sugar at 1 or  2 y (not both) vs.<5% EI free sugar at 1 and 2 y; <10% EI free sugar on at 1 and 2 y, but >5 % at least at 1 or 2 y vs.<5% EI free sugar at 1 and 2 y | | Presence of ECC | | Present or absent | Prevalence ratio = 1.97 (95% CI = 1.13, 3.44) | | | Serious |
| Feldens 2010 24; 202125 | 6 mo | | 44.5 mo | | 340 | | Face-to-face structured interviews | High density of sugar | | Consumed or not consumed | | Consumed vs. not consumed | | Severe ECC at 4 y | | dmfs | RR = 1.43 (95% CI = 1.08, 1.89), P = 0.005 | | | Moderate |
|  | 6 mo (sugary food purchase), 3 y (household sugar purchase) | | 5 y 6 mo | | 233 | | Maternal interview | Sugar-containing items; monthly sugar purchased per person | | Index; kg | | ≤3, 4-6, ≥7;  ≤ median vs  > median | | DMFT | | Presence vs absence | OR = 2.37 (95% CI = 1.02, 1.59), P = 0.036; OR = 1.62 (95% CI = 0.78, 3.36), P = 0.198 | | | Serious |
| Lopes-Gomes 2021 26 | 1-3 y | | 3 y 9 mo | | 137 | | Maternal questionnaire on daily snacks containing sugar | Sugar-containing snacks | | Frequency/d | | ≤2/day at baseline to >2/day; >2/day at baseline to >2/day | | ICDAS | | Dental caries incidence | RR = 1.67 (95% CI 1.09, 2.52); RR = 1.81 (95% CI = 1.14, 2.87) | | | Serious |
| MacKeown 2000 27 | 1 y | | 4 y | | 259 | | Semi-quantitative FFQ | Added sugar | | g/d (continuous) | | Continuous | | dmfs incidence | | dmfs score change from age 1 to 5 y | Not significant | | | Critical |
| Manohar, 2021 28 | 4 mo | | 39 mo | | 718 | | 7 day food diary at 4 mo, 8 mo, 1 y, 2 yr, 3 y | Sugary foods | | Diet trajectory | | Low and gradual rising vs moderate and stable ; low and gradual rising vs high and late declining ; overall trend | | dmfs | | Dental caries at 3-4 y | IRR = 1.30, (95% CI = 0.85, 2.0), P = 0.228 ; Highest vs lowest IRR = 0.90, (95% CI = 0.47, 1.70), P = 0.019 ; overall P = 0.737 | | | Moderate |
| Mattila 2001 29 | 18 mo | | 8.5 y | | 413 | | Semi structured questionnaire | Sweets/candy | | Frequency/wk | | Daily or a couple of times a week vs. more seldom; Once/week vs. more seldom | | dmft/DMFT score at 10 y | | Score at 10 y | Daily/two times/wk OR = 5.5 (95% CI = 1.9, 15.8) ; once/wk OR = 2.4 (95% CI = 0.8, 7.6) | | | Serious |
| Meurman 2010 30 | 18 mo | | 24 mo | | 366 | | Dietary recall questionnaire | Added sugar; sweets snacks | | Frequency/wk | | Added sugar vs. never; Sweet snacks vs. never/seldom | | dmfs | | Caries increment (dichotomous) 18 m to 5 y | Added sugar OR = 2.2, (95% CI = 1.1, 4.5), P = 0.024; Sweet snacks OR = 1.7 (95% CI = 0.8, 3.9), P = 0.169 | | | Serious |
| Peres 2016 31 | 1 mo | | 18 y | | 302 | | FFQ | Sugar intake | | Frequency/d | | High sugar intake vs. low intake (≥2 of ages 4, 15, and 18 y have been measured low intake); Upward sugar intake vs. low intake (≥2 of ages 4, 15, and 18 y have been measured low intake) | | dmft score | | Prevalence and mean dmft score | High: IRR = 1.67 (95% CI = 1.23, 2.25), upward: IRR = 1.22 (95% CI = 0.94, 1.59) | | | Moderate |
| Sakuma 2007 32 | 1.5 y | | 1.5 y | | 5107 | | FFQ | Sweets/candy | | Frequency/d | | Continuous | | Change in caries | | Change in number of teeth with caries | Four cities/districts: β = 0.31, OR = 1.4 (CI = 1.2, 1.5) P < 0.001; β = 0.33, OR = 1.4 (CI = 1.1, 1.7), P < 0.1; β = 0.5, OR = 1.6 (CI = 1.3, 2.1), P < 0.001; β = 0.37, OR = 1.5 (CI = 1.3, 1.7), P < 0.001 | | | Serious |
| Watanabe 2014 11 | 1.5 y | | ~21 mo | | 31202 | | FFQ | Sweet snacks | | Frequency/d | | Daily consumption vs. not consumed: 1 d/wk vs.0 d/wk; 2 d/wk vs.0 d/wk; 3 d/wk vs.0 d/wk | | Dental caries present or absent | | Dichotomous (0, 1) | Once/d (AOR: 2.0 (95% CI: 1.46, 2.74), P < 0.001); twice/d AOR = 3.21 (95% CI = 2.34, 4.40); 3 times/d AOR = 3.90 (95% CI = 2.79, 5.45) vs. none at 1.5 y | | | Serious |
| 2–<5 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| De Melo 2019 33 | 30 mo | | - | | 469 | | Questionnaire | Sweets/candy | | Never, sometimes, daily | | Sweets daily vs. never; Sweets sometimes vs. never | | dmft index | | Increase index from 18-36 mo | Daily: RR = 1.53 (95% CI = 1.09,2.14), P = 0.014; sometimes: RR = 1.12 (95% CI = 0.79, 1.58), P = 0.527 | | | Serious |
| Grindefjord 1996 13 | 30 mo | | 12 mo | | 692 | | Questionnaire completed by parents at 1, 2.5 and 3.5 y | Candy | | Times/d | | ≥1 vs. <1/wk | | Initial/manifest dental caries  (Koch, 1967) at 2.5 & 3.5 y | | Present or absent | OR = 1.63 (CI = 1.04, 2.55), P = 0.032 | | | Serious |
| Hao 2015 34 | 3 y | | 12 mo | | 130 | | FFQ | Sweets/candy | | Frequency/d | | Sweets ≥2 times/d vs.< 2 times/d | | dmfs at 6 mo; dmfs at 12 mo | | Present or absent | P < 0.01; P < 0.01 | | | Serious |
| Holt 199135 | 2 y | | 3 y | | 2139 | | Questionnaire | Sweetened snacks or drinks | | Frequency/d | | 0, 1, 2, 3 or 4 | | dmft count | | Mean dmft | Univariate analysis: % caries free by intake (unadjusted P < 0.05), number of caries by intake (P < 0.01) | | | Critical |
| Hooley 2012 14 | 4.79 y | | 2.05 y | | 4149 | | 24-h dietary recall | High fat foods (meat pie, hamburger, hot dog, sausage, or sausage roll; hot chips or French fries; potato chips or savory snacks and biscuits, doughnuts, cake, pie, or chocolate) | | Frequency/d | | Continuous | | Dental caries (reported by primary caregiver) at 6-7 y and 8-9 y | | Yes/No to occurrence of cavities, extractions or fillings since last survey | At 6-7 y OR = 1.10 (SE = 0.04), P = 0.02; at 8-9 y OR = 1.13 (SE = 0.06), P = 0.01 at 4 y | | | Serious |
| Mei 202116 | 3-4 y | | 2 y | | 549 | | Parental questionnaire on dietary intake | Sweet snacks | | Frequency/d | | 1 time/day vs <1 time/day and >1 time/day vs <1 time/day | | dmft and dmfs (WHO, 1997) | | dmft; ECC | dmft: 1/day vs <1/day b = 0.28 (95% CI = -0.33, 0.89), P = 0.374; >1/day vs <1/day b = 0.89 (95% CI -0.15, 1.94) P = 0.095. ECC 1/day vs <1/day OR = 1.21 (95% CI 0.90, 1.63) P = 0.215; >1/day vs <1/day OR = 1.86 (95% CI 1.06, 3.27) P = 0.03 | | | Serious |
| Pang 2015 17 | 3-6 y | | 2 y | | 887 | | Questionnaire completed by parents | Cookies and sweet breads | | Frequency/d | | ≥ 1/d vs.< 1/d; ≥ 1/d vs.< 1/d | | DMFT/dmft caries | | New cases of caries | OR = 2.01 (95% CI = 1.39, 2.92) | | | Serious |
| Peltzer 2014 36 | 24 mo | | 12 mo | | 597 | | Diary completed by parents | Sweet candy | | Frequency/wk | | Weekly sweet candy intake at 30 mo: 3-7 d/wk vs.0-2 d/wk | | dmft and dmfs | | dmft value at age 36 mo minus that at 24 mo | OR = 1.97 (95% CI = 1.17, 3.31), P < 0.05 | | | Critical |
| Rodrigues 2000 37 | 3 y | | 12 mo | | 510 | | 3-d weighed inventory Frequency of consumption | Sugary food | | Frequency/d | | 4-5 times/d vs.1-2.9 times/d | | Change in dmfs | | Score | OR = 4.29 (95% CI = 1.7, 10.7) | | | Moderate |
| Ruottinen 2004 38 | 37.4 mo | | 6 y | | 89 | | 4-d food record | Added sucrose (sucrose and other free sugars); daily sugar | | % EI | | <10% EI vs. ≥10 % EI; continuous | | dmft/DMFT | | Change in score | Mean = 2.82 (SEM = 0.51) v 1.63 (SEM = 0.26) P = 0.014; P = 0.012 | | | Serious |
| Skafida 2018 18 | 2 y | | 3 y | | 3770 | | FFQ | Sweets or chocolate | | Frequency/mo | | ≥1/d vs. < 1/d | | Decayed, extracted, or filled teeth | | Dichotomous (0, 1) | OR = 1.53 (95% CI = 1.24, 1.89) P < 0.001 | | | Serious |
| Tamaki 2009 19 | 5 or 6 y | | 2.5 y | | 500 | | FFQ | Sweet snacks | | Frequency/d | | Continuous | | Incident caries (baseline to follow-up) | |  | OR = 1.286 (95% CI = 0.822, 2.013) P = 0.271 | | | Critical |
| Thornley 2021 20 | 2 y | | 5 y | | 4111 | | FFQ | Confectionary/cakes; noodles/rice porridge; ice-cream; takeaways | | Frequency/mo | | Continuous | | dmft | | Score | Univariate analysis: Confectionary or cake P < 0.001; Noodles or rice porridge P < 0.001; Ice-cream P < 0.001; Refined breakfast cereals P < 0.001; Takeaways P < 0.001 | | | Critical |
| Winter 2015 39 | 3.5 y | | 3 y | | 566 | | Questionnaire | Sugar index | | Frequency: never, seldom, occasionally,  often, always | | Above vs. below median score (>24 vs. ≤ 24) | | dmft increment | | Incremental change | OR = 1.53 (95% CI = 1.07, 2.2) P = 0.027 | | | Critical |
| Wu 2020 40 | 4.2 y | | 1 y | | 212 | | Questionnaire | Candy | | Frequency/wk | | > 1/wk vs. <1/wk | | dmft rate | | Score | Parameter estimate = -3.093 (95% CI = -1.095, -0.242), P = 0.004 | | | Serious |
| >5 – 10 y |  | |  | |  | |  |  | |  | |  | |  | |  |  | | |  |
| Mahboobi 2021 41 | 7-8 y | | 2 y | | 290 | | 3-day food record | Sugary snacks | | Frequency/day | | ≥2 vs <2 | | CAST index at 2 y | | Dental caries | 38% vs 62% IRR = 0.96 (95% CI = 0.73, 1.27), P = 0.80 | | | Moderate |

\*Estimates are adjusted odds ratios unless otherwise stated

†AOR, adjusted OR; CAST index, Caries Assessment Spectrum and Treatment; dmfs, decayed-missing-filled surfaces (for primary teeth); DAT, dietary assessment tool; dmft, decayed-missing-filled teeth (for primary teeth); DMFT, decayed-missing-filled teeth (for permanent teeth); d1, non-cavitated lesions; d2-3, cavitated lesions; ECC, early childhood caries; FFQ, food-frequency questionnaire; RR = Relative risk; RoB, risk of bias; SSB, sugar-sweetened beverages; %EI, percentage of energy intake; IRR, Incidence rate ratio.

‡Minimum analytical sample size.

**Figure S1** Individual risk of bias assessment for non-randomized studies reporting the effect of unhealthy food and beverage consumption on dental caries in children aged ≤10 years using ROBINS-I

Chart

Description automatically generated with low confidence

**Figure S2** Summary risk of bias across included studies on the effect of unhealthy food and beverage consumption on dental caries in children aged ≤10 years

Chart, bar chart

Description automatically generated

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