**Appendix 3:**

**Table 6: Comparison of WHO** (6), (5), (102), (134) **and SACN** (7) **systematic reviews and meta-analyses on the associations between intake of sugar and sugars-containing beverages and health outcomes (focussed on data for children and adolescents)**

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| --- | --- | --- |
|  | **WHO** | **SACN**  |
| Type of studies included | Weight & Caries: RCTs, prospective cohort studies;Caries: non-randomized intervention case-control, cross sectional, observational ecological studies | RCTs, prospective cohort studies; Case-control, cross-sectional, ecological studies excluded |
| Literature search end | Wt.: Dec 2011; Caries: Nov 2011 | Wt. : Dec 2009; Caries: Jan 2011; both updated: June 2012 |
| Recommen-dations  | GRADEReduced intake of free sugars throughout the life course (*STRONG*).Reduce intake of free sugars < 10% total energy intake (STRONG).Further reduction of the intake of free sugars to < 5% total energy intake (CONDITIONAL, based on caries). | The average population intake of free sugars should not exceed 5% of total dietary energy for age groups from 2 y. upwards. Contribution of free sugars (toward recommended total carbohydrate intake) should in people with a healthy BMI and in energy balance be replaced by: starches, sugars contained within the cellular structure of foods and lactose naturally present in milk/products. In overweight individuals, the reduction of free sugars should be part of a strategy to decrease energy intake. The consumption of SSBs should be minimised in children and adults. |
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| Objective | Provide recommendations on the intake of free sugars to reduce the risk of NCDs in adults (134) and children (5).Particular focus on the prevention and control of unhealthy wt. gain (5, 6) and dental caries (5, 102)**.** | Types of sugarstc in the diet: terminology, classification, definitions.The evidence on dietary sugarsdc and:- cardio-metabolic health (obesity)- oral health in children, adolescents and adults. |
| Exposure | Free sugars(g or kg/day or /yr or % energy)S | Sugars, sugars-sweetened foods and SSBstc |
| Specific research questions  | What is the effect of a reduction or increase in free sugars intake in adults and children?What is the effect of restricting intake of free sugars to below 10% of total energy? | The relationship between (individual) sugars, sugars-sweetened foods and SSBs and:- BMI/body fatness* oral health in children and adolescents (adultsadl)
 |
| Summary of evidence | 1) Body weight (children)(5, 6) | 1. BMI and body fatness (children and adolescents*)* (7)
 |
|  | Reduction in free sugars intake:5 randomized trials; follow up: 16-52 weeksIntervention: reduce sugar-sweetened foods and SSBs;Low compliance with dietary advice;No change in body wt. (measured: BMI or BMI-z score (0.09; 95% CI: -0.14, 0.32)Increase in free sugars intake:21 cohort studies (in 22 articles);; follow up: 1-8 y.; Meta-analysis of 5 prospective cohort studies (with 7 comparisons): Children with the highest intakes of SSBs had a > likelihood being overweight/obese vs. children with the lowest intakes ([OR] 1.55; 95% CI: 1.32, 1.82).Significant heterogeneity: evident in one of the meta-analyses. Some trials: subject to potential bias that could have influenced the findings. Sensitivity analyses: the trends were consistent and assoc. remained, even when excluding data from the potentially biased studies and studies contributing most to the observed heterogeneity. | 1. SSBs (g/, energy/ or servings/day) and BMI
* 6 cohort studies (children ≥ 5 y., adolescents); conflicting evidence; outcome measures: insufficiently comparable for a meta-analysis; 3 US cohorts: assoc. >SSBs, >BMI; 3 European cohorts: no assoc.;
* RCTs: 1 cluster-RCT, UK children, 7-11 y.: 12-months intervention CB; results: CB consumption: < intervention, > control group; % overweight/obese: < in intervention, > in control group, (mean difference 7.7%, 95% CI 2.2, 13.1) (109)

- 2 RCTs after the update search, outcome and exposure measures: insufficiently comparable for a meta-analysis:* normal wt. Dutch children: 18-months intervention (250 ml non-cal., sugar-free beverage/day) vs. control (250 ml SSBs); results: intervention group:< BMI z-score, < skinfold thickness, < waist/hip ratio, < fat mass vs. control group; good retention rates, sufficiently powered (106)
* overweight/obese USA adolescents: 12-months intervention (non-cal. beverages in place of SSBs); results: intervention group: < SSBs, < wt. gain, < BMI increase, vs. control group (107)
1. SSBs (g/, energy/ or servings/day) and body fatness

- 5 cohort studies (measurements: % body fat (3), total body fat (1), fat mass development (1); outcome measures: insufficiently comparable for a meta-analysis; 4 studies: no assoc. SSBs, body fatness/fat distribution; 1 study: SSBs consumption at 5 y.: predictor of adiposity at 5-15 y.; 3 studies: no assoc. fruit juice, body fatness/fat distribution |
|  | **2.) Dental caries (children)** (5, 102) | **2.) Oral health (children and adolescents)** (7) |
|  | 1 non-randomized intervention study, 50 observational studies (8 longitudinal/prospective cohort, 20 ecological/population (1 with children and adults), 22 cross-sectional); (>260,000 participants)47 studies: ≥ 1 positive assoc. sugars intake, dental caries (42 in children, 1 in children and adults,4 in adults)6 studies: positive and null findings (depending on age or ethnic group);7 studies: null findings in all measured assoc.;2 studies: ≥ 1 negative assoc.**What is the effect on dental caries of a reduction/increase in free sugars intake?**8 observational cohort studies; follow up: 1-8 y.: 6 studies accounted for fluoride exposure; results: 7 studies: assoc. > sugars, > dental caries:Positive assoc. amount of free sugars intake, dental cariesWhat is the effect on dental caries of restricting intake of free sugars to < 10% of total energy?- 5 cohort studies: dental caries development when free sugars ≤10% vs. >10% energy; results: all 5 studies: > dental caries when free sugars intake >10% of total energy vs. ≤10% energyWhat is the effect on dental caries of restricting intake of free sugars to < 5% of total energy?* 3 ecological (national population) studies (18,447 participants; children in Japan with low fluoride exposure):

dental caries at <10 (~ 5% energy) vs. >10 to <18.25 kg free sugars/person/y kg (~10% energy); results: development of dental caries decreased in all 3 studies when intake of free sugars was <10 kg/person/y (< 5% energy);correlation (sugars intake, dental caries): 0.6 - 0.8;all studies: log-linear dose-response relationship at free sugars intakes < 10 kg/person/year (i.e. <5% energy)  | 1. Amount of sugarss (g/day, % energy) and dental cariesmpd

- no meta-analyses (data: insufficiently comparable) -4 cohort studies : 3 adjusted for tooth brushing (3 studies: assoc. > sugars consumption, > risk of dental caries; 1 study: assoc. with fissure caries, not for overall 2-y. caries increment or approximal surface caries); 1 did not adjust for tooth brushing (no assoc.)1. **Frequency of sugars (servings/day) and dental cariesmpd**

- 2 cohort studies (3 publications): all adjusted for tooth brushing (no assoc. frequency of sugars consumption, risk of dental caries; 1 study that reports the frequency of bedtime sugars consumption from drinks: assoc. > frequency, > dental caries prevalence)1. Amount and frequency of SSBsssb (servings or ml/day) and dental cariesdd

-7 cohort studies (11 publications): all adjusted for tooth brushing; 5 cohort studies: assoc. > SSBs, > dental cariesdd; 2 cohort studies: no assoc. SSBs, dental caries at 36 months; no assoc. SSBs between meals, 18 months dental caries incrementdd;**d) Amount and frequency of sugars-containing foodsscf and/or sugars confectionery (servings/day or /week) and dental cariesdd****-** 10 cohort studies (11 publications); 5 adjusted for tooth brushing (2 studies: assoc. > sugars confectionery, > dental caries at 18 months and 3.5 y.; 3 studies: no assoc. sugars-sweetened food/sweet confectionery, dental caries); 6 did not adjust for tooth brushing (6 studies: assoc. > sugars-containing foods/confectionery, > dental caries)- 1 study in the update search (not adjust. for tooth brushing; snacking on candy, cake, cookies, ice cream or dried fruit: not assoc. with dental caries incidence, but 2 dietary snacking behaviours assoc. with caries)**e) Frequency of sugars-containing foods and/or sugars confectionery consumption (servings/day or /week) and dental cariesmpd****-** 8 cohort studies (9 publications); 5 adjusted for tooth brushing (3 studies: assoc. frequency of sugars consumption in confectionery, dental caries incidence; 2 studies: no assoc. sugars confectionery/sweet snacks, dental caries incidence), 3 did not adjust for tooth brushing (1: number of between-meal snacks containing > 10% sugars: assoc. with 2-y., but not 3-y., dental caries increment; 2: no assoc. sugars confectionery/snack consumption, dental caries); - 2 cohort studies in the update search (2 adjusted for tooth brushing); (1 study: assoc. frequency of sugars confectionery consumption at 1 y., dental caries at 15 y.; 1 study in children/adolescents with cerebral palsy: assoc. > frequency of sugars consumption, > dental caries) |
| Quality of evidence  | 1. Body wt. (children)
 | 1. BMI and body fatness (children and adolescents)
 |
|  | Reduction in free sugars intake and reduced body wt.: moderateIncrease in free sugars intake and increased body wt.: low | 1. **SSBs and BMI**: no assoc., limited evidence (cohort studies);  effect, limited evidence (RCTs)

There is inadequate energy compensationec for energy delivered as liquid sugar. Greater consumption of SSBs is detrimental to health. The effect is biologically relevant.**b) SSBs and body fatness**: no assoc., limited evidence (cohort studies)No consistent evidence of a sig. change in body fat amount or distribution with SSBs consumption. |
|  | **2.) Dental caries**Positive assoc. between free sugars intake and dental caries: moderatein:All ages (including <5 y. to >65 y.); developing, transitional and industrialized countries; all decades of publication of results.Positive assoc. between free sugars intake < 5% and caries:- all studies from Japan | **2.) Dental caries**1. Amount of sugars (g/day, % energy) and dental cariesmpd: positive assoc., moderate evidence (cohort studies)

Greater consumption of sugars is detrimental to oral health. The assoc. is biologically relevant.1. **Frequency of sugars and dental cariesmpd**: no assoc., limited evidence (cohort studies)
2. Amount and frequency of SSBs and dental cariesdd: assoc., adequate evidence (cohort studies);

Greater consumption of SSBs is detrimental to oral health. The assoc. is biologically relevant.1. Amount and frequency of sugars-containing foods /confectionery and dental cariesdd: assoc., limited evidence (cohort studies)

Greater consumption of sugars containing foods and/or sugars confectionery is detrimental to oral health. The assoc. is biologically relevant.1. Frequency of sugars-containing foods /confectionery and dental cariesmpd: assoc., moderate evidence (cohort studies)

Higher frequency of consumption of sugars-containing foods and/or sugars in confectionery is detrimental to oral health. The assoc. is biologically relevant. |

RCTs = Randomised controlled trials.

SSugars: total sugars, free sugars, added sugars, sucrose or non-milk extrinsic sugars (102)**.**

dcSACN contains the evidence on dietary carbohydrate and: a) colo-rectal health in adults, childhood, infancy; b) cardio-metabolic health (cardiovascular disease, insulin resistance, glycaemic response, obesity); c) oral health.

Total carbohydrates = sugars and sugars-sweetened foods/ beverages; starch and starch-rich foods; dietary fibre; non-digestible oligosaccharides, resistant starch, polyols and polydextrose; and the glycaemic characteristics of carbohydrate-rich foods and diets (glycaemic index and glycaemic load).

adlAdults (SACN includes): Sugars and coronary events, blood pressure; fasting: blood lipids, LDL/HDL cholesterol/triacylglycerol concentration; energy intake; type 2 diabetes mellitus; blood: glucose, insulin; individual sugars (sucrose; glucose, fructose, lactose) and type 2 diabetes mellitus; SSBs and type 2 diabetes mellitus, colon cancer (data are not presented here).

CB =Carbonated Beverages): SSBs and non-cal. sweetened beverages.

SSBs = sugars-sweetened carbonated beverages, non-carbonated fruit drinks and fruit juice; some studies did not define SSBs.

Sugars-containing foods = sweets/candy, between meal sweet food intake, sugars-containing foods/snacks, sucrose rich foods and sugar-starch foods.

sIn the studies exploring the relationship between sugars and oral health it was unclear what was meant by ‘sugars’ (mixture of mono-and di-saccharides or individual mono- and di-saccharides, e.g. sucrose).

ecEnergy compensation: degree of voluntary reduction in intake of other foods/drinks; **mpd**in mixed and permanent dentition; ddin deciduous dentition.

GRADE = Grading of Recommendations Assessment, Development and Evaluation, http://www.gradeworkinggroup.org/.