Swiss Dietary Recommendations for Children and Adolescents: Scientific Background

Beatrice Baumer[1]; Denise Abegglen[2], Linda Beck[3], Claudio Beretta[1], Christine Brombach[1], Sibylle Juvalta[2], Claudia Müller[1], Janice Sych[1], Nataliia Yakovenko[3], Julia Dratva[2]

[1] Zürcher Hochschule für Angewandte Wissenschaften ZHAW, School of Life Sciences and Facility Management, Wädenswil

[2] Zürcher Hochschule für Angewandte Wissenschaften ZHAW, School of Health Sciences, Winterthur

[3] Zürcher Hochschule für Angewandte Wissenschaften ZHAW, School of Life Sciences and Facility Management, Wädenswil, internships

This report was commissioned by the Federal Food Safety and Veterinary Office, contract 0714003136

Wädenswil & Winterthur, 14th November 2025

Summary

Objectives

A healthy lifestyle, particularly during childhood and adolescence, is essential for long-term health, but making healthy food choices can be challenging. In Switzerland, nearly 15% of youth are overweight or obese (per 2023), increasing their risk for non-communicable diseases (NCDs) later in life. Although adult dietary guidelines exist, there are currently no specific recommendations for children aged 4–17. Building on a 2022 report focused on adults, this project aims to develop evidence-based and sustainable nutritional recommendations for Swiss children and adolescents. It includes a literature review on diet and NCD risk, identification of relevant food groups, comparison of European dietary guidelines, and considerations for environmental sustainability in youth diets.

Methodology

The methodology follows the approach of the 2022 Swiss nutrition report, focusing on systematic reviews and meta-analyses (2010–March 2025) related to diet and major NCDs in children aged 4–17. Databases searched include PubMed, Cochrane, and Google Scholar. The search targeted associations between specific food groups and outcomes like obesity, type 2 diabetes, and cardiovascular diseases, including intermediate markers (e.g., fatty liver, hypertension). Articles were screened using strict inclusion/exclusion criteria and graded for evidence quality.

Food groups were assessed rather than individual nutrients or dietary patterns, based on the Swiss Food Pyramid and adjusted for items typically consumed by children and adolescents. Categories include beverages, fruits and vegetables, starch-based products, dairy, protein sources (of plant or animal origin), oils/fats/nuts, and ultra-processed food (snacks and general). For international comparisons, desktop research of dietary guidelines for children (4–17 years) was conducted for selected European countries and using WHO, UNICEF, and FAO databases. For the sustainability analysis, environmental impacts of food consumption in Swiss youth, was estimated, comparing current diets with modified ones (e.g., reduced dairy). Impacts were calculated using established ecological assessment models.

Findings for food groups

Water should be the main fluid source, with no significant link to NCDs (based mainly on cross-sectional studies, CSS). Sugar-sweetened beverages are linked to obesity risk; limiting intake to one portion (≈350 ml) per day is advised (supported by many studies, though these were often performed without adjustment for energy intake). Fruit juices may increase obesity risk if consumed in quantities above one portion per day. Caffeinated drinks should be limited to providing max. 2.5 mg caffeine per kg body weight daily to prevent cardiovascular issues (supported by toxicological data and randomized controlled trials, RCTs). No conclusions could be made for artificially sweetened beverages. Dietary patterns with high levels of fruits and vegetables show potential protective effects against NCDs. Grains (refined vs whole-meal) show inconclusive results. Sugar-containing breakfast cereals show contradictory findings; benefits may relate more to breakfast habits rather than breakfast cereals themselves, other cereals, pseudocereals, and starchy tubers lack sufficient evidence for conclusions. Meat: there is weak evidence linking processed meat to CVD markers; very limited data on the association with obesity. Fish shows weak evidence for lower CVD risk, particularly blood pressure reduction. No conclusions are possible for eggs (insufficient reviews). Milk and dairy show mixed but generally protective associations with obesity, regardless of fat content. There is limited evidence suggesting benefits for diets high in grain legumes. Plant-based milk, meat, fish, and egg alternatives, nuts and seeds, and oils and fats lack conclusive evidence due to limited or no reviews. Confectionary showed contradictory results; the weak positive evidence requires further investigation. There is conflicting evidence for savoury snacks. Ultra-processed foods (UPFs) show weak and inconsistent evidence linking high consumption to obesity, CVD, and metabolic syndrome markers. In summary, strong evidence supports limiting sugary drinks and increasing fruit and vegetable intake, while most other food groups lack conclusive or consistent data. Due to the lack of strong evidence, it was not possible to group food groups according to their influence on the risk of developing obesity, type 2 diabetes or cardiovascular diseases.

However, this review also highlights major methodological challenges in the current literature. Much of the available evidence is based on cross-sectional studies, often performed in low- to middle income countries, with few long-term or standardized prospective studies. There are inconsistent definitions of food groups, limited data from high-income settings, and insufficient adjustment for energy intake and dietary patterns. As a result, current research linking childhood and adolescent dietary intake to later-

life NCDs remains inconclusive, partly due to the long latency between early dietary exposures and disease onset.

Recent research trends are moving away from studying single food groups toward examining overall dietary patterns, which may better reflect real-world eating behaviours. To strengthen dietary guidance for children and adolescents, more rigorous, harmonized, and longitudinal research is urgently needed.

Findings for international comparisons

International nutritional guidelines for children and adolescents share common core messages but differ in their level of detail, age specificity, and use of evidence. Most are directed toward professionals and caregivers rather than young people themselves. Switzerland is distinctive in addressing adolescents directly; however, its recommendations are adapted from adult data, and the supporting evidence base is not clearly documented.

Across countries, the primary objectives of these guidelines are to prevent malnutrition and support healthy growth, though the underlying health rationale is often implicit. There is limited consensus on whether health messages are more effective when directed at children or their parents. Considerations of sustainability are increasingly incorporated but remain inconsistently addressed and, in some contexts, sensitive.

Family and school environments are consistently identified as key settings influencing dietary behaviours, with some countries providing specific recommendations for school food services. The presentation and accessibility of digital formats vary substantially. The Dutch "Schijf van Vijf" stands out for its age- and gender-specific digital tools, offering an engaging model compared to more traditional materials, such as those used in Switzerland. Increased investment in appealing, evidence-based digital resources could enhance the effectiveness of nutrition communication among today's digitally native youth.

Findings environmental aspects

The environmental impact of diets varies by age, dietary patterns, and national context. Although children and adolescents account for a smaller share of overall food consumption, their eating habits are formative and might have long-term implications for health and sustainability. Promoting sustainable, healthy diets from an early age can yield lasting benefits, but children's specific nutritional needs must be carefully addressed. Some European countries now use the Planetary Health Diet as a reference when integrating sustainability into dietary guidelines. Reducing red , in particular processed, meat intake could be a key strategy that aligns health and environmental goals without risking nutrient deficiencies. In contrast, reducing dairy requires more caution, as it remains an important nutrient source during growth. First European experiences show that incorporating sustainability into dietary advice is feasible without compromising nutritional adequacy.

General conclusions

To improve the effectiveness of nutrition guidance, future efforts should focus on conducting high-quality longitudinal research, tailoring age-specific recommendations, integrating sustainability in youth guidelines, enhancing school food policies, empowering parents, and testing which messaging strategies concerning health and / or sustainability, most successfully influence young people's behaviour.

Content

List of abbreviations

ALA	Alpha-linolenic acid
AMI	Acute myocardial infarction
ANSES	French Agency for Food, Environmental and Occupational Health & Safety
ASB	Artificially sweetened beverages
BCAA	Branched-chain amino acids
BF(P)	Body fat (percentage)
BIA	Bioelectrical Impedance Analysis
BLV	Bundesamt für Lebensmittelsicherheit und Veterinärwesen
BMI	Body mass index (weight [kg] / height $[m]^2$)
bpm	Beats per minute (heat rate)
BMI z	The z-score classifies degrees of BMI in children and adolescents
CCS	Case control study
CHD	Coronary heart disease
CHUV	Centre hospitalier universitaire vaudois
CI	Confidence interval
CVD	Cardiovascular diseases
DBP	Diastolic blood pressure
DHA	Docosahexaenoic acid
DONALD	Dortmund Nutritional and Anthropometric Longitudinal Designed Study
DRVs	Dietary References Values
DXA	Dual-energy X-ray Absorptiometry
EFSA	European Food Safety Authority
EPA	Eicosapentaenoic acid
EPIC	European Prospective Investigation into Cancer
FAO	UN Food and Agriculture Organisation
FCDB	Food composition data base
FFQ	Food-frequency questionnaire
FSVO	Federal Food Safety and Veterinary Office
g	Gram
GHG	Greenhouse gas
HDL	High-density lipoproteins
HFCS	High fructose corn syrup
HELENA	Healthy Lifestyle in Europe by Nutrition in Adolescence
HIC	High-income countries
HOMA-IR	Homeostasis Model Assessment of Insulin Resistance
HR	Hazard ratio
IPCC	Intergovernmental Panel on Climate Change
LNCSB	Low and no-calorie sweetened beverages
LDL	Low-density lipoproteins
LMIC	Low- and middle-income countries
MA	Meta-analysis
MUFA	Monounsaturated fatty acids
NA	Not available
NAFLD	Non-alcoholic fatty liver disease
n.s.	Non-significant
NCD	Non-communicable diseases
NNS	Non-nutritive sweetener
NR	Narrative review
OMD	Optimized Mixed Diet
OR	Odds ratio
OS	Observational study
PBF	Percentage body fat
PHDI	Planetary Health Diet Index
PCS	Prospective cohort studies
PI	Ponderal index (weight [kg] / height $[m]^3$)
PUFA	Polyunsaturated fatty acids
R	Review
RCT	Randomized controlled trial
RR	Relative risk
RTEC	Ready-to-eat cereal
SBP	Systolic blood pressure
SCB	Sugar-containing beverages
SFA	Saturated fatty acids
SGE	Schweizerische Gesellschaft für Ernährung
SR	Systematic review
T2D(M)	Type 2 diabetes (mellitus)
TFA	Trans fatty acids
TJ	Terajoule
UNICEF	United Nations Children's Fund
UPF	Ultra-processed foods
UR	Umbrella review
USA	United States of America
WC	Waist circumference
WG	Whole grain
wk	Week
WMD	Weighted mean average
WHO	World Health Organization
y	year

1 Introduction, context, objective

1.1 Introduction

A healthy lifestyle includes a balanced diet. However, despite, or because of the wide variety of food on offer, it is not always easy for consumers to make healthy food choices. The Federal Food Safety and Veterinary Office (FSVO) regularly develops and revises nutritional recommendations and other public health measures to promote a varied and balanced diet for the population across the different stages of life. Childhood and adolescence are considered crucial phases in which the foundations for a healthy lifestyle are acquired (GBD 2021 Risk Factors Collaborators, 2024).

Children and adolescents need a balanced supply of energy and nutrients for their physical and mental development. In Switzerland around 15 per cent of children and adolescents are overweight or obese (Herter-Aeberli et al., 2019), this prevalence is stable, as data from 2023 confirm, with 11.9% overweight, and 2.7% obesity rates in the age range of 6 to 12. (BAG, 2025). Overweight and especially obesity in childhood and adolescence may be risk factors for non-communicable diseases (NCDs) such as diabetes and cardiovascular diseases in adulthood (Reilly & Kelly, 2011), although more robust studies investigating this association are needed (Park et al., 2012). Around half of these diseases can be prevented or at least delayed by a healthy lifestyle and a balanced diet (WHO, 2013), (WHO, 2014), (Benziger et al., 2016).

Promoting healthy eating from an early age is particularly important, as dietary habits formed in childhood strongly influence eating behaviour later in life. According to (Bogaard, 2023), habits such as regular breakfast consumption, low sugar intake, and vegetable preferences are often carried into young adulthood. The authors identified active parental engagement in the eating process as a key determinant of children's dietary behaviours. Their findings suggest that parental modelling alone (e.g., merely eating breakfast in front of the child) is less effective in promoting long-term healthy eating habits than explicit parental communication that explains the reasons for such behaviours, such as emphasizing the benefits of breakfast for health, cognitive performance, and overall well-being (Bogaard, 2023). Other authors made similar observations (Fisberg et al., 2024), (Mahmood et al., 2021). Furthermore, a field experiment by Belot et al. underline that early childhood habits are more malleable, whereas changing dietary behaviour in adulthood is significantly more difficult, underlining the importance of early interventions for healthy nutrition (Belot et al., 2013). Mazzocchi et al. highlight that the first 1'000 days of life are decisive for the child tastes' preferences: Food preferences are closely linked to habits. There is a strong connection between how familiar a particular food is and the preference for this food. Children love what they know and eat what they love. The example set by parents seems to be very important. When addressing an infant and a young child, education is not primarily conveyed through words, but through the repeated offer of a varied and healthy diet and example (Mazzocchi et al., 2021).

On the other hand, food consumption can shift with age and changing life stages. According to Kudlová & Schneidrová, large changes in diets occur between the age of 1 and 5. These changes can differ depending on the country and context (urban vs. rural). Thus, more context-specific research is crucial to better understand the influence of children's diet patterns on the patterns in later stages of life (Kudlová & Schneidrová, 2012).

Because dietary habits in childhood and adolescence often persist into adulthood, early nutrition should consider not only health but also environmental sustainability. Food production and consumption have a major impact on greenhouse gas emissions, land use, and biodiversity. Encouraging sustainable, balanced diets from an early age therefore helps secure lifelong health while also protecting the environment. At the same time, particular attention must be paid to children's needs during growth phases to ensure that considering environmental aspects does not lead to nutrient deficiencies. This balanced approach should be reflected in modern nutritional recommendations, which aim to promote both individual health and the well-being of the planet.

1.2 Context

In 2022 a Swiss review presented scientific literature from 2015 onwards, focused on associations between food groups and major NCDs using a standardized classification system to evaluate the strength and consistency of evidence. It also assessed the ecological footprint of food production and consumption and compared Swiss dietary guidelines with those from neighbouring countries and major international organizations. The report targeted healthy adults aged 18 to 65 years and excluded other age groups as well as specific physiological conditions (e.g., pregnancy, lactation) and disease-specific dietary recommendations. It was structured into four main sections, addressing associations between foods and NCDs, ecological impacts of commonly consumed foods in Switzerland, comparison of dietary guidelines and the identification of food groups relevant to Swiss nutrition policy (Marques-Vidal et al., 2022). The report provided the scientific basis for revising the Swiss dietary guidelines and was used in the development of the new Swiss Food Pyramid for Adults (BLV, 2024). However, despite these advances for the adult population, Switzerland currently lacks official, food-based dietary recommendations for children and adolescents aged 4 to 17 years, beyond the existing Dietary Reference Values for nutrients (DRVs) (BLV, o. J.).

1.3 Objective

The aim of this project is therefore to develop scientifically sound and sustainable nutritional recommendations which can then inform the development of dietary recommendations for the younger Swiss population. This report is conceived as an extension of the 2022 report, by focussing on children and adolescents in the age groups of 4 to 17 years. Although most food categories correspond to those investigated in the above-mentioned report, they will be partially re-grouped and additional food categories, which might be relevant to the targeted age groups, will be included in case of evidence. This report has the following objectives:

- To conduct a literature review and analysis: investigate the impact of food on the risk of selected non-communicable diseases (NCDs), in particular overweight/obesity, type 2 diabetes and cardiovascular diseases, in children and adolescents.
- Grouping and evaluation of foods according to their influence (positive, negative or neutral) on the risk of developing the selected NCDs.
- Comparison and tabulation of European dietary recommendations by age group (including their definition). Differences and similarities between the dietary recommendations of the European Food Safety Authority (EFSA), the WHO and Switzerland are analysed regarding visual presentation, main messages and presentation of the dietary recommendations. If available, initial findings from the menuCH Kids study can be considered (BLV, 2025a).
- Proposal of relevant foods: Identification of relevant foods and food groups for the nutritional recommendations in Switzerland. Review and addition of foods from the new Swiss food pyramid and nutritional disc (BLV, 2024). Determination of the frequency of consumption per age group.
- Consideration of the requirements for a sustainable diet: Analysis of the challenges of a sustainable diet in relation to children and young people and listing of important environmental issues for future dietary recommendations (e.g. meat consumption, seasonality, transport, packaging, nutritional trends, new foods on the market).

2 Methodology, search strategy and evaluation of results

2.1 Food groups

The focus was on food groups and not on individual nutrients, or on dietary patterns. The selection of food items considered was based on the current Swiss Food Pyramid (BLV, 2024) and on the report on dietary recommendations for adults, including foods and beverages that are more frequently or specifically consumed by children and adolescents, the finalised list was discussed with the FSVO (Table 1).

2.2 Systematic literature search

The literature search strategy followed that used for the 2022 report, i.e. was based on the analysis of peer-reviewed systematic reviews and meta-analyses published from 1st January 2010, up to March 2025. Peer-reviewed systematic reviews (SR) and meta-analyses (MA), in English, were searched using a matrix consisting of the age groups, selected non-communicable diseases and intermediate markers in combination with food groups (Table 1) in the common databases (PubMed, Google scholar, Cochrane). Any large-scale studies published in the same time frame and fulfilling the inclusion criteria below (Table 2), but not included in the retrieved SRs, MAs, were also to be included.

Table 1*: Food groups considered for the literature search*

Beverages	Water Sugar-containing beverages (sugar-sweetened beverages or fruit juices) Caffeinated drinks (unsweetened / sweetened, energy drinks) Artificially sweetened beverages
Fruits and vegetables	As a whole group not specified in subcategories
Starch-based products	Wheat-based products Breakfast cereals Other cereals and pseudocereals
Milk and Dairy	As a whole group not specified in subgroups
Protein sources of animal origin	Meat red/white, unprocessed/processed Fish unprocessed / processed Eggs
Protein sources of plant origin	Legumes (pulses) Plant-based meat, fish and egg analogues Plant-based milk alternatives
Oils, fats, nuts	Nuts and seeds Oils and fats
Packaged foods and snacks (incl. Ultra-processed foods)	Snacks (sweet, savoury) Other ultra-processed foods

Table 2: *General search strategy (inclusion and exclusion criteria)*

General search criteria	
outcomes	• Overweight and obesity, with fatty liver (as intermediate outcome), • Type 2 diabetes, with metabolic syndrome, glucose intolerance blood sugar (glucose) as intermediate outcomes • Cardiovascular events, with prehypertension / hypertension and atherosclerosis, ischemic heart disease as intermediate outcomes ➢ Compound search strings for Pubmed and Cochrane, based on outcomes, in appendix A
Age groups	• Targeted age groups 4 to 17 years (for prospective long-term studies: as starting age). ➢ Compound search string Pubmed and Cochrane, based on age group, in appendix A
Study types	• Peer-reviewed systematic reviews (SR) and meta-analyses (MA), ➢ Compound search string Pubmed and Cochrane, based on publication type, in appendix A • Relevant umbrella reviews were retained for general considerations
Combined general search string	• A combined (general) search string for outcomes, age groups and publication types was generated ➢ General search string Pubmed and Cochrane, in appendix A
Food groups and inclusion / exclusion criteria	
Food groups	Search criteria: based on food definitions for each category, expanded based on the authors' expertise on the subject. Search strings for the specific food groups are listed in appendix A.
Combined search string	• Combined general search string AND specific food group string
date	• Starting 1. January 2010
Inclusion criteria	• When all conditions above are fulfilled • When the reviews include mainly (> 50%) studies conducted in Europe or other high-income countries (HIC).
Exclusion criteria	• Whenever the above conditions are not fulfilled (e.g. adult studies, first 4 years), • further exclusion criteria: pregnancy, prenatal studies, focus on the first 1000 days • focus on other outcomes (e.g. dental or mental health, allergies), • focus on dietary interventions (e.g. RCTs) with already overweight/obese children or adolescents, • interventions in school settings, with other outcomes (e.g. modifying dietary behaviour, promoting physical activity) • studies performed mainly (> 50%) in low- and middle-income countries (LMIC), including upper-middle-income countries, unless a stratification (geographic or LMIC vs HIC) was performed in the analysis of the data • when the review consisted of only one article for the selected food group or outcome

The searches were performed by the main author(s) per chapter, who compiled a table, listing the retained reviews, outcomes, age groups, any definitions used for the food groups and the main findings and conclusions of the authors of the MAs and SRs, as verbatim statements, partially abridged and or commented. The authors evaluated the retained reviews with the grading system used in the adult report "CHUV" (Marques-Vidal et al., 2022), which was however slightly adapted, with a lower scoring for SRs and MAs based mainly (> 50%) on cross-sectional studies (CSS) (level B), compared to MAs based on prospective cohort studies (PCS) (level A), see Table 3.

Table 3*: Classes of recommendations and evidence levels. Adapted from (Marques-Vidal et al., 2022)*

Class	Definition
0	Sufficient evidence of no effect (RR/OR= 1 rsp., close to 1 or 0),
I	Evidence and/or general agreement that a higher / regular intake of a given food group is beneficial (risk reduction, including any dose effects)
II	Insufficient / Conflicting evidence and/or divergence of opinion about the benefits or risk of the food, risks/benefits are not statistically significant
III	Significant Evidence and/or general agreement that higher / regular intake a given food group is deleterious (increased risk)
Level	**Definition**
A	Conclusions derived from MAs of RCTSs, PCS, SRs of PCS
B	Conclusions derived from MAs of CCS, SRs of CCS, or NRs
C	Experts' agreement and/or individual relevant PCS, RCTs

RR relative risk, OR odds ratio, MA meta-analysis, CSS cross-sectional study, PCS prospective cohort study, RCT randomized controlled study, NR narrative reviews

2.3 Conclusions and recommendations

Wherever feasible, data on portion sizes should be recorded. Reported data should specify the minimum and maximum intake ranges associated with individual outcomes, as well as the optimal intake levels, where applicable. When available, data should be stratified by age group to ensure appropriate comparability and interpretation.

2.4 Methods for international comparison

A desk-based comparative analysis was undertaken to map existing food-based recommendations for children and adolescents aged 4–17 years across selected European countries. The analysis encompassed Germany, Austria, France, Italy, the United Kingdom, the Netherlands, and Sweden, representing both Switzerland's neighbouring countries and a selection of European states recognised for having comprehensive dietary guidelines. Information was systematically collected from official government and public health authority websites, World Health Organisation (WHO), United Nations' Children Fund (UNICEF), Food and Agriculture Organisation (FAO), and therein included links to national recommendations.

2.5 Methods for the sustainability perspective

A calorie-based scaling approach was used because total energy intake serves as a reasonable proxy for the overall amount of food consumed, which largely determines diet-related environmental impacts. Assuming a similar dietary composition across age groups and varying only total energy intake enables a consistent estimation of relative contributions to total impacts in the absence of detailed age-specific consumption data. Comparable proportional or energy-based approaches have been applied in previous environmental and nutrition modeling studies (Poore & Nemecek, 2018). Data from Beretta and Hellweg, who differentiate 23 food categories to estimate the environmental impacts of food consumption in Switzerland was used (Beretta & Hellweg, 2019). Based on this, the amount of food consumed in Switzerland was calculated for each age group, based on the population (BFS, 2025) and the average recommended energy consumption in kilocalories per day (BLV, 2024). The estimated energy consumption in a specific age group based on recommendations differs between the minimum of 666-1'030 kcal/d in the first year and the maximum of 2'228-2'940 kcal/d between the age of 15-17. The results were used to calculate the share of food consumption and related environmental impacts of children and young adolescents compared to food consumption of the entire population.

In a second step, change was made to the status quo consumption by Beretta and Hellweg by reducing dairy consumption to 2 and 3 portions per day and increasing the consumption of all other food categories proportionally, keeping overall energy intake constant. Subsequently the climate and environmental impacts of these two scenarios based on the data from Beretta and Hellweg, who used the impact methods "IPCC Global Warming Potential 100 years" and "Ecological Scarcity 2013" was calculated (Beretta & Hellweg, 2019). The same procedure was followed twice, once changing dairy consumption in the entire population and once changing it only in the children and adolescents' group. The details are included in a separate Appendix B.

3 Food Groups and association with noncommunicable diseases

3.1 Beverages

3.1.1 Water

Author: Beatrice Baumer   Reviewer: Janice Sych

Introduction

As stated in the Swiss dietary guidelines for adults, beverages provide fluids that the body needs for all life processes. As the body cannot build up reserves, it is important to drink regularly. The recommendation is 1-2 liters of water per day for adults, in the form of tap water, mineral water, unsweetened herbal teas(BLV, 2024), the guidance values being 1.5 mL / kcal (energy need) for infants, decreasing to 1.0 mL / kcal for adults (in temperate weather, normal level of physical activity) (EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA), 2010).

Search strategy

A systematic search was carried out as described in the general methods section. For the NCD outcomes, the combined terms of the search string were used, as defined in the general method and the search string for water, as for all food groups is in appendix A.

Main findings

After applying exclusion criteria (adults, other outcomes, focus on pregnancy and/ or newborns), only one paper was retained (Muckelbauer et al., 2014) (Table 4). This systematic review showed contradictory results, depending on the study type (prospective studies vs. cross-sectional studies).

***Table 4:** Classes of recommendations and evidence levels for water and NCD outcomes*

Ref.	Study type	Outcome	Age group	Food type	Results	Class	Level
(Muckelbauer et al., 2014)	SR based on 13 studies: 4 PCS, 9 CSS	BMI	2-19	Water	Based on CSS evidence, higher water consumption seems to be associated with higher weight status. In contrast, PCSs suggest a weight-reducing effect of water consumption, but evidence for a causal association is still low.	II	B

BMI: body mass index; CSS: Cross-sectional study; PCS: Prospective Cohort Study; SR: Systematic Review

Conclusion

To support healthy hydration habits and reduce potential health risks, water should be the main beverage consumed by children and adolescents. While there is no strong evidence that higher water intake directly reduces disease risk, weak evidence suggests that frequent consumption of energy-providing beverages, including sugar-sweetened and other caloric drinks, including caffeinated drinks, may increase health risks (see chapters 3.1.2 and 3.1.3), and there is no clear evidence that artificially sweetened beverages are beneficial (see chapter 3.1.4) the default fluid should therefore be unsweetened water.

3.1.2 Sugar-Containing Beverages (SCBs)

Authors: Beatrice Baumer   Reviewer: Janice Sych

Introduction

Non-dairy sugar-containing beverages (SCB) are a collective term for sugar-sweetened beverages (SSB) and fruit-juices, with a similar sugar content (8-12% w/v) as main energy source. Sugar-sweetened beverages (SSB) are beverages based on water, sweetened with sugars, such as sucrose, glucose syrups, high-fructose corn syrups (HFCS), or fructose. Other ingredients and additives provide flavour, colour, and possibly micronutrients (vitamins, minerals). Fruit juices are based on juices or diluted fruit concentrates and provide the naturally occurring compounds of the raw material (nutrients such as vitamin C, provitamin A, potassium, and bioactive secondary metabolites), the naturally occurring sugars are in species-specific ratios of sucrose to fructose to glucose. In some cases, the term “100% juice” refers to juices directly expressed from fruits (i.e. not concentrated and reconstituted). SCBs are considered one of the leading sources of added sugars in the diet of USA children (Frantsve-Hawley et al., 2017), as well as in German adolescents (Mesana et al., 2018). A European study concluded that European adolescents consume on average daily 117 kcal from SSB and 70 kcal from fruit juices, i.e. 46 g of sugar (Duffey et al., 2012). Model pathways linking high consumption of SSBs to obesity and other outcomes have been hypothesized (Alcaraz et al., 2021). In the current Swiss food pyramid for adults SCBs are placed at the top (discretionary food products), with a guideline of 0-1 servings per day, i.e. 2 decilitres of sweet drinks such as cola, iced tea, (caffeinated) energy drinks, light or zero drinks, syrup, and fruit juice-based beverages. Up to 4 portions of fruit juices per week are accepted as fruit equivalent in the food pyramid for adults (BLV, 2024).

The classification of flavoured dairy beverages remains ambiguous, as there is no consensus on whether they should be categorized as sugar-sweetened beverages (SSBs), dairy products, or even as ultra-processed foods, in this report they are briefly discussed in chapter 3.4.2.

Search Strategy

A systematic search was carried out in the two databases PubMed and Cochrane. For the NCD outcomes, the combined terms of the search string were used, as defined in the general methods. For the food group, both subcategories (SSB and fruit juices) were searched in combination, because some studies address both together, others separately. The full syntax for searches in PubMed and Cochrane is in appendix A. This search retrieved 121 articles. which were then screened, based on abstract: main exclusion criteria were unavailability of full-text (only abstract), out of scope age-range (prenatal, first 1000 days), focus on specific nutrients, focus on dietary patterns, general context fruits and vegetables, milk-based beverages, life style factors as primary research (sleep, television, media, physical activity), socioeconomic factors (determinants, taxes, role of industry, studies in developing countries), prevention /interventional studies. This narrowed the search to 16 articles for SSB and body weight / BMI / body composition outcomes, 4 for SSB and other outcomes, and 6 for fruit juices, for a total of 26 studies summarized in Table 5.

Main Findings

While SSBs are frequently combined with other discretionary foods (e.g., snacks, sweets, or ultra-processed products), this section includes only studies that specifically targeted SSBs or reported separate data for them.

Across most studies, higher sugar-sweetened beverage (SSB) intake was positively associated with overweight, obesity, and higher body fat in children and adolescents. Most authors did however grade the evidence as weak. The consumption of fruit juice was not associated with an increased body weight, although some studies suggested a possible risk, when increasing the number of servings (Nguyen et al., 2024), (Auerbach et al., 2017). None of the included reviews found evidence supporting a beneficial association between fruit juice consumption and a reduced risk of obesity.

SSBs were studied in association with cardiometabolic risk factors, and higher consumption of SSB, i.e. 750g resp. >1.3 servings per day, (Farhangi et al., 2020), (Hoare et al., 2017). Other authors (Markey et al., 2023) claim that the methodological heterogeneity was too high, making meta-analyses very challenging.

In general heterogeneity is observed at different levels:

- The variability in study designs, populations, and exposure definitions contributes to inconsistencies in findings.
- variability in portion sizes and consumption categories: Reported portion sizes vary widely, ranging from as little as 100 ml to as much as 12 fl. oz (≈350 ml), making comparisons difficult.
- Unclear adjustment for total energy intake: Not all studies account for total energy intake as a confounder, which is crucial for determining the independent effects of SCB consumption (Jakobsen et al., 2023a).
- When total energy intake is considered, associations between SCB and adiposity often weaken, suggesting that energy balance plays a key role (Trumbo & Rivers, 2014)
- Some studies, such as (Crowe-White et al., 2016) and (Frantsve-Hawley et al., 2017), indicate that the observed associations might be overestimated when energy intake is not properly adjusted.

- Lack of change-over-change analysis for long follow-ups: Many studies fail to incorporate a change-over-change analysis (Frantsve-Hawley et al., 2017), which is particularly important for long-term studies involving children and adolescents. This omission neglects time-related changes such as growth, shifts in body composition, and age-related variations in dietary patterns (e.g., changing fruit juice preferences as noted by Auerbach et al., 2017).
- The role of physical activity is also highlighted as a potential confounder. For example, (Grimes et al., 2021) found that the association between SSB consumption and obesity became non-significant after adjusting for physical activity.
- Hoare et al. (2017) further suggest that declining physical activity with age, particularly in adolescent girls, might exacerbate the long-term effects of sustained SCB consumption, potentially leading to obesity and metabolic complications.

Overall, the above methodological concerns underscore the difficulty in drawing definitive conclusions from existing research, particularly regarding causality and long-term health effects.

Conclusion

Despite considerable heterogeneity in study designs, portion sizes, and methodological approaches, the preponderance of evidence indicates a positive association between higher sugar-sweetened beverage (SSB) consumption and increased risk of obesity, with each additional serving of SSB. It should be acknowledged, however, that most studies have not adequately adjusted for total energy intake or physical activity, which may confound the observed relationships.

Importantly however, no evidence supports a protective or beneficial effect of increased SSB consumption (decreased obesity risk). Collectively, these findings reinforce the classification of SSBs as discretionary items rather than essential components of a balanced diet but could be considered an energy source.

One serving of fruit juice per day could still be included as part of a balanced diet. However, all sugar-containing beverages, including fruit juices, should be recognized as sources of energy, with the potential for overconsumption if not accounted for within total energy balance. To mitigate the risk of excessive energy intake, consumption should be moderated, particularly when not matched by an increase in physical activity or of energy expenditure.

Table 5: *Classes of recommendations and evidence levels for sugar-containing beverages and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
SSB and Body weight / BMI / body composition							
(Liu et al., 2024)	MA, 51 studies, mainly CSS	BMI	2-18y	SSB	Meta-analysis by gross national income per capita showed that consuming more sugar-sweetened beverages was a risk factor for childhood overweight and obesity in both low- and middle-income countries/regions (OR = 1.31; 95% CI = 1.21–1.41) and high-income countries/regions (OR = 1.24; 95% CI = 1.13–1.36)	III	B
(Nguyen et al., 2023)	SR and MA of 40 PCS and 8 RCTs (mainly HIC)	Weight gain and BMI	6 months to 17 y	Serving defined as 12 oz (355 ml)	Among cohort studies, each serving/day increase in SSB intake was associated with a 0.07-kg/m^2 (95% CI: 0.04 kg/m^2, 0.10 kg/m^2) higher BMI in children Most studies (n=34) were not adjusted for energy intake	III	A
(Jakobsen et al., 2023a)	SR / MA of 26 CSS	Overweight / obesity	Mean age 5-18y	SSB*	Sugar sweetened beverages* and overweight/obesity: the OR (95% CI) for higher intake of sugar-sweetened beverages versus lower intake of sugar-sweetened beverages was 1.20 (1.09, 1.33) ($p < 0.05$) (I2 = 79.34%) in children and adolescents 5–18 years. In children 5–11 years, the OR (95% CI) was 1.23 (1.10, 1.38) ($p < 0.05$) (n:12) and in adolescents 12–18 years of age, the OR (95% CI) was 1.30 (1.15, 1.46) ($p < 0.05$) (n:3). **(soft drinks, sugary beverages, sweetened beverages, and soda) no 100% fruit juices*	III	B
(Rousham et al., 2022)	SR /MA, 45 RCTs or PCS	Obesity, various markers thereof	< 10.9 years at start	250 ml servings for the MA	To summarize, in children ≤10.9 y, the body of evidence indicates that SSB consumption may increase BMI, percentage body fat, or the risk of overweight/obesity, but 100% fruit juice showed little / no effects on the former outcomes (low certainty). A meta-analysis of 3 studies reporting effects of SSB consumption on change in BMI from baseline to follow-up showed no effect (pooled effect estimate: β = 0.01; 95% CI: −0.00, 0.02).	II	A
(Abbasalizad Farhangi et al., 2022)	SR, based on 33 studies (19 CSS) published 2013-2020, international	BMI / BFP	2-18	Various SSB*	High SSBs consumers were 1.14 times more probable to develop obesity compared with low SSBs consumers (OR: 1.14; CI 0.92–1.35), which were not statistically significant. An increase of 0.75 kg/m^2 in BMI was associated with high SSBs consumption in children and adolescents (weighted mean average): 0.75; CI 0.35–1.15; $p < 0.001$), thus the weight increase was significant. High SSBs consumption was significantly linked with higher WC (WMD: 2.35 cm; CI 1.34, 3.37; $p = 0.016$) with significant heterogeneity. A high SSBs intake was associated with 2.74% increase in BFP (weighted mean average: 2.81; CI 2.21–3.41; $p < 0.001$) with significant heterogeneity among studies. ** carbonated soft drinks, juices or cordials, energy drinks, sugar-sweetened sodas, lactobacillus beverages, milk beverages, tea beverages, coffee drinks, fruit drinks with added sugar, lemonades, yogurt drinks, chocolate milk, and other sugar-added beverages*	III	A-B
(Mayer-Davis et al., 2020)	SR (based on 46 articles, mainly PCS)	Body com-position, overweight, obesity	Baseline 2-14	SSB	In studies examining SSB intake in children, most studies (~80%) reported a significant effect or association between SSB intake and adiposity, however this was not always consistent within studies that reported multiple outcome measures. There were additional concerns related to risk of bias and generalizability. Moderate evidence suggests that higher sugar-sweetened beverage intake is associated with greater adiposity in children. Evidence is insufficient for the relationship between sugar-sweetened beverages compared with low- and no- calorie sweetened beverages on adiposity in children.	II	A
(English et al., 2019)	SR based on RCTs and PCS	Growth, size, body composition	From first 2 y to 11.5 y	SSB	Limited evidence suggests that sugar sweetened beverage consumption during the complementary feeding period (first two years) is associated with increased risk of obesity in childhood, but is not associated with other measures of growth, size, and body composition.	II	A

(Café et al., 2018)	SR 15 cross-sectional studies, 8 other studies	overweight	8-18 y	SSB	One can conclude that there is no consensus in the literature about the association between the intake of sugar-sweetened non-alcoholic drinks or milk and the BMI of adolescents	II	B
(Costa et al., 2018)	SR, based on 12 studies (7 PCS, 2 CSS, 3 interven-tional)	Body fat (DXA, BIA, skinfolds)	5-22	SSB (subtopic, main topic UPF)	Among the studies that evaluated the association between consumption of soft drinks/sweetened beverages and body fat (n 12), eight found associations, which were all in a positive direction (i.e. higher consumption of soft drinks/sweetened beverages was followed by higher levels of body fat). The adjustment variables applied in the individual studies were not consistent, total energy intake was not always included	II-II	A
(Schneider et al., 2017)	NR based on PCS	BMI, BF	Exposure at 10-19		During adolescence, adhering to a dietary pattern characterized by high consumption of energy-dense food, fast foods, sugar-sweetened beverages and soft drinks, as well as low fibre intake, appears to contribute to an increase in body fat in early adulthood.	III	B
(Frantsve-Hawley et al., 2017)	SR, based on 6 RCTs resp. PCS	Weight gain	< 12 y, follow-up 1-10 y	SCB*, 100g portions	MA not possible due to heterogeneity of study designs. Our results support a statistically significant positive association between SCBs and total and central adiposity among children under age 12. This association is most consistent for total adiposity among children <5. **Excluded: dairy beverages*	III	A
(Luger et al., 2017)	SR, limited to 20 PCS and RCTs published between 2013 and 2015	WC, BMI, body composition	mean age 9 y, study duration 0.5–13 years,	SSBs *	The association between SSB consumption and body weight measures was positive in 96% of prospective cohort studies in children and adults including 242,352 participants. The remaining 4% (one study in children) showed no association, and no study showed an inverse or negative association. *Comment: The authors conclude: "By combining the already published evidence with the new one, we conclude that public health policies should aim to reduce the consumption of SSBs and encourage healthy alternatives such as water."* **SSBs: including sodas/soft drinks, fruit juice drinks, syrup-based drinks, flavored water with sugar, and sports drinks*	(II)-III	A
(Bucher Della Torre et al., 2016)	SR of 29 PCS and 3 RCT (all in HIC)	obesity	whole range 1-18	SSBs as heterogeneous group*	The present review shows that most studies rated with strong methodology indicated a positive association between SSB consumption and risk of obesity or obesity, especially among overweight children. In addition, study findings highlight the need for the careful and precise measurement of the consumption of SSBs and of important confounders. *The authors conclude: *"In the absence of a consensus for a definition of SSBs, some studies with neutral quality rating limited their analysis to sugar-sweetened carbonated beverages, most included all beverages with added sugar, while others have included beverages with added as well as natural sugar (i.e., fruit juice). In two studies, SSBs were not differentiated from artificially sweetened beverages during the measures or analysis; therefore, the specific effect of SSBs could not be isolated."*	III	A
(Trumbo & Rivers, 2014)	SR of 8 studies (PCS or CSS)	BMI, adjusted for energy intake			Results of observational studies that examined the relationship between sugar-sweetened beverage intake and obesity risk that were adjusted for energy intake and physical activity were inconsistent for each of the three age groups evaluated (children, adolescents, and adults). From this review, evidence for an association between sugar-sweetened beverage intake and obesity risk is inconsistent when adjustment for energy balance is made.	II	A-B
(Morgan, 2013)	NR of 6 SRs and MAs, these	obesity	School-aged (6-12)	HFCS-sweeten	There is inconclusive scientific evidence to definitively link HFCS beverage consumption in school-aged children to obesity. Consumption of HFCS beverages in children may displace	II	B

	studies include PCS and CSS			ed SSBs	consumption of milk. Many entities contribute to childhood, yet limitation of sweetened beverages may decrease obesity in children		
(Malik et al., 2013)	SR & MA, 20 studies (PCS or clinical trials) USA, Europe, Canada	BMI, overweight, obesity), related cardiometabolic outcomes	Base-line ages 2 to 16 y	12-oz–serving (= 350 ml) /d increment of SSB	Our analysis of 1-y change in BMI included 7 studies with 11 comparisons in 15,736 children and adolescents. The summary estimate indicated that BMI increased by 0.06 (95% CI: 0.02, 0.10; random-effects model) for each additional daily 12-oz serving of SSBs over a 1-y period. However: A total of 5 studies including 2772 children and adolescents were included in our analysis of SSB trials and body weight. Based on these data, we found a nonsignificant difference in change in BMI from reducing SSB consumption [weighted mean difference (WMD): 20.17; 95% CI: 20.39, 0.05; I2 = 74.6%; P heterogeneity = 0.003] in the random-effects model. Results from the fixed-effects model were significant (20.12; 95% CI: 20.22, 20.02).	III	A
SSB and other outcomes							
(Giovannucci et al., 2024b)	SR (5 PCS)	T2DM	2-18	SSB	This systematic review aimed to assess the association between SSB consumption and type 2 diabetes risk. The included prospective studies in children and adolescents evaluated intermediate metabolic markers (fasting glucose and insulin) rather than the primary outcome of type 2 diabetes. No significant associations were observed. Due to the lack of direct evidence on the primary outcome and concerns regarding potential confounding, no conclusion statement could be made.	II	A
(Markey et al., 2023)	SR (4 PCS)	Cardiometabolic risk factors	< 10.9 y	SSB	Methodological heterogeneity was too high across studies to meta-analyze effect estimates, no associations were evident between SSB consumption and blood lipids, glycemic control, or blood pressure,	II	A
(Farhangi et al., 2020)	MA of 14 studies published 2009-2020, of which 8 CSS	Hyper-tension, blood pressure	6-22, most starting 11-12	SSB, intake: 0 to median 750 g / day	High SSB* consumption was associated with 1.67 mmHg increase in systolic blood pressure (SBP) in children and adolescents (WMD: 1.67; CI 1.021–2.321; P < 0.001). The difference in DBP was not significant (WMD: 0.313; CI −0.131–0.757; P = 0.108). High SSB consumers were 1.36 times more likely to develop hypertension compared with low SSB consumers (OR: 1.365; CI 1.145–1.626; P = 0.001). In dose–response meta-analysis, no departure from linearity was observed between SSB intake and change in SBP (P-nonlinearity = 0.707) or DBP (P-nonlinearity = 0.180). **SSBs = sodas/soft drinks, carbonated beverages, non-100% fruit juice drinks, syrup-based drinks, flavored water with sugar, sports and energy drinks, chocolate milk, yogurt drinks, lemonades, Coca-Cola, Sprite, orange juice, Nutrition Express, and Red Bull and sweetened teas*	III	B
(Hoare et al., 2017)	SR, 12 with children and adolescents (6 PCS, 6 CSS	At least one clinical cardiovascular or metabolic risk factor	4-18	Various types, including ASB	Of the studies examining children and adolescents, 10 studies were found finding significant positive associations between SSB consumption and weight-related measures, including overweight/obesity defined by internationally recognized criteria (e.g., WHO, International Obesity Taskforce, higher BMI/BMI z-scores, greater WC, and %BF. Adolescent females who moved into the top tertile of SSB consumption (>1.3 servings/day) between 14 to 17 years were at greater overall cardiometabolic risk (OR: 3.2, 95% CI: 1.6–6.2, p < 0.001), but overall, there is still insufficient data to assess relationships with cardiometabolic outcomes.	III	B
Fruit juices							
(Nguyen et al., 2024)	SR and MA (based on	Changes in BMI	median age, 8	100% fruit juices*	This systematic review and meta-analysis of 17 eligible studies (n = 45 851) found a positive association between intake of 100% fruit juice and weight gain in children. Among cohort studies in	III	A

	17 PCS or RCTs)		[1-15] years		children, each additional serving per day of 100% fruit juice was associated with a 0.03 (95% CI, 0.01-0.05) higher BMI change. The systematic review and meta-analysis of prospective cohort studies in children demonstrated a positive association between 100% fruit juice consumption and change in BMI (0.03; 95% CI, 0.01-0.05), with younger children showing higher BMI for each additional serving per day than older children (0.15; 95% CI, 0.05-0.24 and −0.001; 95% CI, −0.01 to 0.01, respectively). The authors conclude to agree with (Auerbach et al., 2017) **1 serving = 8 oz (237 ml)*		
(Rousham et al., 2022)	SR /MA, based on 17 RCTs or PCS		< 10.9 years starting exposure	250 ml*	The body of evidence for all age groups ≤10.9 y indicates that 100% fruit juice consumption makes little or no difference to increased BMI, percentage body fat, or the risk of overweight/obesity (low certainty). ** as standardized serving for the MA*	II	A
(Mayer-Davis et al., 2020)	SR, 23 studies (PCS and RCTs)	Body composition, overweight, obesity		100% fruit juices	Limited evidence suggests 100% juice intake in children is not associated with adiposity or height in children. The few studies that were significant were not consistent in direction. The evidence in children was limited by lack of clarity in defining the juice exposure; inconsistent quantification of juice consumption, inconsistent measures of adiposity, lack of evidence from stronger study designs, and inadequate adjustment for confounders	II	A
(Frantsve-Hawley et al., 2017)	SR, 15 studies, PCS	Weight gain	<12 years	Fruit juices	Our results [for the association between] for 100 percent fruit juice [and total adiposity or central adiposity] only suggest differences by age; most studies showed negative association in the age group < 12 years old but positive association <5 years old	II	A
(Auerbach et al., 2017)	MA, 8 PCS, mainly USA and Germany	Change in BMI BMI z; PI)	1-18 years, healthy	100% fruit juices	Controlling for total energy intake, 1 daily 6- to 8-oz serving increment of 100% fruit juice was associated with a 0.003 (95% CI: 0.001 to 0.004) unit increase in BMI z score over 1 year in children of all ages (0% increase in BMI percentile). In children ages 1 to 6 years, 1 serving increment was associated with a 0.087 (95% confidence interval: 0.008 to 0.167) unit increase in BMI z score (4% increase in BMI percentile). This increase is not clinically significant. 100% fruit juice consumption was not associated with BMI z score increase in children ages 7 to 18 years.	II-III	A
(Crowe-White et al., 2016)	Evidence-based review, using 12 CSS, 8 PCS	Weight status/ adiposity, PI, BMI	1-18 years	100% fruit juices, also from concentrates	Statistically significant differences between higher and lower fruit juice consumers in terms of weight status were reported only in studies that did not adjust for total energy intake. None of the 11 comparisons that adjusted for total energy intake reported a statistically significant difference between higher and lower fruit juice consumers in terms of weight status. This indicates that consumption of 100% fruit juice has no independent effect on weight status apart from energy intake. In summary, consumption of 100% fruit juice within the context of an overall healthy dietary pattern may play a role in preventing nutrient deficiency without contributing to excess weight gain. Nevertheless, 100% fruit juice should not replace all whole fruit in the diet and these findings do not negate the effects of whole fruit consumption in promoting the same outcomes.	II	B

ASB artificially sweetened beverages , BIA Bioelectrical Impedance Analysis, BMI: body mass index , CI confidence interval, CI Confidence interval, CSS: Cross-sectional Study; DBP diastolic blood pressure, DXA Dual-energy X-ray Absorptiometry HFCS high fructose corn syrup; MA Meta-analysis; HIC High income country, OR Odds ratio, PI: ponderal index, PCS: Prospective Cohort Study; RCT: Randomized-controlled trial, SCB sugar-containing beverage, SPB systolic blood pressure, SR: Systematic Review, SSB Sugar-sweetened beverage, T2DM type 2 diabetes mellitus, UPF ultra-processed food, USA United States of America, WC waist circumference, WHR weight to hight ratio, WHO World Health Organisation, WMD weighted mean average

3.1.3 Caffeine-containing beverages

Authors: Sibylle Juvalta Reviewer: Beatrice Baumer

Introduction

Various beverage types can contain caffeine or related substances (methylxanthines), from coffee, to coffee-milk combinations, *Camellia sinensis* and maté (*Ilex paraguariensis*) based teas, and caffeine or guarana-containing energy drinks, to cocoa-based products (in form of theobromine and theophylline). The consumption of these types of beverages increases during adolescence, with data showing that in Switzerland 6 to 16 year-old adolescents have a daily intake of 39 mg caffeine, mainly via cocoa milk (29%), chocolate (25%), soft drinks (11%), mocha yoghurt (10%) and energy drinks (8%) (Rios-Leyvraz et al., 2020).

The effect of caffeine depends on the rate of metabolism in the liver, where enzymes break down caffeine stepwise to paraxanthine (and other substances) and then to methyluric acids, which are excreted by the kidneys. This process is not immediate, the metabolic rate is defined in half-time rates, which vary between individuals, and between age groups, for examples for adults (2.5-4.5 hours or longer), for newborns approx. 80 hours (Van Dam et al., 2020). Concerns have been expressed about developing a caffeine-dependence in adolescent years, as well as a caffeine-induced disruption of sleep patterns (Bartel et al., 2015; Temple, 2019) and physical complaints like headaches, stomach-aches and low appetite (Kristjansson et al., 2014). The effects of caffeine on children and adolescents' health outcomes are insufficiently determined, therefore it is not possible to derive a safe level of total caffeine intake, however a single intake of 3mg/kg body weight (bw) per day is believed to be safe (EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA), 2015), although some reviewers (Wikoff et al., 2017) refer to recommendations limiting caffeine intake to ≤ 2.5 mg/kg bw/day for children and adolescents, based on a toxicological evaluation (Nawrot et al., 2003). Less is known about the potential toxicity of cocoa methylxanthines (theobromine, theophylline). An EFSA evaluation showed that children and adolescents are indeed the age groups with the highest theobromine intake from dietary sources (with mean values of 0.5 to 1.5 mg/kg bw, the 95^{th} percentile however from 2 to 6.5 mg/kg bw/day). Theobromine is less pharmacologically active than caffeine, and no safety concern is anticipated for intakes below conservative values of 0.3 mg/kg bw/day as a flavouring (Silano et al., 2017).

Search strategy

A systematic search as defined in the general methods was carried out in the two databases PubMed and Cochrane. The Cochrane database was searched for the terms "caffeine", "tea", "coffee", "maté" and "guarana". For the NCD outcomes, the combined terms of the search string described in the methods chapter, was used in combination with the search string for the caffeinated beverages as shown in appendix A. 19 papers were retrieved, further exclusion criteria were pregnancy and sleep patterns; and after hand screening 3 papers were retained and are summarized in Table 6.

Main findings

With respect to effects of caffeine on blood pressure, evidence from 4 of 5 randomized controlled trials suggests a significantly increased blood pressure after administrating 1-5 mg/kg caffeine to children and adolescents (Wikoff et al., 2017). However, the clinical significance of this finding is unclear, because most trials captured only a few events of caffeine exposure and it is unclear if a transient higher blood pressure following caffeine exposure is harmful, both for a short-term and a long-term perspective. Also, certain subgroups seem to be more sensitive to increases in blood pressure following caffeine consumption. For example, Savoca et al. (2005) reported higher blood pressure levels in African American adolescents compared to White adolescents. Considering adverse events of high-blood pressure, some reviews confirm that up to 2.5 mg caffeine /kg body weight can be consumed safely by healthy children (Doepker et al., 2018; Wikoff et al., 2017), as was also reported in an earlier review (Nawrot et al., 2003). In 5 of 6 controlled trials, 1-6 mg/kg caffeine was found to significantly lower the heart rate of children and adolescents (Wikoff et al., 2017). Burrows et al. (2013) conducted a systematic review about the health effects of energy drinks but did not find any studies with children and adolescents who are the main consumers of energy drinks. In our search, we identified reviews of clinical cases of adverse events after consumption of energy drinks (Costantino et al., 2023). As the authors suggest, it is not certain that the adverse events were caused alone by the energy drinks. Most reported adverse events were cardiovascular, e.g. arrhythmias, chest pain or palpitations, or lower heart rate (bradycardia) and neurological problems (e.g. agitation or dizziness). As reported by Ali et al. (2015) and Burrow et al. (2013), interactions between caffeine and other ingredients of energy drinks such as taurine could lead to detrimental outcomes, for example, taurine and caffeine increase the strength of heart contraction (Dobrek, 2025). We did not consider the indirect effects of caffeine on weight due to an altered sleep cycle (Torres-Ugalde et al., 2020).

Conclusion

Caffeine consumption in children and adolescents is associated with a transient increase in blood pressure and a decrease in heart rate, as shown in randomized controlled trials. Prospective studies are needed to determine the long-term effects on cardiovascular health. Doepker et al (2018) suggest to focus research on children and adolescents with significant caffeine intake (> 2 mg/kg bw) and participants who are sensitive to caffeine-mediated blood pressure increases. No studies were identified for the effects of caffeine on diabetes or overweight. Additional research is required to better understand how caffeine's effects differ from those of other methylxanthines in children and adolescents, especially the naturally occurring compounds theobromine and theophylline.

Table 6 *Classes of recommendations and evidence levels for caffeine-containing beverages and outcomes*

Ref.	Study Type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Wikoff et al., 2017)	SR, based on 5 RCTs	CVD (Blood pressure)	3-12, and 12-19	Caffeine-containing sources*	The objective of this systematic review was to assess whether newer research supports the 2003 conclusion (Nawrot et al., 2003) that caffeine intake up to 2.5 mg/kg per day in children and adolescents is not linked to adverse effects. Overall, the studies consistently showed that caffeine can cause small increases in blood pressure across all populations, but the biological or health significance of these minor changes remains uncertain. * *i.e. beverages, supplements, sport bars*	II	A
Wikoff et al. 2017	SR of 6 RCTs	CVD (heart rate)	3-12, and 12-19	Caffeine containing sources*	A significant decrease in heart rate (~4-6 bpm change) was observed in 5 from 6 trials with 1-6 mg caffeine /kg body weight	II	A
Ali et al. (2015)	SR of cases of adverse events	CVD (arrhythmias)	13-54	Energy drinks	Adverse events after energy drink consumption. 35% of cardiovascular adverse events were related to arrhythmias.	III	C

bpm beats per minute, CVD cardiovascular diseases, RCT: Randomized-controlled trial SR: Systematic Review

3.1.4 Artificially sweetened beverages

Author: Beatrice Baumer

Concerns regarding the adverse health effects of sugar-sweetened beverages (SSBs), including their contribution to excessive caloric intake and weight gain have led to growing public and scientific interest in non-nutritive sweeteners (NNS) as potential alternatives. These compounds provide sweetness with little to no caloric value, thereby offering a strategy to reduce overall sugar consumption without compromising palatability. In the United States, both the prevalence and total intake of NNS have increased substantially, nearly tripling over the past decade among children aged 2–19 years (Karalexi et al., 2018). Artificially sweetened beverages (ASBs), a major source of NNS exposure, are formulated using a range of approved sweetening agents, including acesulfame potassium (acesulfame-K), aspartame, neotame, saccharin, sucralose, and stevia-derived glycosides (Brown et al., 2010). The increasing consumption of these products has raised questions regarding their long-term health implications, particularly in pediatric populations, warranting careful evaluation of their potential benefits and risks relative to traditional SSBs.

Search strategy

A systematic search as defined in the general methods was performed in the final phase of the revision of this report, with the PubMed database only. For the NCD outcomes, the combined terms of the search string described in the methods (chapter 2), was used in combination with the search string for ASBs, as shown in appendix A. 175 papers were retrieved in this phase, however, after screening for exclusion criteria (other outcomes, focus on adults, pregnancy, focus on SSB, taxes, ASB as an example of UPFs) and after hand-screening, only 7 papers investigating the association with body weight and composition were retained and are summarized in Table 7. No papers were found investigating ASB and T2DM, for lack of primary studies. Giovannucci et al found only one primary study when researching this topic, this paper was therefore not included in the overview (Giovannucci et al., 2024a).

Main findings

Most reviews suggest that the primary source of non-nutritive sweetener (NNS) intake is through beverages, although several do not clearly distinguish among different dietary sources. Most studies included in the retained papers examine the association between NNS or artificially sweetened beverage (ASB) consumption and measures of body weight or body composition. Only one study reported a potential increase in BMI associated with NNS intake (Karalexi et al., 2018), whereas the remaining studies demonstrated mixed or inconclusive associations. Some evidence indicates minor potential benefits of substituting ASBs for SSBs, particularly among individuals with high SSB consumption (Espinosa et al., 2024); however, the current data are insufficient to justify recommending ASBs as a health-promoting alternative to SSBs. Furthermore, no data was found on different types of NNS.

Conclusion

Overall, the existing evidence does not support a consistent association between NNS and improved measures of body weight or body composition. Although limited data suggest that substituting ABS for SSB may confer small benefits in individuals with high SSB consumption, the findings remain mixed, largely inconclusive, and insufficient to guide public health recommendations. The absence of data comparing different types of non-nutritive sweeteners further restricts interpretation. These observations align with current WHO recommendations, which advise against the use of non-sugar sweeteners for weight control or the reduction of noncommunicable disease risk (for the general population) (World Health Organization, 2023).

Table 7: *Classes of recommendations and evidence levels for artificially sweetened beverages and outcomes*

Ref.	Study Type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(H. A. Raynor et al., 2024)	SR based on 2 PCS	BMI	2-19y	ASB	Low- and no-calorie sweetened beverage consumption by children and adolescents may not be associated with growth, body composition, and risk of obesity. This conclusion statement is based on evidence graded as limited.	II	A
(Espinosa et al., 2024)	SR based on 5 RCTs, 8 PCS	BMI	2-9, 10-19	NNS vs sugar	Results with RCT: less BMI gain among those allocated to replace SSBs with NNS beverages [MD = -0.114 kg/m^2 (95% CI]-0.207, -0.021), compared with participants with sustained SSB intake. On the other hand, pooled results from 8 PCS indicate that each serving (12-fl oz or 355 mL) of NNS beverages was not associated with long-term BMI changes. However, in certain scenarios, there was a noticeable trend suggesting a potential positive association between NNS beverage intake and BMI gain.	I-II	A
(Rousham et al., 2022)	SR eased on 7 studies (RCTs, PCSs)	BMI	<10.9 y	ASB	The body of evidence for all age groups ≤10.9 y indicates that ASB consumption makes little or no difference to increased BMI, percentage body fat, or the risk of overweight/obesity (low certainty)	II	A
(Mayer-Davis et al., 2020)	SR based on 17 PCS	Growth, body composition, BMI		Low and no-calorie sweetened beverages LNCSB)	Most studies (~75%) reported no association for the main outcome measure(s) of adiposity among the study populations. The remaining studies had mixed associations and methodologic concerns	II	A
(Karalexi et al., 2018)	SR based on 13 studies (9 for BMI, 3 for fat mass)	BMI, fat mass	2-19	NNS	Systematic assessment of observational studies showed no association of NNS intake during childhood with fat mass accumulation and waist circumference and a small, but statistically significant association with BMI increase (OR 1.15, 95% CI 1.06-1.25).	III	A
(Reid et al., 2016) (only abstract)	6 cohort studies and 2 RCT	BMI; growth velocity, adverse metabolic effects	<12 y	NNS	Half of the cohorts reported increasing weight gain or fat mass accumulation with increasing NNS intake, and pooled data from 2 cohorts showed a significant correlation with BMI gain (weighted mean correlation 0.023, 95% confidence interval 0.006 to 0.041). RCTs reported contradictory effects on weight change in children receiving NNSs.	II-III	B
(Brown et al., 2010)	SR based on 18 studies (RCT, PCS, CSS)	Weight gain and BMI	0-18	Artificial sweeteners	Epidemiologic studies suggest an association between ABS consumption and weight gain in children. However, RCTs are limited and inconclusive, showing no clear metabolic benefits or harms. While causality has not been established, the potential contribution of artificial sweeteners to the global rise in pediatric obesity and diabetes merits further investigation	II	B

ASB artificially sweetened beverages, BMI body mass index, CI confidence interval, CSS cross-sectional studies, LNCSB Low and no-calorie sweetened beverages, MD mean difference, NNS Non-nutritive sweeteners, OR odds ratio, PCS prospective cohort studies, RCT randomized control studies

3.2 Fruit and vegetables

Authors: Christine Brombach / Linda Beck   Reviewers: Janice Sych / Beatrice Baumer

Introduction

This chapter includes, whenever possible raw and minimally processed fruit and vegetables, e.g. as purées but without added sugar. Vegetables are considered the edible components of plants, including roots, tubers, bulbs, stems, stalks, leaves, flowers and fruiting vegetables (such as tomatoes, cucumbers, aubergines etc. as per Swiss food legislation (VLpH, o. J.). Fruits from a nutritional perspective are sugar-containing botanical fruits. Definitions vary however, e.g. in the Swiss Food Pyramid, starchy tubers (potatoes) are not considered vegetables, but a starch source (BLV, 2024).

Fruits and vegetables are essential components of a healthy diet due to their low energy density and high nutrient density. Their low energy density results primarily from their high water content. Evidence from the Dortmund Nutritional and Anthropometric Longitudinally Designed Study (DONALD) indicates that regular consumption of fruits and vegetables improves the hydration status in children aged 4–10 years (Montenegro-Bethancourt et al., 2013). Fruit and vegetables are furthermore sources of dietary fibre and phytochemicals (McCarthy et al., 2020). Fruits and vegetables are sources of vitamins, depending on their botanical characteristics, in particular vitamin C and folate, provitamin A and E (Slavin & Lloyd, 2012). They also serve as important sources of minerals, such as potassium, calcium, zinc and magnesium.

In Switzerland, children are advised to consume five portions of fruits and vegetables in a variety of colours each day, with three portions coming from vegetables and two from fruits (SGE, 2024a). This is equivalent to the recommendation for adults (BLV, 2024), although portion sizes vary according to age.

Search strategy

A systematic search as defined in the general methods was carried out in the two databases PubMed and Cochrane. For the NCD outcomes, the combined terms of the search string described in the methods chapter was used in combination with the search string for the fruit and vegetables as shown in appendix A. In PubMed 170 articles were retrieved. After the screening process, 12 papers were retained. In the Cochrane database 32 Cochrane reviews were identified, however, none of them could be included. Most frequent reasons for exclusion were a focus on pregnancy or a lack of investigation of the association between fruit and vegetable consumption and NCDs, or with a majority (>50%) of the primary studies included being from non-HIC countries.

Main findings

Twelve systematic reviews and meta-analyses were included to analyze the association between fruit and vegetable consumption and non-communicable diseases, such as obesity, T2DM and CVDs and their metabolic markers (see Table 8). Most papers examined the correlation with overweight and dietary patterns with high or low fruit and vegetable intake. Data on the actual fruit and vegetable intake were not provided, and no review addressed the topic of the cooking or processing degree. Furthermore, it is not always clear whether tubers (i.e. potatoes) are considered vegetables or starchy food.
The association of fruit and vegetable consumption and overweight and obesity was studied in seven publications. Five articles did not find a significant effect or reported inconsistent results (Boushey et al., 2020a; Ledoux et al., 2011; Poorolajal et al., 2020a, Collese et al., 2017), (Liu et al., 2024). The remaining two articles, however, described an inverse association between fruit and vegetable intake and overweight and obesity, (Alosaimi et al., 2023), (Wang et al., 2024).
Regarding cardiovascular health, three studies found an inverse association between the intake of fruits and vegetables and cardiovascular markers, considering blood pressure and / or blood lipid profile (Alosaimi et al., 2023; Anderson et al., 2024; Collese et al., 2017). On the other hand, one study reported limited or inconsistent results about the correlation between fruit and vegetable consumption and cardiometabolic factors (2020 Dietary Guidelines Advisory Committee, 2020).
Boushey et al. examined T2DM outcomes in children; however, the limited number of eligible studies precluded the authors from drawing any definitive conclusions (Boushey et al., 2020b). (Talegawkar et al., 2024a) observed a possible inverse association between dietary patterns rich in fruits and vegetables and diabetes-related biomarkers. However, these authors refrained from making formal conclusions about the evidence, as these associations did not directly establish a link with a decreased risk for diabetes incidence.

Lastly, two articles studied the association of fruit and vegetable intake and metabolic syndrome. Both studies reported an inverse association between higher consumption and the risk of metabolic syndrome (Collese et al., 2017; Tian et al., 2018).

Conclusion

Most of the included studies suggest a potential preventive effect of dietary patterns rich in fruits and vegetables on non-communicable diseases (NCDs). The evidence appears to be somewhat stronger for the adverse effects of dietary patterns low in fruit and vegetable intake than for the protective effects of higher consumption. Findings related to overweight and obesity generally indicate an inverse association, although the evidence remains modest. Similar trends have been observed for cardiovascular health and metabolic syndrome. In contrast, data on T2DM are limited and inconclusive, with only one study suggesting a possible inverse association.
Overall, these findings highlight the potential role of fruit and vegetable intake in preventing the selected NCDs and underscore the importance of avoiding diets low in these foods. Nevertheless, further well-designed studies are needed to strengthen the evidence base, particularly in relation to T2DM.
In conclusion, while dietary patterns rich in fruits and vegetables appear to play a role in preventing certain NCDs, evidence on the most effective strategies to increase vegetable consumption remains limited. Current research indicates that child-feeding practice and multicomponent interventions probably lead to only small improvements in fruit and vegetable intake among children under five years, while parent nutrition education alone may have little or no effect (Hodder et al., 2024).

Table 8 *Classes of recommendations and evidence levels for fruit and vegetables and outcomes*

Ref.	**Study Type**	**Outcome**	**Age group**	**Food type**	**Summary / Results / Conclusions by the authors / Comments**	**Class**	**Level**
Dietary patterns high in vegetables and / or fruit							
(Anderson et al., 2024)	SR of RCT and PCS	CVD (Hypertension, Dyslipidemia)	2-18 years	Fruit and Vegetables	Moderate level of evidence indicating dietary patterns <u>higher in vegetables and fruits</u> are associated with lower blood pressure (lower systolic and diastolic blood pressure) and blood and triglycerides, for children and adolescents, later in life. These conclusions are based on 19 articles examining children and adolescents (1RCT and 18 cohorts). Studies showed similar direction of the results, but differences in effect size; some study groups were small, and some studies had good design and study conduct. *Comment: The class of evidence selected for this review: II, because the exposure was diet-related, not specific for fruit and vegetables*	II	A
(Wang et al., 2024)	MA of RCTs	Overweight and Obesity	3-18 years	Fruit	Association of <u>increased fruit intake</u> and lower prevalence of obesity compared to control group (OR: 0.74 [0.60; 0.90], $p < 0.05$).	I	A
(Liu et al., 2024)	MA, mainly CSS (82%)	Overweight and Obesity	2-18 years	Fruit and Vegetables	In the meta-analysis by gross national income per capita, the pooled results showed that <u>consuming more fruit and/or vegetable was a protective factor</u> for childhood overweight and obesity in LMIC (OR = 0.77; 95% CI = 0.69–0.85), <u>but not in HIC</u> (OR = 0.83; 95% CI = 0.68–1.02)	II	BC
(Talegawkar et al., 2024b)	SR of RCT and PCS	Type 2 Diabetes	Under 18 years	Fruit and Vegetables	The selected 15 articles (1 RCT; 14 cohort studies) reported a possible association of <u>dietary patterns higher in vegetables and fruits</u> with lower insulin, blood glucose and HOMA-IR. However, the authors then make a summary statement that no conclusion can be drawn because of substantial concerns with directness (incident type 2 diabetes).	(I)-II	A
(2020 Dietary Guidelines Advisory Committee, 2020)	SR of 4 PCS	CVD	Under 18 years	Fruit and Vegetables	Limited evidence indicating <u>dietary patterns higher in fruits and vegetables</u> to be associated with lower blood pressure and improved blood lipid levels (including low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, and triglycerides) later in life.	II	A
(Poorolajal et al., 2020)	SR and MA of CSS, (50% in HIC)	Overweight and Obesity	5-19 years	Fruit and Vegetables	Compared with insufficient quantities, no significant effect was observed for <u>sufficient fruit and vegetable consumption</u> (≥4 serving per day or ≥5 times per week) on risk of overweight and obesity (OR: 0.92 [0.84; 1.01].	II	B
(Boushey et al., 2020b)	SR (found 1 PCS only)	Type 2 Diabetes	Under 18 years	Fruit and Vegetables	Insufficient evidence to establish a relationship between <u>dietary patterns including fruits and vegetables</u> and the risk of type 2 diabetes, i.e. one article examined dietary patterns of adolescents. *Comment: dietary patterns assessed by the "alternative healthy eating score"*	II	C
(Tian et al., 2018)	MA of 3 PCS, and 2 CSS	Metabolic Syndrome	6-19 years	Fruits and Vegetables	Inverse association of higher consumption of fruits (OR: 0.87 [0.81; 0.94]) and vegetables (OR: 0.80 [0.72; 0.89]), based on two studies, and risk of metabolic syndrome for adolescents.	I	B-C

(Collese et al., 2017)	SR of 10 CSS, 1 PCS	Metabolic syndrome, CVD, Obesity	10-19 years	Fruit and Vegetables	The associations between fruit and vegetable consumption and indicators of cardiovascular risk in adolescents are inconsistent, likely because of heterogeneity in the methods used to assess and classify consumption and to define cardiovascular risk in adolescents	II	B
(Ledoux et al., 2011)	SR of 1 ES and 4 PCS	Overweight and Obesity	1-14 years	Fruit and Vegetables	Experimental studies: No association between fruit and vegetable consumption and adiposity among children. Longitudinal studies: Inconsistent results regarding the association between fruit and vegetable consumption and adiposity among children One study found inverse association between fruit and vegetable intake and adiposity, One study found an inverse association but only in boys (only when not controlled for energy intake) One study found no association between fruit and vegetable intake and adiposity, while another study did find a positive association between fruit and vegetable intake and adiposity	II	A
Dietary patterns low in fruit and vegetables							
(Alosaimi et al., 2023)	SR of CSS (n=49) and PCS (n=4)	Overweight / Obesity, CVD	5-24 years	Fruits and Vegetables	Unhealthy clusters compromising <u>low consumption of fruits and vegetables</u> had higher adiposity and higher risk of cardiovascular disease. Comment: this review focussed on unhealthy eating habits, combined with other factors (sociodemographic, mental health)	I	B
(Boushey et al., 2020a)	SR of 12 PCS	Overweight and Obesity	Mean age between 2 and 15 y	Fruit and Vegetables	Limited evidence indicating <u>dietary patterns lower in fruits and vegetables</u> to be associated with <u>higher BMI</u> and fat-mass index in adolescence.	I-II	A

CVD Cardiovascular diseases, BMI Body mass index, CSS: Cross-sectional Study; ES experimental study, HIC High-income countries, HOMA-IR Homeostasis Model Assessment of Insulin Resistance SR: Systematic Review; LMIC low- to middle income countries, MA: Meta-analysis; OR Odds ratio, PCS: Prospective Cohort Study; PS: Prospective Study; RCT: Randomized-controlled trial

3.3 Starch-based products

3.3.1 Grains / whole-grain based products / dietary fibre

Authors: Christine Brombach / Linda Beck Reviewer: Beatrice Baumer

Introduction

Whole grains and foods made with whole grains, such as whole-grain bread, porridge, and ready-to-eat cereals, are widely recognized for their health benefits. Epidemiological studies in adults indicate an inverse linear relationship between whole grain consumption and the risk of several non-communicable diseases, including CVDs, T2DM, obesity, and certain cancers. Observational research has shown that consuming 2–3 servings of whole grains per day (the upper limit in most studies) is associated with approximately 21% lower risk of CVD and 26% lower risk of T2DM compared to rare or non-consumers. However, intervention studies have not demonstrated a similar reduction in CVD markers over a 4-month period. The health-protective effects of whole grains are partly attributed to insoluble fibre and bioactive compounds found in the bran and germ, such as antioxidant micronutrients, carotenoids, minerals, polyphenols, and vitamins. (Mann et al., 2015)

Although global dietary recommendations encourage greater whole grain consumption, country-specific guidelines vary widely, and there is currently no quantitative recommendation for children and adolescents in Switzerland.

Search strategy

A systematic search as defined in the general methods was carried out in the two databases PubMed and Cochrane. For the NCD outcomes, the combined terms of the search string described in the methods chapter was used in combination with the search string for whole grain and wheat products, as in appendix A. In PubMed 9 articles were retrieved, in Cochrane no results were found. After the screening process, 2 articles were retained (Table 9).

Main findings

Jakobsen et al. investigated the association of various food items and overweight and obesity in children (Jakobsen et al., 2023a). The authors found that an increased intake in refined grains was associated with an increased risk of overweight and obesity in children and adolescents. Whereas an increased intake of whole grains was associated with a decreased risk.
An additional hand search was conducted which looked more generally for dietary fibres, whole grains and whole foods in studies conducted with children and adolescence which did not fall into the strict category of our search strings. A study on the diet quality of Canadians found that adults with balanced consumption of whole and non-whole grains had a significantly lower proportion of obesity and overweight. Logistic regression analysis further confirmed that adults with balanced grain intake had a reduced likelihood of being obese or overweight. In contrast, no significant differences in obesity and overweight prevalence were observed among children and adolescents based on whole grain consumption patterns (Hosseini et al., 2019).

Conclusion

The evidence from one study suggests that grain refinement level may influence the effects of grains on overweight and obesity, with whole grains showing a negative association and refined grains a positive association (Jakobsen et al., 2023a). The effects of dietary fibre on cardiometabolic health, on the other hand, remains unclear (Reynolds et al., 2020). Due to this very limited evidence, more age-specific research is needed to assess the effects of whole grain and dietary fibre consumption on NCDs.

***Table 9:** Classes of recommendations and evidence levels for whole meal-based products and outcomes*

Ref.	Study Type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Jakobsen et al., 2023a)	SR and MA of 4 OS (2 CSS, 1 PCS, 1 secondary analysis)	Overweight and Obesity	Mean age 5-8 y	Wholegrain / refined grains	Higher intake of refined grains was associated with a non-significant increased risk of overweight / obesity (OR: 1.28, $p < 0.05$). In contrast, higher intake of whole grain was associated with a decreased risk of overweight and obesity (OR: 0.86, $p = 0.04$).	II	B-C
(Reynolds et al., 2020)	SR of PCS	Overweight and Obesity	1-19.3 years	Dietary fibre	Potential dietary fibre intake begins at 13-16 g a day for 2-year-olds and increases until the age of 10 years, when values are comparable with an adult range of 25-30 g a day. Conclusions: Given the inconsistency in findings from cohort studies other than an absence of detrimental effects, it seems appropriate that recommendations regarding childhood fibre intake are extrapolated from relevant adult data.	II	B

CSS: Cross-sectional Study; OS observational study, PCS: Prospective Cohort Study; PS: Prospective Study; RG: refined grain, SR Systematic Review; WG: Whole grain

3.3.2 Sugar-containing breakfast cereals

Authors: Sibylle Juvalta Reviewers: Denise Abegglen / Beatrice Baumer

Introduction

Ready-to-eat cereals (RTEC) are defined as “cereal food that is processed so that it can be eaten without preparation.” They are typically consumed with the addition of cow’s milk and are considered a convenient breakfast option (Michels et al., 2016). Compared with other foods frequently consumed by European adolescents, RTEC can contribute positively to dietary quality, for example by helping to meet fibre intake recommendations (Michels et al., 2016; Derbyshire & Ruxton, 2025). Breakfast cereals, however, are not a standardized product, and their nutritional composition varies considerably. This variability is reflected, for instance, in the wide range of Nutri-Score ratings observed on the French market (Richonnet et al., 2021). Common characteristics of these products include the use of refined cereals, added sugars, and other ingredients, as well as vitamin and mineral enrichment. RTECs contain varying amounts of sugar, contributing between 8% and 18% of total sugar intake in children according to international studies (Derbyshire & Ruxton, 2025). In Switzerland, the menuCH study found that breakfast cereals account for 2.7% of added sugar intake among adults (Chatelan et al., 2019).

This food group was specifically highlighted in this report because it is frequently marketed to children. Indeed, children and adolescents are higher consumers of RTEC than adults (Derbyshire & Ruxton, 2025).

In 2015, the Swiss Federal Food Safety and Veterinary Office (FSVO) entered a voluntary agreement with the yogurt and breakfast cereal industry to gradually reduce the sugar content of these products. Over the years the median added sugar has decreased from 16.6 to 10.2%. In breakfast cereals specifically targeted at children, the median added sugar was reduced from 22.9% (2021) to 17.0% in 2024 (BLV, 2025b). These data suggest that, owing to their relatively high sugar content, breakfast cereals may be classified within the discretionary (ultra-processed) food group. Consistently, the literature indicates that breakfast cereals are indeed often studied as part of this broader food group rather than being examined as a distinct category (see chapter 3.8.).

Search strategy

A systematic search as defined in the general methods was carried out in the two databases PubMed and Cochrane. For the NCD outcomes, the combined terms of the search string described in the methods chapter was used in combination with the search string for sugar-containing breakfast cereals, as in appendix A. 17 publications were retrieved following the search. After hand screening 3 publications were retained for the overview (in Table 10). The Cochrane library was searched for “cereals”, “ready-to-eat” and “grains”, no further papers were identified.

Main findings

Based on three cross-sectional primary studies, the systematic review of Jakobsen et al reported a nonsignificant lower chance of overweight for children and adolescents with a high intake of cereals (OR= 0.83, CI: 0.49, 1.39). Their definition of cereals included ready to eat cereal, bread and cereal, porridge, and instant noodles. In the studies which examined the effects of RTECs and porridge, it is unclear, if those products were sweetened or not (Jakobsen et al., 2023a).

Sanders et al. (2022) reviewed studies on presweetened RTECs. Among 18 cross-sectional studies, 12 reported lower body weight linked to higher RTEC intake, 6 found no association, and none showed a higher body weight associated with RTEC consumption. Two prospective studies supported this finding: one in boys (Albertson et al., 2009) and another in low-income minority children at risk for type II diabetes (Balvin Frantzen et al., 2013). Neither study assessed the sugar content of the cereals, though total sugar intake increased with higher RTEC consumption.

Priebe and McMonagle (2016) summarized the health benefits connected with high consumption of RTEC. A prospective study found lower total cholesterol level in boys compared to girls and another prospective study showed higher concentration of the "good cholesterol" (high density lipoprotein, HDL) in children consuming RTEC in combination with nutritional education.

In papers not retained for the purposes of this review, some studies reported that children from low-income minorities who frequently consumed RTEC "had greater intakes of essential nutrients at baseline and significantly lower BMI over a 3-year period." (Balvin Frantzen et al., 2013).

Discussion and conclusion

Taken together, these findings indicate that the underlying research question in many RTEC studies may be less about what kind of breakfast children and adolescents consume, and more fundamentally about whether they consume breakfast at all. The most recent findings from the Swiss MenuCH Kids study show that 25.5% of Swiss teenagers (14-17 years) never have breakfast during the week (BLV, 2025a).

A substantial portion of the evidence linking pre-sweetened RTEC to lower BMI or body fat is complicated by several limitations. Many studies and reviews are industry-funded or authored by individuals with industry affiliations (Balvin Frantzen et al., 2013; Michels et al., 2016; Priebe & McMonagle, 2016; Sanders et al., 2022) and even these authors emphasize the need to better account for confounders such as physical activity, socioeconomic status, and regular breakfast consumption.

Additionally, most prospective studies focus on the frequency of RTEC consumption rather than comparing RTEC with other breakfast types. Such comparisons may be more informative: for example, in Swiss adults, unsweetened breakfast cereals, but not RTEC or refined bread—were associated with reduced abdominal obesity (Chatelan et al., 2018).

A further limitation is the lack of detailed reporting on sugar content. While RTEC consumers often have higher total sugar intake, research in youth typically centres on overweight and obesity, leaving major gaps regarding cardiometabolic outcomes such as T2DM. Evidence from adults suggests that whole-grain breakfast cereals may reduce diabetes risk, but these findings cannot be directly generalized to children or to pre-sweetened RTEC products.

In sum, while RTEC consumption may help increase fibre, vitamin and mineral intake and may encourage breakfast consumption among children and adolescents, future research must disentangle the independent effects of breakfast consumption from those of RTEC specifically and determine whether higher sugar intake from RTEC poses adverse health risks.

Table 10 *Classes of recommendations and evidence levels for sugar-containing breakfast cereals and outcome*

Ref.	Study Type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Jakobsen et al., 2023a)	SR based on 2 CSS, 1 PCS, and one secondary analysis	Overweight and Obesity	5-18	Cereals in general*	Cereals: the OR (95% CI) for overweight/obesity when comparing higher intake of cereals versus lower intake of cereals was 0.83 (0.49, 1.39) (p = 0.47) **Cereals were defined as ready to eat cereal, bread and cereal, porridge, and instant noodles* *Comment: the heterogeneity of food group definitions in the original papers could be a factor in the*	II	B-(C)
Sanders et al. 2022	SR, 18 CSS, 2 prospective longitudinal RCT, 5 RCT	Overweight and Obesity	4-18	Ready-to-eat cereals	12 of the 18 CSS suggest that children and adolescents who consume ready-to-eat cereals (RTEC) tend to have lower BMI, reduced risk of overweight/obesity, and healthier abdominal fat indicators compared to non-consumers. Benefits appear consistent for both presweetened and non-presweetened RTEC, and no studies found harmful effects on body weight or composition. Overall, evidence seems to support RTEC as part of a healthy diet in youth, though more trials are needed to confirm causality.	I	B
(Priebe & McMonagle, 2016)	SR, 32 CSS, 8 PCS, 24 RCTs	Intake of nutrients, risk factors for cardiovascular disease and type 2 diabetes, BMI/ body weight, satiety, food intake	1-18	Ready-to-eat cereals	Evidence on ready-to-eat cereal (RTEC) consumption and health outcomes is mixed. In children with elevated LDL cholesterol, higher intake was linked to modest reductions in total and LDL cholesterol in boys but not in girls, where HDL cholesterol decreased slightly. Randomized trials indicated that RTEC, especially when combined with nutritional education, may help increase HDL cholesterol and limit weight or fat gain, but effects on other lipid parameters and body weight were less consistent. A consistent concern across studies is the association between frequent RTEC consumption and higher total sugar intake, partly due to the cereals themselves. Given that free sugar intake already exceeds recommendations in many children, this remains an important limitation. Overall, RTEC consumption shows some potential benefits for lipid profiles and BMI, but these are modest, variable, and counterbalanced by risks related to sugar intake.	II	B

BMI Body mass index, CSS: Cross-sectional Study; HDL high-density lipoprotein, LDL Low-density lipoprotein PCS: Prospective Cohort Study, RCT randomized control trial, RTEC ready to eat cereal, SR: Systematic Review

3.3.3 Other cereals, pseudocereals and starchy tubers

Author: Beatrice Baumer Reviewer: Denise Abegglen

Introduction

A range of starch-based foods was included in this category, encompassing potatoes and other tubers, non-wheat cereals, and pseudocereals, all of which are generally regarded as components of a main dish. The current recommendation for adults is 3 portions of cereal products and potatoes a day, at least half of which should be in the form of non-refined products (BLV, 2024). Foods in this group mainly supply the body energy in the form of starch, depending on the degree of processing they are a source of fibre, and some are considered protein sources, e.g. buckwheat flour (14% of energy derived from protein), quinoa (14.7% of energy derived from protein), calculations based on data provided by the Swiss food composition data base (FSVO, o. J.). Potential benefits for adults, i.e. in the prevention of NCDs, have been object of discussion, e.g. (Nandan et al., 2024).

Search Strategy

A systematic search was carried out as described in the general methods section. For the NCD outcomes, the combined terms of the search string were used, as defined in the general method. The search strings for the This chapter focuses on the food group “other cereals, pseudocereals, and starchy tubers.” Wheat and wheat-based products are excluded, as they are addressed separately (chapter 3.3.1) due to the additional consideration of wholemeal versus refined flour, a specific aspect not discussed with pseudocereals. Products containing added ingredients, such as snack foods and sweetened bakery products, are also excluded and discussed in (discussed in chapters 3.7 and 3.7.2 respectively).
This search retrieved 33 articles; however, after applying the general inclusion and exclusion criteria, none were relevant for the topic.

Main Findings & Conclusion

No specific conclusions or recommendations can be drawn for this food group. Considering the nutritional composition of these food items, they may be regarded as nutrient dense. However, this group might benefit from further differentiation, for instance, distinguishing between starch-based foods (such as potatoes together with cereals and other starchy cereals) and pseudocereals together with legumes, to better reflect their distinct nutritional profiles and potential health effects.

3.4 Protein sources of animal origin

Protein source of animals origin, i.e. meat, fish, eggs and dairy, are the main sources of protein in children in developed countries (Garcia-Iborra et al., 2023), and often the intake is above the recommended levels. Some studies show that this could be associated with a higher risk for elevated BMIs in childhood and adolescence (Stokes et al., 2021) (Arnesen et al., 2022), or for later obesity (Hörnell et al., 2013). Focus of this report is, however, confined to food-group-level associations with NCDs, and it should not be interpreted as a review of nutrient-specific effects, which fall outside the scope of this review.

3.4.1 Meat, Fish and Eggs

Authors: Janice Sych / Linda Beck Reviewers: Denise Abegglen / Beatrice Baumer

Introduction

Meat, fish and eggs are essential components of a balanced diet for children, providing nutrients that support their growth and development (Eaton et al., 2019). These animal-based sources provide energy, are rich in protein of high biological value and contain a variety of micronutrients as zinc, iron (in form of heme iron), choline, vitamin A, vitamin B_{12} and essential fatty acids which are significant for bone and muscle growth, cognitive development and immune function in children (Lutter et al., 2018; Michaelsen & Greer, 2014; Murphy & Allen, 2003). Alongside other animal proteins, eggs are positively viewed for their high quality protein and other growth-promoting nutrients and have potential to improve nutritional status and reduce stunting (Larson et al., 2024; Willett et al., 2019).

Meat is defined as all edible parts of approved animal species, including game, poultry and hoofed animals (VLtH, 2016). Pork, beef, lamb and veal are classified as red meat (Lofgren, 2013), poultry is white meat, whereas “processed meat” is meat which has been processed with the addition of other substances (salt, nitrates, nitrites or smoking, other ingredients) to improve its colour, texture, taste or durability (Rohrmann & Linseisen, 2016).

The category “fish” includes all wild or captive marine or freshwater animals (VLtH, 2016)

For adults, the revised food pyramid continues to present meat, fish and eggs on the fourth level, along with grain legumes (pulses). It is recommended to consume one portion of a protein-rich food per day, with emphasis on alternating between different sources of protein across the week. Additionally, processed meat should not be consumed more than two to three times per week (BLV, 2024).

Search strategy

A systematic search as defined in the general methods was carried out in the two databases PubMed and Cochrane, completed by a brief scan of Google Scholar. For the NCD outcomes, the combined terms of the search string were used in combination with the search string for the food group of meat, fish and eggs as shown in appendix A.

In PubMed 105 articles related to the meat category, 40 for fish and seafood and 16 for eggs were identified. Following the screening process, 3 articles remained for meat, 4 for fish and seafood and none for eggs. In the Cochrane database 2 reviews for meat, 2 for fish and 2 for eggs were initially retrieved, however, all were excluded during the screening process. The most frequent reason for exclusion was that the primary studies focused on pregnancy and not on children, as well as reviews based mainly (> 50%) on data from non-HIC countries, or in the case of fish, focus on supplementation with fish oils. Reviews on vegan, exclusively plant-based, diets were also considered as being out of scope for this topic.

Main findings

Seven reviews and meta-analyses were included to analyse the association of animal-based protein sources and the non-communicable diseases in children. Most studies focus on meat consumption, without providing a good level of precision on various meat forms, and with no relevant reviews for eggs (see Table 11). Most studies furthermore investigated dietary patterns with high or low intake of meat and or fish.

Meat

Studies are conducted worldwide to evaluate the association between dietary patterns characterized by a high intake of red meat, particularly in its processed form of processed red meat, and the risk of obesity. Multiple studies, often conducted in LMIC, show that there is an association with an increased risk of overweight and obesity (Boushey et al., 2020a; Yang et al., 2012) (Jakobsen et al., 2023a). No review was found however focussing on studies performed mainly in HIC countries for the association with overweight / obesity.

There is some evidence that such dietary patterns are linked to hypertension and elevated blood lipid concentrations, both of which are key risk factors for cardiovascular disease (2020 Dietary Guidelines Advisory Committee, 2020); Anderson et al., 2024;). Evidence on the link between meat consumption and T2DM remains insufficient, though processed and red meat may contribute to higher insulin, blood glucose and high levels of “Homeostasis Model Assessment of Insulin Resistance” (HOMA-IR) (Talegawkar et al., 2024).

Fish

Evidence on fish and seafood consumption and NCDs in children is mainly limited, with no conclusive findings (Boushey et al., 2020b; Snetselaar et al., 2020; Torfadottir & Ulven, 2024). However, two studies suggest dietary patterns higher in fish may be linked to lower blood pressures and improved blood lipid profiles (2020 Dietary Guidelines Advisory Committee, 2020; Anderson et al., 2024). Furthermore, one article found a possible association of higher fish and seafood consumption as shown by lower blood glucose, HOMA-IR and insulin levels (Talegawkar et al., 2024).

Eggs

No relevant reviews were found investigating egg intake in HIC.

Conclusion

The available evidence provides weak to moderate support for an association between higher intake of red and processed meat and elevated cardiovascular risk markers in children. Evidence in high-income countries (HICs) is limited compared with adult studies and research from low- and middle-income countries (LMICs), reducing the strength of conclusions. Processed meat appears most likely to confer risk, particularly at high consumption levels; however, inconsistent definitions across studies limit comparability. Further research is needed to clarify the effects of different meat types, including white meat (e.g. poultry) and unprocessed red meat, before specific recommendations can be made. Potential benefits of heme iron from red meat should also be balanced against possible health risks. Evidence on fish and seafood consumption remains sparse, though some studies indicate potential cardiovascular and metabolic benefits. Lastly, evidence on egg consumption is limited. It is important to consider that many processed foods contain eggs as ingredients, making it challenging to quantify the health impact of eggs alone.

Overall, the existing evidence is very weak and generally lacks quantitative data. Information on portion sizes was often not transparently reported, particularly in studies of dietary patterns (Neves et al., 2021; Talegawkar et al., 2024). Additional research is therefore necessary to strengthen understanding of these associations and to inform evidence-based dietary recommendations for children.

***Table 11** Classes of recommendations and evidence levels for meat fish and eggs, and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
Dietary patterns with low meat							
(Anderson et al., 2024)	SR of 1 RCT and 18 PCS	CVD (Hypertension, Dyslipidemia)	2-18 years	Red and processed meats in different dietary patterns	Moderate evidence indicating dietary patterns lower in red and processed meats to be associated with lower blood pressure and improve blood lipid profiles later in life.	I-II	A
(Talegawkar et al., 2024a)	SR of 1 RCT and 14 PCS	T2DM and pre-diabetes markers	Under 18 years	Red and processed meat	Possible association of dietary patterns including lower intake of red and processed meet with lower insulin, blood glucose and HOMA-IR. The authors also stated that a conclusion statement cannot be drawn about the relationship between dietary patterns consumed by children and adolescents and risk of type 2 diabetes because of substantial concerns with directness.	II	A
(2020 Dietary Guidelines Advisory Committee, 2020)	SR of PCS	CVD (Hypertension, Dyslipidemia)	Mean age between 7 and 14 years	Processed meat	Limited evidence indicating dietary patterns lower in processed meat to be associated with lower blood pressure and improved blood lipid profiles later in life.	I-II	IIA
Dietary patterns including fish							
(Anderson et al., 2024)	SR of 19 articles: 18 PCS, 1 RCT	CVD (Hypertension, Dyslipidemia)	2-18 years	Fish and seafood	Moderate evidence indicating dietary patterns higher in fish and / or seafood to be associated with lower blood pressure and improved blood lipid profiles later in life.	I-II	B
(Talegawkar et al., 2024a)	SR of 12 PCS	Type 2 Diabetes	Under 18 years	Fish and seafood	Possible association of dietary patterns including higher intake of fish and seafood with lower insulin, blood glucose and HOMA-IR, but no direct assessment of risk of T2DM	II	A
(Snetselaar et al., 2020)	SR of 2 RCTs and 2 PCS	CVD	Under 18 years	Seafood*	Insufficient evidence of seafood consumption and risk of CVD. **Definition seafood: marine animals that live in the sea and in freshwater lakes and rivers. Seafood includes fish (e.g., salmon, tuna, trout, and tilapia) and shellfish (e.g., shrimp, crab, and oysters).*	II	A
(2020 Dietary Guidelines Advisory Committee, Dietary Patterns Subcommittee, 2020)	SR of 4 PCS	CVD (Hypertension, Dyslipidemia)	Mean age between 7 and 14 years	Fish	Limited evidence indicating dietary patterns higher in fish to be associated with lower blood pressure and improved blood lipid profiles later in life.	II	A

CSS: Cross-sectional Study; CVD cardiovascular diseases, HOMA-IR Homeostasis Model Assessment of Insulin Resistance, MA: Meta-analysis; PCS: Prospective Cohort Study; RCT: Randomized-controlled trial; SR: Systematic Review

3.4.2 Milk, dairy products and cheese

Author: Beatrice Baumer Reviewers: Christine Brombach / Nataliia Yakovenko

Introduction

Dairy foods, often considered staple foods, provide essential nutrients such as protein, including branched-chain amino acids (BCAAs), calcium, phosphorus, riboflavin, iodine, vitamin D, Vitamin A and vitamin B_{12}, depending on processing and feeding of the dairy cows. The current Swiss food pyramid for adults recommends 2-3 portions of dairy products daily. It is recommended to avoid sugar-containing milk products (e.g. beverages) (BLV, 2024). Butter and ghee are considered a fat source and are discussed separately.
International recommendations for dairy intake suggest 2–3 servings for young children and 3–5 servings for adolescents, often emphasizing low-fat options. Despite concerns that full-fat dairy may contribute to weight gain, research has explored its role in weight regulation, with potential benefits attributed to other matrix components such as leucine, which supports lean body mass, and calcium, which may influence fat metabolism (Thorning et al., 2017), (Li et al., 2024). While several mechanisms have been proposed for dairy's potential role in obesity prevention, further research is needed to clarify its effects. A further necessary consideration is that milk, together with hen's eggs is the most common allergen in young children, accounting for approx. 20% of food allergic reactions, resp. on 37% of allergic paediatric patients (Ferrari & Eng, 2011).

Search Strategy

A systematic search was carried out in the two databases PubMed and Cochrane. For the NCD outcomes, the combined terms of the search string were used, as defined in the general methods. For the milk and dairy food group, the syntax was used in PubMed is shown in appendix A, already excluding topics such as human milk, breast milk, breast feeding. This search retrieved 56 articles, which were then screened, based on abstract, and short text checks: main exclusion criteria were unavailable full-text, out of scope age-range (pregnancy, prenatal, first 1000 days, adults), focus on specific nutrients, focus on dietary patterns), socioeconomic factors (taxes, role of industry, studies in developing countries), prevention /interventional studies, medical conditions (kidney disease PCOS, mental diseases, cancer, type 1 diabetes, lactose intolerance) and focus on non-HIC countries (> 50%). This narrowed the search to 12 articles, of which the main findings are summarized in Table 12.

Main Findings

Across all 12 studies reviewed, no consistent positive association emerged between high intake of milk and dairy products and overweight or obesity. Instead, the evidence either points to no clear link or a slight inverse association, suggesting that greater dairy consumption may be modestly related to lower rates of overweight/obesity. Notably, this finding held true even when results were stratified by fat content - none of the studies reported a positive association regardless of whether the dairy was whole-fat or reduced-fat (O'Sullivan et al., 2020) (Vanderhout et al., 2020), (H. Raynor et al., 2024).
Studying the association between milk/dairy consumption and health outcomes (mainly obesity and body composition) has challenges:

- Quantifying the exposure: serving sizes are not always defined, serving sizes of milk and other dairy products (e.g. cheese, are not the same). proposed defining (Jakobsen et al., 2023b) airy portions based on calcium content, but this approach has not been widely adopted.
- Study heterogeneity: Studies vary widely in design, sample size, age range, duration, and adjustment models. Cross-sectional studies dominate the literature, limiting the ability to infer causation, in particular this type of study would not identify reverse causality, e.g. consumption of reduced fat products might be a measure taken for overweight participants. (Babio et al., 2022), furthermore, not all give details on energy adjustments, which could neutralize associations (O'Sullivan et al., 2020)
- Adjustment for energy intake: Not all primary studies report an adjustment for total energy intake.(Babio et al., 2022; Louie et al., 2011) This could confound findings in primary studies, and be relevant when comparing full-fat milk to low-fat milk (Dougkas et al., 2019), (Louie et al., 2011)
- Numerous studies have highlighted that relying solely on BMI (or BMI z-scores) to assess obesity in children and adolescents may be insufficient, as variations in body composition also play a crucial role and should be systematically evaluated.
- Some authors underline the potential benefits of dairy products as a source of calcium, iodine, riboflavin, vitamin B_{12}, potassium, and vitamin A (Fayet-Moore, 2016)

Conclusion

There is no definitive evidence supporting the limitation of milk and dairy consumption due to obesity concerns. On the other hand, some studies suggest dairy consumption may have a protective effect against overweight and obesity, while others report no association.
Mechanistic explanations suggest that whole milk may promote satiety, reducing the intake of other high-calorie foods. Other mechanistic explanations focus on milk as a source of calcium, an adequate intake might favour a shift in the body composition increasing the lean mass.
The inverse association between milk consumption and sugar-sweetened beverage intake suggests that milk may act as a healthier alternative to sugary drinks. The role of flavored milk drinks, which provide essential nutrients but also contribute to sugar intake, as well as to caffeine intake in case of coffee-based milk beverages, in childhood nutrition and weight management should be investigated in more detail.
Many findings are based on cross-sectional studies, there is a need for well-conceived prospective studies and / or RCTs, with a more precise assessment of serving sizes per product category and designs to control for confounders such as energy intake and expenditure, dietary patterns, and sweetened beverage consumption.

***Table 12** Classes of recommendations and evidence levels for milk and dairy products and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Grade
(H. Raynor et al., 2024)	SR 43 studies, of which 26 PCS (international, mainly, but not only in HIC)	Obesity		Dairy (and alternatives)	Total milk consumption in younger children may be associated with favourable growth and body composition, as well as a lower risk of obesity during childhood. In contrast, no clear conclusions can be drawn for older children and adolescents due to inconsistencies and limitations in the available evidence. Among younger children, consumption of higher-fat milk compared with lower-fat milk may also be linked to favourable growth outcomes and a reduced risk of obesity. However, for older children and adolescents, the evidence is insufficient to establish any relationship between milk fat content and growth, body composition, or obesity risk. No evidence is available regarding the effects of sweetened milk consumption in younger children, while limited evidence suggests little or no relationship among older children and adolescents.	II-(III)	A
(Jakobsen et al., 2023a)	SR & MA of 16 studies, most CSS, 7 from Asian, Middle Eastern or Latin American data	BMI	5-18, with / without obesity	Total dairy was defined to include white milk, flavored/chocolate milk, dairy and cheese with varying fat content	OR (95% CI) for higher intake of total dairy compared to lower intake of total dairy was 0.94 (0.86, 1.04) (p = 0.26) (I2 = 88.50%) in children and adolescents 5–18 years. *Comment:* This review included 16 predominantly CSS with diverse objectives and settings, examining factors such as gender, BMI, dietary patterns, vitamin D status, calcium intake, and milk type. Owing to substantial heterogeneity, comparability is limited, and the reported OR should be interpreted with caution.	II	B
(Jakobsen et al., 2023a)	SR & MA, 5 RCTs	BMI, Body composition (fat, lean mass)	Healthy 5-18, with/without obesity	higher-dairy diets*	Based on five RCTs (n:5), a higher-dairy diet was found to reduce body fat percentage −0.47 [−0.92, −0.03] (p=0.04). A higher-dairy diet was also found to increase lean body mass (kg) 0.34 [0.06, 0.62] (p=0.02) (n:2), but did not affect BMI z-score −0.05 [−0.16, 0.06] (p=0.39) (n:4). **higher-dairy diets were defined as 3–4 servings (1 serving=200–250 mL) of dairy/day or>800 mg calcium/day from dairy products or≥1200 mg calcium/day from dairy products and lower-dairy diets was defined as 0–2 servings of dairy/day or<600 mg calcium/day from dairy products or no intervention*	I	A
(Babio et al., 2022)	SR and MA of 24 studies published up to 2021, (CSS and PCS), 15 studies were retained for the MA (international)	BMI z	2-21, PCS with follow-up: 1-3.2 years	total dairy, total milk, total yogurt, and cheese	In the MA from CSS, results showed an inverse association between total dairy consumption and obesity prevalence (OR (95% CI): 0.66 (0.48–0.91), but a non-significant positive relationship between dairy consumption and overweight, when results for overweight and obesity were merged,0.90 (0.76 –1.08): Regarding PCS (n=5), total milk consumption was positively associated with overweight prevalence (OR (95% CI): 1.13 (1.01–1.26)) and incidence (RR (95%CI): 1.17 (1.01–1.35)) risk..	II-(III)	(A)-B
(O'Sullivan et al., 2020)	12 with PCS/RCT data, , or 15 CSS, mainly USA, Canada, European	measures of adiposity	2-18 y	whole- and reduced-fat dairy intake*	Studies were consistent in reporting that whole-fat dairy products were not associated with increased measures of weight gain or adiposity. ** Dairy products were defined as products with some or all of the fat removed (including "low-fat" and "skim" versions)*	II	A-B
(O'Sullivan et al., 2020)	PCS/RCT and 4 CSS	biomarkers of cardio-metabolic disease risk		whole- and reduced-fat dairy intake*	Most evidence indicated that consumption of whole-fat dairy was not associated with increased cardiometabolic risk, although a change from whole-fat to reduced-fat dairy improved outcomes for some risk factors in 1 study. Taken as a whole, the limited literature in this field is not consistent with dietary guidelines recommending that children consume preferably reduced-fat dairy products.	II	A-B

					**where whole-fat" dairy product was defined as a product with the natural fat content, vs "reduced-fat"*		
(Vanderhout et al., 2020)	SR and MA, 14 studies included in the MA 11 CSS, 3 PCS	adiposity	1-18	Whole milk (3.25% fat) vs. reduced fat milk (2,1 0.1% fat)	MA included 14 studies that measured the proportion of children who consumed whole milk compared with reduced-fat milk and direct measures of overweight or obesity. Among children who consumed whole (3.25% fat) compared with reduced-fat (0.12%) milk, the OR of overweight or obesity was 0.61 (95% CI: 0.52, 0.72; P < 0.0001), but heterogeneity between studies was high (I2 = 73.8%). Based on study type: cross-sectional studies showed a significant risk reduction 0.56 [0.46-0.69], but the risk reduction in prospective studies was not significant 0.76 [0.48-1.21]	(I, CSS) (II, PCS)	A-B
(Dougkas et al., 2019)	Narrative SR with broad purpose, 94 CSS (published 1990-2017)	Various outcomes, but focusing on obesity and indicators of obesity	Mainly from 4 to 19y (only 7 studies included 2-4 y)	'milk' and 'other dairy products*'	Milk and other dairy products are consistently found to be not associated, or inversely associated, with obesity and indicators of adiposity in children. Adjustment for energy intake tended to change inverse associations to neutral. Little evidence to suggest that the relationship varied by type of milk or dairy product, or age of the children, although there was a dearth of evidence for young children. Only 9 of the 94 studies found a positive association between milk and other dairy products and body fatness. * refer to liquid drinking milk and foods containing Ca which are made from milk such as cheese, yoghurt and fromage frais, ice-cream and dairy desserts	II	B
(Lu et al., 2016)	SR and MA 10 of PCS, (50% overlap with the studies selected by Louie et al)	BMI, PBF, WC	2-12	Dairy general, including ice cream and dairy desserts, in not quantified servings (for ice cream, as % of energy)	As compared with those who were in the lowest group of dairy consumption, children in the highest intake group were 38% less likely to have childhood overweight/obesity (pooled odds ratio (OR) = 0.62; 95% confidence interval (CI): 0.49, 0.80). With each 1 serving/day increment in dairy consumption, the percentage of body fat was reduced by 0.65% (β = 0.65; 95% CI: − 1.35, 0.06; P = 0.07), and the risk of overweight/obesity was 13% lower (OR = 0.87; 95% CI: 0.74, 0.98).	III	A
(Fayet-Moore, 2016)	SR of 10 CSS and 2 PCS	Intake, (BMI, WC, PBF)	2-18	Chocolate flavoured milks	There is no association between flavored milk intake and weight status among normal-weight children, and some contradictory effects of flavored milk intake have been observed in subgroups of overweight children.	II	B
(Dror, 2014)	SR and MA based on 36 studies (22 for MA), mainly CSS	BMI, BMI z-score, PBF, WC,	Stratified (2-5 y), (5-11y), (12-19y)	Milk, dairy (not specified)	No significant association was found between dairy intake and adiposity in the aggregated data, although statistical heterogeneity was high (I2 = 0.72). Among adolescents, however, dairy intake was inversely associated with adiposity (effect size −0.26, [−0.38, −0.14]).	I-II	B
(Louie et al., 2011)	SR, based on 10 PCS published between 1980 and 2010, all with, follow-ups 1-10 years (mainly USA)	BMI, PBF	Children and adolescents, ages 2-14	All dairy (non-fortified)	Most studies (6 out of 10) found no significant link between dairy consumption and overweight/obesity in children and adolescents. 3 studies showed a protective effect, while one study reported an increased risk associated with high milk intake (≥3 servings/day), likely due to higher calorie consumption. Some evidence suggested that higher dairy intake in early childhood was linked to lower BMI, skinfold thickness, and body fat later in childhood. However, measurement units for dairy intake were inconsistent across studies	I-II	A

BMI(z) body mass index, CI confidence interval, CSS: Cross-sectional Study; SR: Systematic Review; MA: Meta-analysis; PBF percent body fat, PCS: Prospective Cohort Study; OR odds ratio, RCT: Randomized-controlled trial, WC waist circumference,

3.5 Protein sources of plant origin

3.5.1 Grain legumes (pulses)

Authors: Beatrice Baumer / Linda Beck Reviewers: Christine Brombach / Nataliia Yakovenko

Introduction

Grain legumes are the ripe, dry seeds of papilionaceous plants or leguminous plants, such as peas, lentils, beans, peanuts and soybeans (VLpH, o. J.) and are rich sources of protein, carbohydrates and various micronutrients (Gebrelibanos et al., 2013).

However, grain legumes also contain several components that have been linked to potential negative health effects. Some varieties include anti-nutritional factors that can reduce nutrient absorption and may contribute to impaired growth in children. In addition, soybeans in particular contain high levels of isoflavones (Messina et al., 2017). Because these compounds can bind to estrogen receptors, their possible hormonal effects, especially during childhood, have been the subject of ongoing discussion and concern (ANSES, 2025). In addition, some grain legumes (soybeans, lupins) have allergenic potential, needing specific labelling warnings (LIV, o. J.), (Abu Risha et al., 2024).

This chapter will address grain legumes, as such, or as minimally processed meal components, but retaining most of the chemical characteristics of the raw material. This excludes traditional products such as tofu (see chapter 3.5.3), soy drink (see chapter 3.5.2) and plant-based meat analogues (see chapter 3.5.3).

Search Strategy

The two databases PubMed and Cochrane were searched systematically with the search string as defined in the general methods combined with the string for grain legumes as shown in appendix A. In PubMed 15 articles were retained, in Cochrane 2 articles. After the screening of the publications, 5 articles from PubMed and none from Cochrane were retained (see Table 13). The most frequent reason for exclusion was the focus on gestational diabetes, or reviews based mainly on studies performed in LMIC, or the retrieved paper included only one study and could thus not be considered a review.

Main Findings

Five reviews were included to examine the association of NCDs and grain legumes in children, with T2DM markers and obesity each covered in one review and cardiovascular markers in three articles. An additional paper, where grain legumes are investigated together with other dietary fibre souces is discussed in chapter 3.3.1.

The evidence linking dietary patterns including grain legumes to overweight and obesity in children and adolescents remains scarce (Boushey et al., 2020a).
The limited evidence indicates a possible association between grain legume consumption and improved blood lipid, insulin and glucose levels, overweight and obesity.
Two articles reported limited evidence for the association between dietary patterns that include soy protein and grain legumes and improved blood profile levels, specifically triglycerides, low- and high-density lipoprotein cholesterol (2020 Dietary Guidelines Advisory Committee, 2020; Anderson et al., 2024; Messina et al., 2017).
One paper examined the association of dietary patterns including grain legumes and T2DM markers and reported a possible link between dietary patterns including grain legumes with improved diabetes markers, including insulin, blood glucose and HOMA-IR levels (Talegawkar et al., 2024a).

Conclusion

The evidence obtained from the systematic search in two databases is very limited. While some findings indicate potential benefits of legume consumption on CVD and diabetes markers, but also on overweight and obesity, the evidence remains deficient. Furthermore, the recommendations for consumption quantities in children is scarce, with one paper indicating 5-10 g/d of soy protein (equivalent to 1 serving of traditional soyfood) (Messina et al., 2017) . Further studies are needed to clarify the relationship of legume consumption and NCDs and develop recommendations for children and adolescents.

Table 13 *Classes of recommendations and evidence levels for grain legumes and outcomes*

Ref.	**Study type**	**Outcome**	**Age group**	**Food type**	**Summary / Results / Conclusions by the authors / Comments**	**Class**	**Level**
(Anderson et al., 2024)	SR of RCT and PCS	CVD (Hypertension, Dyslipidemia)	2-18 years	Grain legumes	Moderate evidence indicating dietary patterns higher in legumes to be associated with lower blood pressure and improve blood lipid profiles later in life.	I	A
(Talegawkar et al., 2024a)	SR of 10 PCS	T2DM	Under 18 years	Grain legumes	Possible association of dietary patterns including higher intake of legumes and lower insulin, blood glucose and HOMA-IR levels, but no conclusion can be drawn for T2DM	II	A
(Boushey et al., 2020a)	SR of PCS	Overweight and Obesity	Mean age between 2 and 15 years	Grain legumes	Inconsistent evidence on association between dietary patterns including legumes and overweight and obesity.	II	A
(Messina et al., 2017)	Review of 6 RCTs	CVD (blood lipid levels)	3-15 years	Soy protein	Limited evidence of a positive effect of soy consumption on blood lipid levels.	II	A
(2020 Dietary Guidelines Advisory Committee, 2020)	SR of PCS	CVD (blood lipid levels, hypertension)	Mean age between 7 and 14 years	Grain legumes	Limited evidence indicating dietary patterns higher in legumes to be associated with lower blood pressure and improved blood lipid profiles later in life.	II	A

CSS: Cross-sectional Study; CVD cardiovascular diseases, HOMA-IR Homeostasis Model Assessment of Insulin Resistance, PCS: Prospective Cohort Study, SR: Systematic Review; RCT: Randomized-controlled trial, T2DM type 2 diabetes mellitus

.

3.5.2 Plant-based milk alternatives

Authors: Beatrice Baumer / Linda Beck Reviewers: Christine Brombach/ Nataliia Yakovenko

Introduction

Milk alternatives are made from a variety of raw materials as pulses (e.g. soy drink), seeds and nuts (e.g. almond-based drinks) and cereals (e.g. oat or rice-based drinks). Their composition varies, depending on the raw material, being either protein, fat or carbohydrate focused. Any data addressing these differences will be highlighted.
While the consumption of plant-based drinks has been increasing in recent years, including among children, these non-dairy milk alternatives have been shown to lack nutritional balance (Sethi et al., 2016; Soczynska et al., 2024; Zaugg, 2023). The Swiss dietary recommendations state that plant-based drinks based on soy can be an equivalent alternative to cow's milk, while in contrast, plant-based drinks made from oats, rice or almonds contain low amounts of protein (BLV, 2024). Furthermore, unfortified plant-based milk alternatives contain less calcium and iodine than milk and may also include anti-nutritional factors (Chalupa-Krebzdak et al., 2018). However, these alternatives often have a more favourable fat composition and higher levels of vitamin E and soluble fibre.

Search Strategy

The two databases PubMed and Cochrane were searched systematically with the search string as defined in the general methods combined with the string for plant-based drinks as shown in appendix A. We identified one article in PubMed and none in Cochrane (see Table 14).

Main Findings

The included systematic review examined the impact of plant-based drink consumption on growth and nutritional status in children and adolescents The observational studies included in the review found that the consumption of such alternatives was associated with a lower BMI, height and vitamin D status. However, this association was not consistent across studies. For examples studies with female adolescents indicated that fortified soy drink may support bone health in adolescents who do not drink cow milk. (Soczynska et al., 2024).

Conclusion

While the systematic review by Socynska et al. suggests a possible association of plant-based drink consumption and BMI, the evidence remains inconsistent and scarce (Soczynska et al., 2024). More studies are required to better understand the role of plant-based milk consumption in children's health, this is also a conclusion of a review milk alternatives for both children and adults (H. Raynor et al., 2024)

***Table 14** Classes of recommendations and evidence levels for plant-based milk alternatives and outcomes*

Reference	Study Type	Outcome	Age Groups	Food Type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Soczynska et al., 2024)	SR of CSS, PCS, RCT	BMI	1-18 years	Plant-based milk alternatives	Observational studies found that consumption of plant-based milk was associated with lower childhood body mass index (BMI), height, and serum vitamin D concentrations compared with cow milk. No association was found between soymilk consumption and BMI in adolescent girls.	II	B

BMI body mass index, CSS: Cross-sectional Study; PCS: Prospective Cohort Study, RCT randomized controlled trail, SR: Systematic Review

3.5.3 Plant-based meat, fish and egg analogues

Authors: Linda Beck / Janice Sych Reviewers: Christine Brombach / Nataliia Yakovenko

Introduction

This chapter focuses on products derived from plant-based raw materials that are processed into protein-rich alternatives to meat, fish, or eggs, and that serve similar culinary functions as their animal-based counterparts. Certain recipes and processing steps can substantially alter the nutritional and structural composition relative to the original raw materials, such that these products may also be classified as ultra-processed. These products could be an option for children and adolescents following a plant-based (vegan) diet, which in some cases can be low in protein (Koller et al., 2024).

Driven by the growing demand for sustainable, healthy, ethical, and nutritious food options, plant-based alternatives to meat, fish, and eggs have been gaining popularity (McClements & Grossmann, 2021). An analysis of plant-based meat analogues in the Spanish market indicated that these products are often higher in fibre and complex carbohydrates and contain lower levels of cholesterol and fat, potentially offering health benefits (Costa-Catala et al., 2023). However, concerns have been raised regarding the suitability of meat analogues as a readily bioavailable protein source, particularly for the elderly (Berrazaga et al., 2019). No studies were identified examining the digestibility of these products in children, and research on the digestibility of plant-based protein foods has only begun to receive more attention in recent years, e.g. (Rivera del Rio et al., 2022) (Sá et al., 2020).

Search Strategy

The search in the PubMed database resulted in 34 articles, while the search in Cochrane returned 49 publications. However, after the screening of the literature, no articles matched the inclusion criteria.

Conclusion

No studies were found investigating the association between plant-based meat analogues, fish, or egg analogues and health outcomes in children. Further specific research is warranted to better understand their role in child and adolescent nutrition, in particular for children and adolescents following plant-based diets. Otherwise, these products risk being grouped with other ultra-processed foods, where their distinct effects may be overlooked due to the heterogeneity of the category.

3.6 Oils, fats, nuts

3.6.1 Nuts and seeds

Authors: Beatrice Baumer Reviewers: Christine Brombach / Nataliia Yakovenko

Introduction

Nuts and seeds are not botanically identical. Seeds are the plant's reproductive units, formed from a fertilized ovule and containing an embryo, a food reserve (endosperm or cotyledons), and a protective outer coating. In contrast, nuts are hard-shelled, indehiscent fruits that do not open to release their seed and typically contain a single seed. Botanically, examples of seeds include sunflower seeds, flaxseeds, and grain legumes such as beans and lentils, whereas true nuts include acorns, chestnuts, and hazelnuts. Many foods commonly referred to as "nuts" (e.g., almonds, walnuts, and cashews) are technically seeds or drupes rather than true botanical nuts.
From a nutritional perspective, a distinction is made between protein-rich seeds, which are generally grouped as grain legumes, and oil-rich seeds, which are nutritionally comparable to fat-rich nuts. Both nuts and oil-rich seeds are characterized by their high content of monounsaturated and polyunsaturated fatty acids, as well as appreciable amounts of protein and dietary fibre. In addition to providing antioxidants, they are important sources of micronutrients such as magnesium, zinc, and selenium, which play essential roles in growth and development during childhood. When salted, nuts and seeds are often consumed as snacks (see chapter 3.7.2), however dietary recommendations for adults emphasize the consumption of unsalted products (BLV, 2024).

Search Strategy

The two databases PubMed and Cochrane were searched systematically. The general search terms, as described in the methods, were combined with a search string specifically targeting unsalted nuts and seeds, the food group specific search terms are provided in appendix A.

Main findings

A total of six papers were retrieved; however, none met the inclusion criteria because the studies involved adult populations, and the food groups assessed did not specifically focus on nut consumption.

Conclusion

No review papers were identified that specifically examined the association between nut and/or seed intake and outcomes such as obesity, cardiovascular diseases, or markers of T2DM. However, nuts are frequently included as components of so-called "prudent diets" in adults, alongside fruits, vegetables, white meat, and fish (Krieger et al., 2019) (Cena & Calder, 2020). Most studies investigating «prudent» dietary patterns (including nuts) in children originate from Asian populations, where the composition of these diets may differ from Western dietary models (Liberali et al., 2020). In contrast, findings from the EU Childhood Obesity Project Trial indicated that a diet rich in dietary fibre from fruits, vegetables, pulses, and nuts from early childhood was associated with a healthier cardiovascular profile, independent of body weight (Larrosa et al., 2021).

3.6.2 Oils and fats

Author Beatrice Baumer Reviewers: Christine Brombach / Nataliia Yakovenko

Introduction

The objective of this chapter was to identify studies assessing the consumption of oils and fats as food groups (i.e., not specific fatty acids) in relation to the selected health outcomes. Fat-containing processed foods are addressed in other sections of this report.

Search strategy

The PubMed database was screened systematically using the predefined search string combined with the specific terms for fats and oils, as provided in appendix A. To improve the relevance of the results and reduce the number of unrelated articles, exclusion terms such as exercise and pregnancy were applied. This search initially yielded 149 articles. However, after applying the screening criteria, none of them met the inclusion criteria.

Conclusion

Most excluded studies examined fat intake in the context of overall macronutrient composition and physical activity, rather than assessing fats and oils as distinct food categories. This highlights a notable gap in the literature, indicating the need for research specifically addressing the role and health effects of individual fat sources, such as vegetable oils and animal fats (e.g., butter), within dietary patterns, particularly in children and adolescents. To date, the focus has been on comparisons between high- and low-fat dairy products (see chapter 3.4.2), with limited attention to other fat sources.

3.7 Snacks

Authors: Beatrice Baumer / Linda Beck Reviewer: Sibylle Juvalta

Introduction

While there is no universal definition of "snacks", they can be defined as foods consumed between meals (Blaine et al., 2017; Fiore et al., 2024; Musaiger, 2011), and therefore could be any food category. On average, children of the NEST cohort study in North Carolina aged 2 to 6 years consume approximately 2.2 snacks per day, contributing significantly to the total energy intake (Xue et al., 2019). Snacks thus play a non-negligeable role in young children's diets but remain inconsistently defined in both nutrition research and dietary guidelines. While some recommendations suggest that snacks should include multiple food groups and contribute to an overall healthy eating pattern, e.g. (Stadt Zürich, 2025), many snack foods consumed by children are high in added sugars or sodium. Recent qualitative reviews highlight that caregivers hold diverse and sometimes conflicting perceptions of snacks, viewing them as both healthy and unhealthy, using them to manage behaviour or hunger, and often associating less healthy snacks with pleasure and convenience (Killion et al., 2023).

The frequent consumption of energy-dense or highly processed options has raised concerns about potential health impacts (Almoraie et al., 2021), and are often considered a component of obesogenic dietary patterns (Liberali et al., 2020)
To investigate the association between snack intake and health outcomes some researchers e.g. (Xue et al., 2019) applied the food definitions used for the “snacks” category in the Nutrition Data System for Research (NDSR)—a dietary analysis software developed by the Nutrition Coordinating Center at the University of Minnesota. The NDSR enables the collection of 24-hour dietary recalls and food records, automatically linking reported foods to a comprehensive, standardized nutrient database („NDSR Software“, o. J.).
For the present report, an effort was made to differentiate between sugar-containing and savoury snack options.

3.7.1 Sweet snacks (confectionary)

This sub-chapter addresses snacks, with a particular focus on sugar-containing varieties, defined as those including sucrose, glucose, fructose, glucose syrup, or similar added sugars. Although no universally accepted definition of “sweet snacks” exists, the Swiss Food Pyramids lists examples such as chocolate, chocolate spreads, and sweet pastries. In contrast, the Swiss Food Composition Database categorizes sweet snacks into the following subgroups: bars, cakes and tarts, candies, fruits gums and chewing gum, chocolate and cocoa products, cookies/biscuits, creams and puddings, jams and sweet sandwich spreads, milk-based ice cream, other sweet pastries, other sweets (i.e. marzipan, meringue, candied fruit), sugar and sweeteners, water-based ice cream (FSVO, o. J.) . In international literature, sweet snacks are sometimes included in the group of “ultra-processed foods”, see chapter 3.8, but there are studies focussing on confectionary, a term also used here for the literature search.

Depending on the subcategory the sugar content varies between 10 and 95% (e.g. hard caramels). These products are often described as “high energy”; however, the energy content varies based on the water and fat content, from low energy products (water-based ice cream, 88 kcal / 100g) to nut-containing chocolate spreads (550-570 kcal / 100g), with intermediate products such as puddings (120-130 kcal/100g), jams (240-260 kcal / 100g) and hard candies (385 kcal/100g). Due to the high sugar content, and possible high energy density, all are considered discretionary products in the Swiss food pyramid (BLV, 2024).

Search Strategy

The systematic search was carried out in the database PubMed and Cochrane, used the terms above, as well as the general term confectionary and included individual sweet snacks. A total of 13 articles were retrieved in PubMed, none in Cochrane. After the screening process 1 article remained (see Table 15), either because sweet snacks were grouped with other processed foods, or because most of the articles were bases on studies performed in LMICs).

Table 15 *Classes of recommendations and evidence levels for sweet snacks and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Gasser et al., 2016)	MA, based on 11 CSS	Overweight, obesity, BMI, BMI z-score, body composition, WC, PBF	2-18	chocolate, non-chocolate confection-ary	In the MA, which examined the combined outcome of overweight and obesity, the odds of overweight or obesity were 18% lower (OR: 0.82; 95% CI: 0.69, 0.97) for subjects in the highest category of consumption than for a reference category of consumption. Thus, a 1-time/wk or a 1 portion increase in consumption was associated with a 13% (OR: 0.87; 95% CI: 0.85, 0.88) decrease in the odds of overweight or obesity.	III	B

BMI / BMI z-score, body mass index (score), CI confidence interval, CSS: Cross-sectional Study, MA: Meta-analysis, OR odds ratio, wk week

Main Findings

This review highlights the complexities in making public health recommendations as the evidence is based mainly on cross-sectional studies. The findings suggest an unexpected inverse or null association between confectionery consumption and obesity-related outcomes. The authors (Gasser et al., 2016) themselves formulated some hypotheses, also discussed in the individual articles they reviewed, e.g.

- Energy compensation & satiety: confectionery, despite being high in sugar, might contribute to satiety, leading to reduced overall energy intake.
- Possible beneficial effects of components in some confectionary products (e.g. flavonoids in cocoa-based products)
- Dietary substitution: higher confectionery consumers may consume less fat, leading to lower overall energy intake.
- Reverse causality: overweight individuals may reduce confectionery consumption more than non-overweight individuals, making it appear that higher confectionery intake is associated with lower weight.
- Bias & underreporting: overweight individuals may underreport confectionery intake more than their non-overweight peers, leading to misleading associations.

Conclusion

The paradoxical inverse association between confectionery intake and overweight challenges conventional assumptions about sugar and obesity. This finding likely reflects a combination of behavioural and methodological factors, including reporting bias and self-regulatory eating patterns, rather than a protective effect of confectionery itself. Future dietary guidelines should be informed by longitudinal and experimental research that can better distinguish causality from confounding. Overly broad sugar-reduction campaigns risk overlooking the more significant contributors to obesity, such as overall dietary quality, other obesogenic food groups and lifestyle factors.

3.7.2 (Savoury) Snacks

Introduction

This sub-chapter addresses snacks, with a particular focus on savoury options, to exclude the effect of sugar. The Swiss pyramid lists as examples only crisps, savoury snacks and salted nuts (BLV, 2024), whereas the Swiss Food Composition Database lists the following subcategories: chips/crisps, puff pastry snacks, salt sticks and pretzels, salted nuts, seeds and kernels, other savoury snacks (FSVO, o. J.). An overlap between these groupings and other food groups (ultra-processed foods in general, bakery products, seeds and nuts, other snacks containing sugar) is inevitable.

Search Strategy

The systematic search was carried out in the database PubMed, where the general string, as defined in the methods, was combined with terms concerning snacks (syntax in appendix A). As mentioned, the focus is primarily on savoury options, leading to the inclusion of individual savoury snack as search terms. A total of 46 articles were retrieved in PubMed. After the screening process, 4 articles remained (Table 16). The main exclusion criteria were articles based on studies performed in non-HIC countries, and snacks being grouped together with other ultra-processed food.

Main Findings

Four systematic reviews analysed the association of snacking behaviour and NCDs in children in HIC. Of these, one article examined the effect of snacks on non-alcoholic fatty liver disease (NAFLD), while the others investigated the association with overweight and obesity.

Raj et al. examined the association of snacking behaviour and non-alcoholic fatty liver disease and found a potential positive association (Raj S et al., 2023).

Articles examining the association with overweight and obesity provided inconsistent results. While 1 articles reported potential positive associations of snacking and obesity (Fiore et al., 2024), other articles found conflicting or non-significant evidence for the relationship between snacking and obesity (Jakobsen et al., 2023a), (Poorolajal et al., 2020).

Conclusion

The evidence regarding the effect of snack consumption on overweight and obesity remains inconsistent. However, studies suggest that the association largely depends on the type of snack consumed, particularly its energy density, as well as its fat and sugar content. (Verduci et al., 2021). Overall, this indicates that the energy intake through snacks, particularly due to their fat and sugar content, but also the portion-size of snacks may play a more critical role in obesity than the snacking behaviour itself (Saltaouras et al., 2024; Verduci et al., 2021).

Given the inconsistencies in the current literature and the lack of standardized definitions for snacking, and snacks themselves, further research is needed to clarify the association with overweight and obesity in children.

***Table 16** Classes of recommendations and evidence levels for savoury snacks and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Fiore et al., 2024) – only abstract	SR of CSS, PCS	Overweight and Obesity	1-18 years	Snacks	Conflicting evidence on the association between snacking and overweight / obesity: No association in normal weight children, positive association between snacking and BMI in underweight children, negative association between snacking and BMI in overweight children, negative association of having less than 3 snacks per day and overweight / obesity; positive association between more than 2 snacks per day and overweight / obesity; decrease in overweight / obesity with increasing snack frequency, Higher BMI in children with highest snack consumption	III	B
(Jakobsen et al., 2023a)	SR and MA of 6 CSS and 2 PCS	Overweight / Obesity	Mean age between 5-18y	Savoury-salty snacks*	The OR (95% CI) for higher intake of savoury-salty snacks compared to lower intake of savoury-salty snacks was 0.99 (0.82, 1.21) (p = 0.96) (I2 = 78.54) in children and adolescents 5–18 years. In children 5–11 years, the OR (95% CI) was 1.01 (0.47, 2.18) (p = 0.97) (n:4) ** chips/fried potatoes, crisps, popcorn, peanuts, and corn chips*	II	B
(Raj S et al., 2023)	SR of 6 CSS	NAFLD	2-23 years	Snacks	Potential association of a <u>Western dietary pattern</u>, characterised by high red meat, processed and preserved meat, fish and shrimp, seafood, dairy products, western fat food, snack food, carbonated beverages, alcoholic beverages, and coffee, with increased risk of NAFLD.	II	C
(Poorolajal et al., 2020)	SR and MA of cross-sectional studies	Overweight and Obesity	5-19 years	Snacks	Potential inverse association of eating snacks ≥ 4 times per week (OR: 0.84 [0.71; 1.00]) and overweight / obesity.	I-II	B

BMI / BMI z-score, body mass index (score), CI confidence interval, CSS: Cross-sectional Study, MA: Meta-analysis, NAFLD Non-alcoholic fatty liver disease, OR odds ratio, PCS prospective cohort study, SR: Systematic Review; wk week

3.8 Ultra-Processed Foods

Authors: Beatrice Baumer / Linda Beck Reviewer: Janice Sych

Introduction

No universal definition of “ultra-processed foods” (UPFs) exists. Among the various definitions, the most widely used is the NOVA classification, specifically NOVA 4, which categorizes foods based on both processing methods and ingredient composition (Monteiro et al., 2019). According to NOVA 4, a product is considered ultra-processed if it contains highly refined ingredients and / or additives designed to enhance the palatability. Despite this definition, UPFs constitute a highly heterogeneous group with

widely variable nutritional profiles. Some products classified as ultra-processed may be nutrient-dense and relatively healthy, whereas others are energy-dense and nutrient-poor (Fedde et al., 2022), (Marino et al., 2021), (Petrus et al., 2021), and some could even be classified as being "healthy" (Derbyshire, 2019), (Louie, 2025). This variability has generated debate around the classification and the potential health implications of UPFs. Certain food groups are, by default, often categorized as ultra-processed. These include ready-to-heat meals, sweet and savoury snacks, and fast foods (Monteiro et al., 2019). Such foods typically feature complex recipes with high quantities of refined fats and sugars. Their formulation, combined with flavour enhancers, contributes to high palatability, which can promote overconsumption contribute to diet-related non-communicable diseases (NCDs), e.g. adiposity (Chang et al., 2021).
Typically, this type of ultra-processed foods include food groups already discussed separately in other chapters (SCB, sweet and savoury snacks), but also ready-to-eat-meals such as fast food.

Search Strategy

The systematic search was carried out in the database PubMed. The systematic search was carried out in the database PubMed, where the general string, as defined in the methods, was combined with terms concerning ultra-processed foods (syntax in appendix A).

After the screening process 34 articles remained, which were then manually screened, studies making no distinction between adult and children's cohorts were excluded, as well as others focusing on obesogenic environments, low-income countries. Many studies have been performed in Brazil, and reviews based on >50% Brazilian studies and or other LMICs were excluded (Robles et al., 2024), (Frías et al., 2023) (De Amicis et al., 2022), (de Oliveira et al., 2022), (Poorolajal et al., 2020) or focussed mainly on SSBs (Markey et al., 2023). For others only an abstract was available (Petridi et al., 2024), resp. relevant supplemental material is not available (Rousham et al., 2022), ultimately 4 articles were retained (Table 17).

Main Findings, discussion

The retrieved papers (in Table 17) show weak evidence that overconsumption of ultra-processed foods (UPFs, including sugar-sweetened beverages, snacks, and fast food) in children is associated with a slightly higher risk of obesity.

The research identified several key challenges in examining the relationship between ultra-processed food (UPF) intake and non-communicable diseases (NCDs). One major issue is the lack of a universal definition of UPFs, as studies apply different classification systems—such as the NOVA framework or nutrient-based criteria, particularly those identifying "high fat, salt, and sugar" (HFSS) products, and / or different food groupings. Moreover, methods for quantifying UPF consumption vary considerably (e.g., percentage of total energy intake, frequency, or total grams), and it is often unclear to what extent adjustments for energy intake are made.

Most studies found with the first screening of the literature, then excluded in the second, were based mainly on cross-sectional studies, limiting causal inference, and many were conducted in Brazil, reflecting a specific LMIC context that may not generalize globally. However, these studies have led to the incorporation of recommendations to reduce the consumption of NOVA 4 products in many Latin American countries (Corrêa Rezende et al., 2022).

One research group brought up an interesting question: did the lockdown phases during the COVID pandemic lead to an increase in the consumption of UPFs in the more recent children's cohorts, how permanent is this shift? (De Amicis et al., 2022).

Conclusion

The existing body of research provides evidence that excessive consumption of ultra-processed foods (UPFs), including sugar-sweetened beverages, snacks, and fast food, among children is associated with an increased risk of obesity. Considering the strong influence of early-life dietary habits on long-term health outcomes, precautionary measures should be incorporated into public health policies. These could include, for instance, marketing restrictions targeting children, as recommended by the World Health Organization(WHO Europe, 2023).

Table 17 *Classes of recommendations and evidence levels for ultra-processed food (UPF) and outcomes*

Ref.	Study type	Outcome	Age group	Food type	Summary / Results / Conclusions by the authors / Comments	Class	Level
(Stanford et al., 2024)	SR, with 25 PCS	growth (in infants, young children up to age 24 months, children, adolescents), Height, length/stature-for-age, Weight, weight-for-age, Stunting, failure to thrive, wasting, BMI-for-age, weight-for-length/stature Body circumferences (arm, neck, thigh), Head circumference, body composition, skinfold thickness, fat mass, ectopic fat, Fat-free mass or lean mass, WC, WHR, Risk of obesity, BMI Weight gain	2-19	All included studies described the types of UPF contributing to the dietary pattern. However, the groupings of foods that were classified as UPF widely varied across studies*.	Children and Adolescents Conclusion statement and grade: Dietary patterns consumed by children and adolescents with higher amounts of foods classified as UPF are associated with greater adiposity (fat mass, waist circumference, BMI) and risk of overweight. The authors grade the evidence as limited. Few studies were designed and conducted well, in particular: no mention made of adjustments to energy intake. Summary of evidence: The direction of results was similar across studies, but effect size differed. **Common sources or types of UPF contributing to the dietary patterns included: SSB, processed meats and meat products, sugar-sweetened foods, packaged salty/savory and/or sweet snack foods, ready-to-eat meals and dishes*	III	A
(Leed et al., 2023)	SR, based on 2 CSS	Arterial stiffness	0-18	Fast food	There was limited evidence to indicate an adverse effect of total fat intake, sodium intake and fast-food consumption.	II	B-C
(Jia et al., 2021)	SR / MA, based on 87 studies, 16 PCS, 71 CSS	Overweight / obesity and obesity markers (WC, skinfold thickness)		Fast-food restaurants (FFR)	The authors identified16 PCS and 71 CSS conducted in 14 countries (mainly HIC) were identified. While higher FFR access was not associated with weight-related behaviours (eg, dietary quality score and frequency of food consumption) in most studies, it was commonly associated with more fast-food consumption. Despite that, insignificant results were observed for all meta-analyses conducted by different measures of FFR access in the neighbourhood and weight-related outcomes, although 17 of 39 studies reported positive associations when using overweight/obesity as the outcome.	II	B
(Costa et al., 2018)	SR, 15 PCS (with follow-ups of 4 to 10 years) and 6 CSS	BMI and body composition	7-14	Broad category UPF, from snacks, to confectionary, ice cream, fast food etc	Our review showed that most studies have found positive associations between consumption of ultra-processed food and body fat during childhood and adolescence. There is a need to use a standardized classification that considers the level of food processing to promote comparability between studies. In particular: no adjustment to energy intake, main food categories: SSB	III	A-B

CCS: Case-Control Study, CSS Cross-sectional study, FFR fast-food restaurant, MA: Meta-analysis; PBF percentage body fat, NRS: Nonrandomized study; PCS: Prospective Cohort Study, OS: Observational studies; PCS: Prospective cohort studies, RCT: Randomized-controlled trial; SR: Systematic Review, UPF ultra-processed food, WC waist circumference, WHR waist to hip ratio

3.9 Summary association between food groups and NCDs

***Table 18** Summary of principle findings per food groups*

Food group	Conclusion	Strength of evidence
water	Should be main fluid source No significant effect on NCDs	Based mainly on CSS
Sugar-sweetened beverages	Excessive consumption is a risk factor for obesity. Tentative: one portion per day maximum, as an energy source	Many studies, both CSS and PCS, most remark however a lack of adjustment for energy intake / needs
Fruit juices	More than 1 portion per day could be associated with a higher risk for obesity	Mainly based on PCS
Caffeine containing drinks	An upper limit of 2.5 mg caffeine/ kg body weight seems indicated, to prevent cardiovascular events	Based or toxicological data, and RCTs
Artificially sweetened beverages	Inconclusive data	Based on RCTs, PCS and CSS
Fruit and vegetables	Potential preventive effect of dietary patterns rich in fruits and vegetables on non-communicable diseases (NCDs).	Based on PCS and CSS
Grains (wheat: refined vs whole-meal)	Inconclusive data	Based on CSS
Sugar-containing breakfast cereals (ready to eat cereals)	Contradictory data (protective to not conclusive) possibly breakfast habits per se are more important	Based on CSS
Other cereals, pseudocereals and starchy tubers	No conclusion possible	No relevant reviews found
Meat	Processed meat: Weak evidence for association with CVD markers	No relevant reviews found for obesity (for HIC) PCS for association with CVD markers
Fish	Weak evidence association with lower CVD risk (blood pressure)	Based on PCS
Eggs	No conclusion possible	No relevant reviews found
Milk, dairy cheese	Contradictory results for association with obesity, pointing towards potential protective effects, independently of fat content	Based on PCS and CSS
Grain legumes (pulses)	Data limited, with limited evidence for benefits of a diet high in grain legumes	Based on PCS
Plant-based milk alternatives	No conclusion possible	Based mainly on CSS, some PCS
Plant-based meat, fish and egg analogues	No conclusion possible	No relevant reviews found
Nuts and seeds	No conclusion possible	No relevant reviews found
Oils and fats	No conclusion possible	No relevant reviews found
Sweets / sweet snacks	Potential benefits, this association needs more investigation	Based on CSS
Savoury snacks	Conflicting evidence	Based on CSS
Ultra-processed Foods (UPFs)	Weak (but not consistent) evidence that, a high intake in UPFs might be associated with obesity, CVD, markers of metabolic syndrome	Based on PCS and CSS

CSS cross-sectional studies, CVD cardiovascular diseases, HIC high-income countries, NCD non-communicable diseases, PCS prospective cohort studies,

The current body of research investigating the relationship between food groups and non-communicable diseases (NCDs) in children and adolescents remains limited and inconclusive. This review focused specifically on dietary intake during childhood and adolescence, excluding prenatal influences and nutrition in the first years of life. However, a major challenge in this field is that many NCDs, such as cardiovascular diseases, T2DM, and certain cancers, typically develop only later in life. This time lag makes it difficult to establish early-life dietary determinants of disease through observational research, especially when longitudinal data are lacking.

Most available evidence is based on CSS, which limits the ability to draw causal conclusions and raises concerns about residual confounding. In addition, dietary intake data are often inconsistently reported. Food groups are poorly characterized und classifications can vary (e.g. potatoes as vegetables or starchy food, nuts and seeds, depending on whether salted/unsalted) and portion sizes or methods of quantification vary widely across studies. These inconsistencies undermine the comparability of findings and complicate the synthesis of evidence.

Given these limitations, recent research has increasingly shifted focus toward overall dietary patterns rather than individual food groups, to better reflect real-world eating behaviours and cumulative dietary exposures. Typical food dietary patterns which could be associated with a lower risk for cardiovascular disease markers are those with higher intakes of vegetables, fruits, whole grains, fish, low-fat dairy, legumes, and lower intake of sugar-sweetened beverages, other sweets, and processed meat (2020 Dietary Guidelines Advisory Committee, 2020). On the other hand, vegan diets have both benefits and risks for children and adolescents (Koller et al., 2024). While this shift towards investigating dietary patterns is valuable, it further underscores the need for high-quality longitudinal research that incorporates well-defined, standardized measures of food group intake and tracks health outcomes over time. To strengthen the evidence base, future studies should aim to improve dietary assessment methods, ensure clearer classification of food groups, and adopt long-term follow-up designs that can more accurately capture the developmental origins of NCDs.

4 International comparison

Authors: Julia Dratva and Christine Brombach

4.1 Nutritional and dietary guidelines for children and adolescents

The desktop search provided an overview of national nutritional and dietary guidelines for each of the targeted countries (Table 19). The guidelines differ in terms of child and adolescent specificity. Some are basically general guidelines, based on the assumption that dietary guidelines are the same for children and adults. Examples of such an approach are France and Italy. These countries provide separate recommendations on the transferability of the guidelines, adaptions of portion sizes (see example for France, or g of specific foods /day, per age group.

Most countries provide visuals to convey simple messages and reach a broad audience. These visuals are often graphical images of food plates (UK), food pyramids (Austria) or food wheels (Netherlands) (selection in Table 20). Examples are provided by many nutritional societies in many, but not all countries. Some have websites that present recommendations and guidelines in a simple language using videos or the above-mentioned visuals.

Furthermore, some guidelines include specific recommendations for certain nutrients (e.g., vitamins and minerals), emphasizing the need for a nutrient-dense diet, one that provides adequate micronutrients relative to energy intake, to meet reference values (Table 21). Other guidelines are tailored to specific age groups and are based on evidence relevant to children and adolescents, as seen, for example, in the UK (England). The 4–17-year age range is often subdivided into smaller groups to account for age-specific nutritional requirements. Although not the primary focus of this review, it is worth noting that several countries, such as Italy, Austria, and Sweden, also provide explicit dietary guidelines for kindergartens and school canteens.

4.2 Key similarities, differences and overarching messages

A summary of the key recommendations of the reviewed guidelines is shown in Table 21.

The comparison of the recommendations across the European countries indicates a high similarity in the overarching messages, however they differ in the detail of dietary recommendations. The overarching recommendations are:

- A healthy diet means eating neither too much nor too little (maintaining an energy balance) and ensuring that the nutritional composition is diverse and composed of different food groups (see Table 21).
- Most dietary recommendations contain Three-Tiered Food Groups:
    - “Preferred” foods: mainly nutrient-rich and recommended in large amounts, with general agreement that the following food groups belong in this category: Beverages (water), vegetables, fruit, starchy foods (preferably with fibre), milk/ dairy, pulses (grain legumes), nuts & seeds. Meat, fish and eggs are sometimes grouped here, or listed under “accepted foods”
    - "Accepted" foods, to be consumed in moderation (smaller portions and / or not daily): juices, fats and oils, meat (e.g. up to 3 portions), fish (e.g. 1-2 portions/wk), and eggs (up to 2 / wk)
    - "Tolerated" (discretionary) foods, with limited consumption, in general high-energy / low-nutrient-dense foods (e.g., sweets, fast food, sugary drinks, ultra-processed food).
- Recommendations on quantity and type of fluids (no sugar containing fluids).

Further, almost all guidelines mention non-food-based messages related to energy expenditure and food intake, such as physical activity, screentime, and sleep (Table 21). Some guidelines also address parents as role models, family meals, and peer-influences in adolescence. UNICEF makes a specific recommendation to limit exposure to food/beverage marketing (e.g. limiting screen time), (WHO, 2023) (WHO Europe, 2023).

Table 19: *National nutritional guidelines including recommendations for children and adolescents*

Country	Latest update	Reviewed guidelines / agencies	Age range	Webpages
Switzerland	2024	BLV (FSVO) (BLV, 2024) and SGE	0 – 18 y.	https://www.sge-ssn.ch/media/Merkblatt_Ernaehrung_von_Kindern_2016_4.pdf, accessed 2025,02.07 https://www.sge-ssn.ch/media/ct_protected_attachments/77408d9f35b55981ac0a8d45701fc3/SGE_MB_Jugendliche_DE.pdf, accessed 2025,02.27
Austria	2017	AGES / BMSGPK	4-10y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/austria/en/ https://www.richtigessenvonanfangan.at/de/nationale-ernaehrungsempfehlungen-fuer-4-bis-10-jaehrige/ (Bundesministerium für Soziales, Gesundheit, Pflege und Konsumentenschutz (BMSGPK), 2017) https://www.ages.at/mensch/ernaehrung-lebensmittel/ernaehrungsempfehlungen
Germany	2024	Eat and drink well – recommendations of the German Nutrition Society (DGE)		https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/germany/en/ https://www.dge.de/gesunde-ernaehrung/gut-essen-und-trinken/dge-empfehlungen/
France	2019	French Agency for Food, Environmental and Occupational Health & Safety (ANSES)/ (ANSES, 2019)	4 – 17 y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/france/en https://www.anses.fr/en/system/files/NUT2017SA0142EN.pdf, accessed 2025.02,07 https://www.mangerbouger.fr/manger-mieux/a-tout-age-et-a-chaque-etape-de-la-vie/enfants-et-adolescents-de-4-a-17-ans
Italy	2018	Health Ministry / Centro di ricerca alimenti e nutrizione: **Linee guida per una sana alimentazione 2018**	12–23 ms, 24–47 ms; 4–6y, 7–10 y; 11–14 y, 15–17 y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/italy/en/ https://www.crea.gov.it/web/alimenti-e-nutrizione/-/linee-guida-per-una-sana-alimentazione-2018 (Rossi, Berni Canani, et al., 2022)
	2022	(Rossi, Martone, et al., 2022)	1 – 17 y	(Rossi, Martone, et al., 2022)
Netherlands		**Health Council of the Netherlands** *"Richtlijnen Goede Voeding 2015"* (Dietary Guidelines 2015)	0-18 y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/netherlands/en/ Homepage Voedingscentrum | Voedingscentrum https://www.voedingscentrum.nl/nl.aspx Wat geef ik mijn kind als avondeten en toetje? (4 t/m 13 jaar) | Voedingscentrum
Sweden	2012		0-17 y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/sweden/en/ , accessed 2025, 02.27 https://www.livsmedelsverket.se/en/ https://www.livsmedelsverket.se/globalassets/publikationsdatabas/andra-sprak/national-guidelines-for-school-meals_swedish-food-agency.pdf
	2025	(Swedish Food Agency, o. J.)	?	Only for adults and small children?
United Kingdom	2016	Public Health England: Government recommendations for energy and nutrients for males and females	1 - 18 y	https://www.fao.org/nutrition/education/food-dietary-guidelines/regions/countries/united-kingdom/en/ https://assets.publishing.service.gov.uk/media/5a749fece5274a44083b82d8/government_dietary_recommendations.pdf
WHO	2012 -23	Separate guidelines for specific nutrients (sugars intake 2015, potassium 2012, sodium 2012, carbohydrates 2023)		https://www.who.int/publications/i/item/9789241549028 , https://www.who.int/publications/i/item/9789240073630, accessed 2025.02.07
	2018	Guideline: implementing effective actions for improving adolescent nutrition	adole-scents	https://www.who.int/publications/i/item/9789241513708
UNICEF	2020	United Nations Children's Fund (UNICEF). Review of national Food-Based Dietary Guidelines and associated guidance for infants, children, adolescents, pregnant and lactating women. New York: UNICEF, 2020	0 – 18 yrs.	https://www.unicef.org/media/102761/file/2021-Food-based-Dietary-Guidelines-final.pdf

Table 20: *Examples of visualisations in European countries*

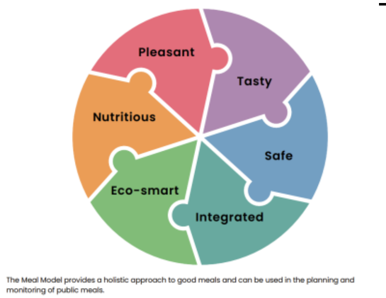
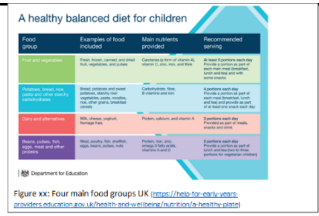
Country	**France**	**Netherlands**	**Sweden**	**UK**
Visual	 	Schijf van Vijf («The wheel of Five")  	 	 Figure xx: Four main food groups UK (https://help-for-early-years-providers.education.gov.uk/health-and-wellbeing/nutrition/a-healthy-plate)
Comments	French portion adaptations to the child's age: Ages 3-6: About half of an adult portion. Ages 7-10: About one-third smaller than an adult portion. Early adolescence: Like an adult portion. Ages 15-17 (growth period): Portions may be larger than those for adults.	The webpage provides digital tools and applications that enable individualisation and scalability of portion sizes for different age groups and for both male and female adolescents. Its attractive design, clear language, visual elements, and accessible digital format make it easy to understand.	Model developed for schools: consists of six different areas, all of which are important for the health and enjoyment of the food.	
Non food-related recommendations	At least 60 minutes of moderate physical activity per day is essential for children and adolescents. Screen time should be limited and regulated, especially for adolescents, as it impacts sleep and overall health. Adequate sleep is important and should be protected from screen exposure, with healthcare professionals playing a key role in promoting healthy habits.			

Table 21 *Overview of recommendations for children*

Country / organisation	Specified focus in current recommendation (nutrients N/ food F/ prevention P, sustainability S)	Last update	Age groups (excl. Newborns, toddlers)	**Preferred food groups** B Beverages/fluids V Vegetables, F fruit S: starchy foods, D: Milk/ dairy P: Pulses, M Meat and fish, E Eggs N Nuts & seeds	**Accepted / smaller portions** J Juices O oils & fats M Meat	**Tolerated (discretionary) food groups** S sugar containing drinks C caffeine drinks FF Fast Food	Portion sizes given	Vitamin D specifics	Other nutrients, e.g. iodine	Other recommendations, physical activity, diet type etc.	Visuals
Switzerland / SGE	N / P/	2024	0-1-2, 2-3, 4-6, 7-9, 10-12, 13-14, 15 -18	B, V, F, S, D, P, M, E, N (from 7 y.o.)	J, O, M	Limited S, C, FF – from 12 y.o.	Yes, per age group	Yes, per age group		Yes (physical activity, snacks, teeth health, mindful eating, parental example)	Yes Nutrition circle
Austria	N / P / S	2020	1-3, 4-10	B, V, F, D, P, M, E, N	J, O, M	Limited, with energy max S, FF. No Alcohol	-	Yes, per age group	Yes, Iron, Folate, Iodine	School buffet, physical activity, snacks, parental example)	Food pyramid Videos
Germany (DGE)	N/ (P / S)	2023	1-4, 4-15	B, V, F, D, P, M, E, N	J, O, M	Limited S	-	DACH Reference values	DACH Reference values	Nutrition in day care and schools	Food plate
France (MangerBouger)	N/ P/ S	- 2019	0-3, 4-17	B, V, F, D, P, M, E, N	-	Limited S, salt, processed meat, alcohol	Yes, per age group	-	-	Yes (physical activity, seasonality)	Nutri score, France
Italy (Rossi et al., 2022)	Based on nutrients, energy, protein	2019	1-2, 2-4, 4-6, 7-10, 11-14, 15-17	Fibre	-	-	Yes for 1-4 yo	Yes	B_{12}, B6, Calcium, Iron etc	No, separate school/kindergarten guidelines	No
Netherlands	N / P / S		0-18	all	-	S, FF, refined starchy foods, alcohol	Yes	-	-	Yes (physical activity, school, eating at people's houses,	Nutrition wheel
Sweden	N / P / S	2015	2-17	all	M	S	No	Yes	Yes	Yes	Food plate
UK	F/ P	2022	2 - 17	all	J	S, F, Salt	some	-	-	Yes	Food plate
UNICEF	P	2020	0-18	all	-	-	-				
WHO	P / S	2023	2 - 17	all		S, FF, Salt, K				Safe Environment	

4.3 Swiss guidelines in context

Nutrient-specific recommendations

The Swiss nutrition plate summarizes the most important messages for healthy eating and physical activity habits in children aged 4 to 12 years (Figure 1).The Swiss nutritional guidelines for children also include general advice for parents and address common questions, such as those concerning special children's food products, vegetarian diets, enjoyment and fun around meals, and dental health. The general topics of the plate are to drink water, eat fruits and vegetables in a variety, to eat regularly, to eat diverse foods and to enjoy food with all senses. Parents receive practical everyday tips, such as:

- Foster a shared mealtime culture and eat together as often as possible – the family table is much more than just a place to eat.
- Create a pleasant and welcoming atmosphere during meals and include children in the conversation.
- Consider children's menu preferences when planning meals, while also maintaining your own choices. With agreed-upon "house rules" and compromises, you can maintain both the joy of eating and a balanced intake of essential nutrients.
- Avoid using food as a form of pressure – whether as a punishment, threat, reward, or comfort. Doing so can lead to unhealthy eating behaviours that may last into adulthood.

Portion counts are generally similar for children aged 1 to 12 across all food groups. However, specific portion sizes are tailored according to age.

Figure 1 The Swiss nutritional guidelines for children also include general advice for parents and address common questions, such as those concerning special children's food products, vegetarian diets, enjoyment and fun around meals, and dental health. The general topics of the plate are to drink water, eat fruits and vegetables in a variety, to eat regularly, to eat diverse foods and to enjoy food with all senses. Parents receive practical everyday tips, such as:

- Foster a shared mealtime culture and eat together as often as possible – the family table is much more than just a place to eat.
- Create a pleasant and welcoming atmosphere during meals and include children in the conversation.
- Consider children's menu preferences when planning meals, while also maintaining your own choices. With agreed-upon "house rules" and compromises, you can maintain both the joy of eating and a balanced intake of essential nutrients.
- Avoid using food as a form of pressure – whether as a punishment, threat, reward, or comfort. Doing so can lead to unhealthy eating behaviours that may last into adulthood.

Portion counts are generally similar for children aged 1 to 12 across all food groups. However, specific portion sizes are tailored according to age.

***Figure 1** The Swiss nutrition plate (SGE, 2024a)*

<u>Portion sizes and reference values for children and adolescents</u>

Adolescents aged 12 and above are directly addressed in the Swiss nutritional guidelines of the SGE. The guidelines refer to the food pyramid for adults and emphasize that the energy and nutrient requirements of adolescents are often higher than those of adults. The amounts and portions indicated serve as general guidelines. Actual needs depend on biological sex, height, and level of physical activity.

Several topics are highlighted that are especially relevant for teenagers: fitness and sports, regular and varied eating, balanced meals and appropriate portion sizes, snacking, vegetarianism, and sugary drinks—which are not recommended as thirst quenchers. The guidelines also provide daily examples to illustrate what a healthy day can look like.

Weight-related issues are also addressed. Overall, the recommendations are specifically tailored to adolescents, delivering important information in a way that is informative without being dogmatic.

There are no specific recommendations for school catering, however, the City of Zurich has specific recommendations for the school lunch catering business, which serves as a strict guideline to the lunches offered (Stadt Zürich, 2025).

4.4 Conclusions and recommendations

Overall, the international guidelines are comparable regarding the main messages both regarding the food-specific and the non-food specific guidelines. The guidelines themselves differ considerably in details provided and age specificity. Very few countries provide the evidence alongside their guidelines, but some do rely on child-specific data on nutritional intake and reference values. The current Swiss guidelines are derived from the adult guidelines; however, it remains unclear whether they are evidence-based. Unlike the recommendations for adolescents in other countries, the guidelines from the Swiss Society for Nutrition (SGE) are addressed directly to adolescents, aiming to appeal to their sense of personal responsibility (SGE, 2025).

Most countries provide nutritional recommendations both for professionals and for parents and caretakers. Some countries have national websites or audience specific documents for lay-people. Few address children and adolescents, however, it would be recommended to provide information and guidance in view of reaching the different age-groups, possibly differentiated as children, young and older adolescents.

While the health context isn't always explicitly stated, the context is implicit. Guidelines are set with the aim to prevent malnutrition (lack of micronutrients, overweight & obesity) and promote healthy growth. However, there is still no consensus on whether explicit statements concerning the nutrition and health have a greater impact, and which consumers should be targeted, parents or children and adolescents.

Regarding the context of nutrition, the family context is often mentioned, and parents are addressed as role models and responsible for their children's diets, especially in the younger children and adolescents. Next to the home and family environment school environments are shared by all children and adolescents. Some countries have specific guidance or policies for kindergarten and school canteens and catering. Given the time children and adolescents spend in school where they have snacks at break and often also lunch, addressing school catering seems relevant in the promotion of healthy nutrition. (WHO, o. J.-a)

In general, the formats and visibility of nutritional guidelines in digital media vary widely. A standout example is the Dutch "Schijf van Vijf", which offers digitally scalable portion sizes tailored to different age groups as well as to male and female adolescents. Thanks to its appealing design, simple language, strong visual elements, and easy digital accessibility, it is likely far more effective at engaging young people than traditional fact sheets. We therefore recommend further research and testing on the effectiveness of digital tools in reaching this highly digitalized age group.

5 Sustainability aspects

Authors: Claudio Beretta, Claudia Müller

5.1 General relevance of diets for sustainability

Several studies show that the environmental impacts of diets vary substantially depending on the type of products consumed. For example, Walker et al. calculated the environmental impacts of different diets across Europe. The results show large variations ranging from 0.9 kg CO_2-eq/cap in Greece to 3.0 kg CO_2-eq/cap in Spain (Walker et al., 2018). Jungbluth et al. compared the impacts of different diets in Switzerland. Thereafter, a vegan Swiss diet causes 36% lower environmental impacts than the average Swiss diet, whereas a meat-dominated diet causes 27% higher impacts (measured with the Ecological Scarcity 2013 method). The most sustainable diet (plant-based) creates less than half the environmental impacts of the most unsustainable diet (meat-dominated) (Jungbluth et al., 2015). Consequently, dietary recommendations can have a large impact on the environmental footprint of a country's food system. But what is the contribution of children's and adolescents' diets to the overall environmental footprint of the food system?

5.2 Relevance of children's and adolescents' diets for sustainability

The environmental impact of food consumption depends on the amount and the composition of the food consumed. We calculated the amount of food consumed in Switzerland for each age group based on the population (BFS, 2024) and the average recommended energy consumption in kilocalories per day (BLV, 2024). The estimated energy consumption based on recommendations is lowest in the first year (666-1'030 kcal/d) and reaches a maximum with the age of 15-17 (2'228-2'940 kcal/d) and then slightly decreases (1'700-2'800 kcal/d with the age of >65) (BLV, 2024).

The results show that in Switzerland 9-10 Terajoule (TJ) of food per day are consumed by children and young adolescents (4-17 years), whereas the rest of the population consumes 55-66 TJ per day (for calculations see appendix B, separate document). Hence, children and young adolescents only consume 13% of the calories consumed in Switzerland. This is slightly lower than their share in the population (14%).

Therefore, the direct influence of dietary recommendations for adults on the environmental impact of the food consumed is 7-8 times higher than the impact of dietary recommendations for children and adolescents. Because adults contribute disproportionately to the overall environmental impact of food consumption, sustainability considerations must be applied cautiously when contemplating reductions in recommended intake levels for children and adolescents. Before lowering recommendations for environmentally relevant food groups, it is essential to thoroughly evaluate the potential risks of nutrient inadequacies in younger age groups. For example, Kersting et al. identified dairy products as a key nutrient source for children and therefore chose not to reduce recommended intake for this category; for nuts and peanuts, they even increased recommendations (from 1.70 % energy in the Optimized Mixed Diet to 4.85 % energy) (Kersting et al., 2024).

Depending on their origin, nuts and seeds can also be associated with relatively high environmental impacts (BLV, 2022). In the case of dairy products, further research is needed to understand if and how dairy consumption in early childhood should be adapted compared to adults. On the one hand, potential risk of nutrient deficiencies should be minimized, on the other hand, a life-long dairy consumption increase should be avoided due to substantial additional impacts on the environment as well as possibly, animal welfare (Mulligan & Doherty, 2008) (Case Study 1). For example, recommendations could be combined with explanations that milk consumption primarily creates benefits in the early life stage but rather creates environmental problems if consumed in high amounts during the whole life.

Case Study 1 : Environmental impacts of recommendations of 3 versus 2 portions of milk and dairy products for children and adolescents

Dairy products account for around 20–25% of the overall environmental impacts of current Swiss food consumption, but contribute disproportionately to climate impacts, making up about 30% of total greenhouse gas emissions (Beretta & Hellweg, 2019 and Jungbluth et al., 2024). For adults, the average Planetary Health Diet (PHD) recommendation (153 kcal) is 2-3 times lower than the present consumption for dairy products in terms of kilocalories consumed according to Agristat (153 kcal instead of 423 kcal) (Agristat, 2024 and Eat Lancet Commission, 2019), (Eggenschwiler et al., o. J.). Considering that the actual intake might be lower than the consumption level reported by Agristat due to household food waste, the difference might be slightly lower.
Compared to the PHD, the present Swiss dietary recommendations for dairy products are slightly higher, suggesting 2 portions per day since September 2024 (formerly 3 portions were recommended). The guidelines don't specify calorie intake, but since one portion varies between about 100-150 kcal depending on the type of dairy product, the Swiss recommendation lies in the upper range of the PHD recommendation for dairy products (0-306 kcal).
The difference between a recommendation of 2 portions and 3 portions of dairy products for the entire population, assuming 100-150 kcal/portion, corresponds to a difference of about 2.8-5.6% of total climate impacts of food consumption. If the recommendations are only related to children and young adolescents (age 4-17 years), the climate impacts increase from 2 to 3 portions of dairy products by 0.4-0.8%. The results show that the environmental impacts increase by 2-3 times less than the climate impacts.
This shows that lowering dairy product consumption creates larger direct environmental benefits, if it is focused on adults rather than on children. However, indirect effects of increased dairy product consumption of children on eating habits in their later stages of life need to be considered as well when formulating healthy and sustainable dietary recommendations for children. According to the menuCH study, adults aged 18 to 75 consume an average of just 2 portions of milk and dairy products per day although the previous recommendation over the past years was 3 portions (BLV, 2017). Thus, consumption appears to decrease with age. This could indicate that the recommendation for children and adolescents can remain at 3 portions, with an expected decrease in consumption in adulthood.

5.3 Planetary Health Diet – adaption to children and adolescence

The WHO's Guidelines on Sustainable Healthy Diets (2019) outline a dietary model that supports both human health and environmental sustainability. These diets emphasize breastfeeding, the consumption of diverse, safe, and minimally processed foods, and the limitation of highly processed products and sugary beverages to reduce the risk of non-communicable diseases. From an ecological perspective, they aim to limit greenhouse gas emissions, land and water use, and the application of nitrogen, phosphorus, and other chemicals, while also preserving biodiversity. Importantly, such diets must also be culturally acceptable, accessible, and feasible, without placing disproportionate burdens, especially on women, in terms of time or financial resources (WHO, 2019).

A possible implementation of this concept is the Planetary Health Diet (PHD), developed by the EAT-Lancet Commission (Willett et al., 2019). Designed primarily for adults, the PHD focuses on preventing chronic diseases while promoting environmental sustainability through a predominantly plant-based dietary pattern that allows limited intake of animal-sourced foods. Cacau et al developed an index to evaluate the adherence to the PHD, the PHD Index (PHDI) (Cacau et al., 2021).

However, applying this model to children and adolescents presents specific challenges. Unlike adults, younger individuals undergo dynamic phases of growth and development, which come with changing energy and nutrient requirements. It remains uncertain whether the health benefits observed in adults can be directly translated to younger age groups. Cacau et al. applied the PHDI to data from the "Healthy Lifestyle in Europe by Nutrition in Adolescence" (HELENA) project and observed that a 10-point increase in the PHDI was linked to better cardiovascular health in European adolescents, showing lower odds of having high blood pressure, and high blood cholesterol, even after adjusting for demographic and lifestyle factors (Cacau et al., 2024). Another model to evaluate the adherence to the PHD was used by (Montejano Vallejo et al., 2022), they observed that a higher adherence to the PHD in adolescence (based on data from the DONALD study) was also beneficial with respect to anthropometric markers in early adulthood, although not for further cardiometabolic risk markers. These observations are promising, however evidence on long-term impacts in these age groups is still limited.

Moreover, the original PHD may fall short of meeting the full nutritional demands of growing children and adolescents. Nutrients such as bioavailable protein, iron, calcium, and vitamins B_{12} and D are especially critical during these developmental stages and require careful attention (Conti et al., 2024). Without appropriate adaptations, there is a risk that a strictly plant-based diet may not provide adequate nutrition for younger populations.

Conclusion: The Planetary Health Diet offers a valuable framework for aligning dietary habits with goals for human and planetary health. Yet, its implementation in children and adolescents requires careful modification to ensure nutritional adequacy. Ongoing research is essential to refine these adaptations and assess their effectiveness over the long term.

5.4 Sustainability considerations in children’s and adolescents’ dietary recommendations

In recent years, several European countries have begun to systematically integrate sustainability considerations into their national dietary guidelines. Increasingly, these guidelines are designed not only to provide adequate amounts of nutrients, but also to reduce the environmental impact of dietary patterns. On the FAO website, a corresponding section is provided for each country that includes sustainability aspects in its dietary guidelines (FAO, o. J.). Although the data available there is not always up to date, it offers a useful overview. In the specific guidelines for children and young adolescents, however, sustainability considerations are still lacking in most cases.

When sustainability aspects are considered, integration is typically driven more by life cycle assessment data for various food groups, used in mathematical models, than by overarching concepts like the Planetary Health Diet. Nonetheless, the resulting patterns generally alig n with its principles, favoring less animal-based and more plant-based foods.

Sweden was one of the first countries in Europe to integrate sustainability criteria into its dietary guidelines. These guidelines apply to adults and children aged two years and older. The recommendations are based on the Nordic Nutrition Recommendations (Nordic Council of Ministers, 2023). In addition, findings from life cycle analyses as well as national and international studies on the environmental burden of food were considered. The guidelines promote increased consumption of plant-based foods while reducing the intake of red and processed meat (Brugard Konde et al., o. J.).

Also in the **Netherlands**, sustainability has been systematically integrated into national dietary guidelines, known as the Schijf van Vijf (*Wheel of Five*), which apply to all age groups, including children and adolescents. These guidelines not only promote nutritional adequacy but also address environmental concerns by setting upper intake limits for animal-based foods associated with high greenhouse gas emissions. Specifically, they recommend limiting meat consumption to no more than 500 grams per week, including 2 to 3 servings of dairy products daily, and consuming fish no more than once per week (Brink et al., 2019), (FAO, o. J.).

This approach is supported by a series of complementary studies (Brink et al., 2019; Kramer et al., 2017; Temme et al., 2015), which demonstrate how environmental sustainability can be effectively embedded into national food-based dietary recommendations without compromising health. Collectively, these studies confirm that animal-based foods (especially red meat and dairy) contribute disproportionately to environmental burdens such as greenhouse gas emissions, land use, and fossil energy demand. Consequently, reducing the intake of these products emerges as a key strategy to lower the environmental footprint of the Dutch diet.

Brink et al. (2019) used a diet optimization model to develop age- and population-specific dietary guidelines that align nutritional needs with environmental constraints. High-impact food groups, including red meat and dairy, were assigned maximum thresholds, and the resulting recommendations were incorporated into practical tools like the above-mentioned *Wheel of Five*.

Kramer et al. (2017) applied linear programming to design diets for Dutch men and women aged 9 to 69 years that meet both nutritional and environmental criteria while staying as close as possible to current eating patterns. Their findings suggest that significant environmental benefits can be achieved primarily by reducing meat consumption, without requiring major changes to dairy or fish intake, which remain important for nutritional adequacy.

Temme et al. (2015) focused on children's diets (2 to 6 years) and modelled the environmental effects of replacing 30% or 100% of meat and dairy with plant-based alternatives. Even partial substitution resulted in substantial reductions in greenhouse gas emissions and land use, while preserving most nutrient intakes. However, full replacement raised concerns regarding the adequacy of essential micronutrients such as vitamin B_{12} and zinc.

Together, these studies underscore the potential of shifting towards more plant-based diets as an effective means of reducing environmental impacts. However, such transitions must be carefully managed to ensure they continue to meet the nutritional needs of the population, particularly among vulnerable groups.

In **Germany**, the updated dietary guidelines released by the German Nutrition Society (DGE) in 2024 also explicitly address sustainability. They are based on a mathematical optimization model that considers not only health aspects but also environmental impacts such as greenhouse gas emissions and land use. The result is a plant-based dietary pattern with a reduced proportion of animal-based foods (Schäfer et al., 2024). However, these recommendations currently apply only to adults. According to the DGE, revised guidelines for infants, children, and adolescents are under development and will also incorporate sustainability considerations.

Recent research by Kersting et al. (2024) demonstrates that a shift towards greater environmental sustainability is also feasible for younger age groups. They used the so-called Planetary Health Index (PHDI) that measures how well a diet follows the EAT-Lancet reference diet by scoring intake from 16 food groups (Cacau et al., 2021). Higher scores reflect for example more fruits, vegetables and whole grains, balanced amounts of dairy, fish and eggs, and limited red meat and added sugars, with a maximum of 150 points. By applying the PHDI to the Optimized Mixed Diet (OMD) for children and adolescents in Germany, the authors showed that targeted changes in food selection, such as increasing nuts, grain legumes, green vegetables, and whole grains, while reducing red meat, tubers and potatoes, can significantly improve the diet's sustainability profile. The PHDI score increased from 68.24 to 81.51 points, without compromising nutrient adequacy or meal structure. Importantly, the study included dairy products due to their nutritional importance for children and retained a small amount of high-fat, high-sugar foods that are typically well accepted by this age group (e.g. chocolate, ice cream, fine bakery items). These "tolerated foods" contribute to energy intake more than "added sugars" alone and would have needed to be drastically reduced to further improve the PHDI score, at the cost of dietary acceptance. The findings underscore that the environmental optimization of children's diets is achievable but must carefully balance sustainability goals with the specific nutritional and sensory needs of growing children.

5.5 Conclusions

The environmental impact of diets varies considerably across age groups, dietary patterns, and national contexts. Although children and adolescents account for only a small share of total food consumption, their dietary habits play a crucial role in shaping future food system sustainability. Early life stages are decisive in forming long-term eating behaviors, suggesting that promoting sustainable and healthy diets from a young age can yield lasting benefits for both individual health and environmental outcomes. However, the unique nutritional needs of growing individuals must be carefully considered when adapting adult-focused dietary models, such as the Planetary Health Diet, for younger populations.

Reducing the consumption of red and processed meat emerges as a particularly effective strategy to align health and environmental goals without risking nutrient deficiencies. In contrast, the reduction of dairy products requires more cautious consideration, as dairy remains an important source of essential nutrients during growth and development. Experiences from European countries demonstrate that integrating sustainability into dietary guidelines is feasible without compromising health, although targeted adjustments are necessary. Moving forward, it is essential to continue refining dietary recommendations for children and adolescents, balancing immediate nutritional adequacy with the long-term goal of fostering sustainable dietary patterns across the lifespan.

6 General conclusion and recommendations

Limitations

Due to budget limitations, this report is based on systematic reviews and/or meta-analyses. A common feature among these reviews is that most include primary studies with various designs (RCTs, PCS, CSS), often without restrictions on publication date, or geographical specifications. Furthermore, this led to some primary studies been retained in several reviews (not always in the same combinations). This contrasts with the reviews conducted in the USA for the revision of the 2025-2030 Dietary Guidelines. These reviews, published mainly in 2024, were organized by food group and outcome and were based on primary studies including only RCTs and PCS (CSS excluded), conducted in countries classified as high to very high on the Human Development Index (HDI) and published between 2000–2023 (USDA Nutrition Evidence Systematic Review Branch, o. J.)

In retrospect, this approach is both valid and transparent. Interestingly, however, our broader inclusion criteria led to similar conclusions for most food groups.

Strength of findings

Current research linking food group intake during childhood and adolescence to the development of NCDs like obesity, T2DM and CVDs is limited and inconclusive. A major challenge is the long-time lag between early dietary habits and disease onset, compounded by reliance on cross-sectional studies, inconsistent dietary data, and poorly standardized food group classifications.

Recent research trends emphasize overall dietary patterns rather than isolated food groups. To advance the field, better dietary assessment methods, clearer food classifications, and longitudinal studies are urgently needed.

International dietary guidelines for children and adolescents show consistent main messages, but vary in detail, age specificity, and use of evidence. Switzerland's adolescent guidelines are based on adult data and focus on personal responsibility, while other countries often target professionals or parents. There is limited direct communication to adolescents themselves, the Netherland's "Schijf van Vijf" being one of the exceptions.

Most guidelines operate implicitly within a health promotion context, addressing malnutrition, overweight, and healthy growth. The inclusion of sustainability considerations is growing, but still rare in child-focused guidelines. Successful examples like the Dutch "Schijf van Vijf" demonstrate the value of clear, visually appealing, and digitally accessible guidance for young audiences. School environments and parental modelling are recognized as crucial influences on children's diets.

Public Health Conclusiones

- **Evidence gaps** in early dietary determinants of NCDs weaken the foundation for childhood-specific dietary guidelines.
- **Current guidelines** often fail to effectively reach young people directly, missing a key opportunity for early prevention.
- **Sustainability aspects** are increasingly included in adult dietary guidelines but remain largely absent for children and adolescents.
- **School and family settings** are vital arenas for shaping healthy eating habits during childhood and adolescence.

Recommendations

1. **Invest in high-quality longitudinal studies** that build upon the observations and findings derived from cross-sectional research, such as the menuCH-Kids study (BLV, 2025a). There is also a need for the standardization of food group definitions and the use of appropriate dietary assessment tools to ensure comparability and validity across studies.
2. **Develop age- and developmentally appropriate guidelines**: Tailor communications to children, younger adolescents, and older adolescents separately, using engaging, digital-friendly formats.
3. **Address sustainability explicitly**: Gradually introduce sustainability principles in child and adolescent dietary guidelines, using age-appropriate messaging that resonates without alienating audiences.
4. **Enhance school food environments**: Implement national standards and healthy catering policies in schools to reinforce guidelines where children spend a significant part of their day.

5. **Strengthen parental engagement**: Provide resources that support parents as role models while also empowering children and adolescents to make informed food choices.
6. **Evaluate communication strategies**: Study the effectiveness of explicit health versus sustainability messaging and adapt approaches based on audience responsiveness.

Conflicts of interest: The authors have no potential conflicts of interest to disclose.

IT tools and internet resources used for this report:

- Literature search: https://pubmed.ncbi.nlm.nih.gov/, https://www.cochranelibrary.com/, https://scholar.google.com/
- reference management tool: Zotero www.zotero.org
- Writing: some text passages were re-worded with AI assistance: https://chatgpt.com/

7 List of tables

8 References

2020 Dietary Guidelines Advisory Committee. (2020). *Dietary Patterns and Risk of Cardiovascular Disease: A Systematic Review*. http://www.ncbi.nlm.nih.gov/books/NBK578519/

Abbasalizad Farhangi, M., Mohammadi Tofigh, A., Jahangiri, L., Nikniaz, Z., & Nikniaz, L. (2022). Sugar-sweetened beverages intake and the risk of obesity in children: An updated systematic review and dose-response meta-analysis. *Pediatric Obesity*, *17*(8), e12914. https://doi.org/10.1111/ijpo.12914

Abu Risha, M., Rick, E.-M., Plum, M., & Jappe, U. (2024). Legume Allergens Pea, Chickpea, Lentil, Lupine and Beyond. *Current Allergy and Asthma Reports*, *24*(9), 527–548. https://doi.org/10.1007/s11882-024-01165-7

Albertson, A. M., Affenito, S. G., Bauserman, R., Holschuh, N. M., Eldridge, A. L., & Barton, B. A. (2009). The Relationship of Ready-to-Eat Cereal Consumption to Nutrient Intake, Blood Lipids, and Body Mass Index of Children as They Age through Adolescence. *Journal of the American Dietetic Association*, *109*(9), 1557–1565. https://doi.org/10.1016/j.jada.2009.06.363

Ali, F., Rehman, H., Babayan, Z., Stapleton, D., & Joshi, D.-D. (2015). Energy drinks and their adverse health effects: A systematic review of the current evidence. *Postgraduate Medicine*, *127*(3), 308–322. https://doi.org/10.1080/00325481.2015.1001712

Almoraie, N. M., Saqaan, R., Alharthi, R., Alamoudi, A., Badh, L., & Shatwan, I. M. (2021). Snacking patterns throughout the life span: Potential implications on health. *Nutrition Research*, *91*, 81–94. https://doi.org/10.1016/j.nutres.2021.05.001

Alosaimi, N., Sherar, L. B., Griffiths, P., & Pearson, N. (2023). Clustering of diet, physical activity and sedentary behaviour and related physical and mental health outcomes: A systematic review. *BMC Public Health*, *23*(1), 1572. https://doi.org/10.1186/s12889-023-16372-6

Anderson, C. A. M., Gardner, C., Talegawkar, S., Hoelscher, D. M., Stanford, F. C., Tobias, D., Booth, S., Fung, T., Deierlein, A., Giovannucci, E., Raynor, H., Taylor, C., Raghavan, R., English, L. K., Reigh, N., Huang, S., Higgins, M., Callahan, E. H., Fultz, A., … Obbagy, J. (2024). *Dietary Patterns and Risk of Cardiovascular Disease: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK612535/

ANSES. (2019). *OPINION of the French Agency for Food, Environmental and Occupational Health & Safety on the updating of the PNNS dietary guidelines for children from four to 17 years of age*. https://www.anses.fr/en/system/files/NUT2017SA0142EN.pdf

ANSES. (2025). *AVIS de l'Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail relatif à l'élaboration de VTR long terme par voie orale pour les isoflavones*. https://www.anses.fr/sites/default/files/VSR2022SA0221RA.pdf

Arnesen, E. K., Thorisdottir, B., Lamberg-Allardt, C., Bärebring, L., Nwaru, B., Dierkes, J., Ramel, A., & Åkesson, A. (2022). Protein intake in children and growth and risk of overweight or obesity: A systematic review and meta-analysis. *Food & Nutrition Research*. https://doi.org/10.29219/fnr.v66.8242

Auerbach, B. J., Wolf, F. M., Hikida, A., Vallila-Buchman, P., Littman, A., Thompson, D., Louden, D., Taber, D. R., & Krieger, J. (2017). Fruit Juice and Change in BMI: A Meta-analysis. *Pediatrics*, *139*(4), e20162454. https://doi.org/10.1542/peds.2016-2454

Babio, N., Becerra-Tomás, N., Nishi, S. K., López-González, L., Paz-Graniel, I., García-Gavilán, J., Schröder, H., Martín-Calvo, N., & Salas-Salvadó, J. (2022). Total dairy consumption in relation to overweight and obesity in children and adolescents: A systematic review and meta-analysis. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *23 Suppl 1*, e13400. https://doi.org/10.1111/obr.13400

BAG. (2025). *Übergewicht und Adipositas (Alter: 6–12) | MonAM | BAG*. https://ind.obsan.admin.ch/indicator/monam/uebergewicht-und-adipositas-alter-6-12

Balvin Frantzen, L., Treviño, R. P., Echon, R. M., Garcia-Dominic, O., & DiMarco, N. (2013). Association between Frequency of Ready-to-Eat Cereal Consumption, Nutrient Intakes, and Body Mass Index in Fourth- to Sixth-Grade Low-Income Minority Children. *Journal of the Academy of Nutrition and Dietetics*, *113*(4), 511–519. https://doi.org/10.1016/j.jand.2013.01.006

Bartel, K. A., Gradisar, M., & Williamson, P. (2015). Protective and risk factors for adolescent sleep: A meta-analytic review. *Sleep Medicine Reviews*, *21*, 72–85. https://doi.org/10.1016/j.smrv.2014.08.002

Belot, M., James, J., & Nolen, P. (2013). *Changing Eating Habits: A Field Experiment in Primary Schools* (No. 219; ESE Discussion Papers, S. 52). ESE. https://www.pure.ed.ac.uk/ws/portalfiles/portal/20026351/219_Changing_habits_Belot.pdf

Benziger, C. P., Roth, G. A., & Moran, A. E. (2016). The Global Burden of Disease Study and the Preventable Burden of NCD. *Global Heart*, *11*(4), 393–397. https://doi.org/10.1016/j.gheart.2016.10.024

Beretta, C., & Hellweg, S. (2019). *Lebensmittelverluste in der Schweiz:Umweltbelastung und Vermeidungspotenzial*. ETH. https://www.bafu.admin.ch/dam/bafu/de/dokumente/abfall/externe-studien-berichte/lebensmittelverluste-in-der-schweiz-umweltbelastung-und-verminderungspotenzial.pdf.download.pdf/ETH-Bericht_Foodwaste_FINAL.pdf

Berrazaga, I., Micard, V., Gueugneau, M., & Walrand, S. (2019). The Role of the Anabolic Properties of Plant- versus Animal-Based Protein Sources in Supporting Muscle Mass Maintenance: A Critical Review. *Nutrients*, *11*(8), Article 8. https://doi.org/10.3390/nu11081825

BFS. (2025). *Ständige Wohnbevölkerung nach Geschlecht und Alter, 1860-2023*. PX-Web. http://www.pxweb.bfs.admin.ch/pxweb/de/px-x-0102030000_101/px-x-0102030000_101/px-x-0102030000_101.px/

Blaine, R. E., Kachurak, A., Davison, K. K., Klabunde, R., & Fisher, J. O. (2017). Food parenting and child snacking: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 146. https://doi.org/10.1186/s12966-017-0593-9

BLV. (2017). *Milch- und Milchproduktekonsum in der Schweiz 2014/15*. BLV.

BLV. (2024). *Schweizer Ernährungsempfehlungen*. https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/empfehlungen-informationen/schweizer-ernaehrungsempfehlungen.html

BLV. (2025a). *menuCH-Kids: Einblick in das Essverhalten junger Menschen in der Schweiz*. https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/menuch-kids.html

BLV. (2025b). *Zuckerreduktion*. https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/produktzusammensetzung/zuckerreduktion.html

Bogaard, L. (2023). Parent Influences on the Dietary Habits of Young Adults. *Berkeley Undergraduate Journal*, *37*(1). https://doi.org/10.5070/B337162077

Boushey, C., Ard, J., Bazzano, L., Heymsfield, S., Mayer-Davis, E., Sabaté, J., Snetselaar, L., Van Horn, L., Schneeman, B., English, L. K., Bates, M., Callahan, E., Butera, G., Terry, N., & Obbagy, J. (2020a). *Dietary Patterns and Growth, Size, Body Composition, and/or Risk of Overweight or Obesity: A Systematic Review*. http://www.ncbi.nlm.nih.gov/books/NBK577644/

Boushey, C., Ard, J., Bazzano, L., Heymsfield, S., Mayer-Davis, E., Sabaté, J., Snetselaar, L., Van Horn, L., Schneeman, B., English, L. K., Bates, M., Callahan, E., Butera, G., Terry, N., & Obbagy, J. (2020b). *Dietary Patterns and Risk of Type 2 Diabetes: A Systematic Review*. http://www.ncbi.nlm.nih.gov/books/NBK578518/

Brink, E., Rossum, C. van, Postma-Smeets, A., Stafleu, A., Wolvers, D., Dooren, C. van, Toxopeus, I., Buurma-Rethans, E., Geurts, M., & Ocké, M. (2019). Development of healthy and sustainable food-based dietary guidelines for the Netherlands. *Public Health Nutrition*, *22*(13), 2419–2435. https://doi.org/10.1017/S1368980019001435

Brown, R. J., de Banate, M. A., & Rother, K. I. (2010). Artificial sweeteners: A systematic review of metabolic effects in youth. *International Journal of Pediatric Obesity: IJPO: An Official Journal of the International Association for the Study of Obesity*, *5*(4), 305–312. https://doi.org/10.3109/17477160903497027

Brugard Konde, B., Bjerselius, R., Haglund, L., & Jannson, A. (o. J.). *Advice on Healthy Food Habits—A Risks and Benefits Management Report*. https://openknowledge.fao.org/server/api/core/bitstreams/45116cab-2d8e-4e48-bd06-a7759d63930c/content

Bundesministerium für Soziales, Gesundheit, Pflege und Konsumentenschutz (BMSGPK). (2017). *Empfehlung der Nationalen Ernährungskommission Ernährungsempfehlungen für Kinder im Alter von 4—10 Jahren*. BMSGPK.

Burrows, T., Pursey, K., Neve, M., & Stanwell, P. (2013). What are the health implications associated with the consumption of energy drinks? A systematic review. *Nutrition Reviews*, *71*(3), 135–148. https://doi.org/10.1111/nure.12005

Cacau, L. T., De Carli, E., de Carvalho, A. M., Lotufo, P. A., Moreno, L. A., Bensenor, I. M., & Marchioni, D. M. (2021). Development and Validation of an Index Based on EAT-Lancet Recommendations: The Planetary Health Diet Index. *Nutrients*, *13*(5), 1698. https://doi.org/10.3390/nu13051698

Cacau, L. T., Hanley-Cook, G. T., Vandevijvere, S., Leclercq, C., De Henauw, S., Santaliestra-Pasias, A., Manios, Y., Mourouti, N., Esperanza Díaz, L., Gonzalez-Gross, M., Widhalm, K., Molnar, D., Stehle, P., Kafatos, A., Gottrand, F., Kersting, M., Castillo, M., Lachat, C., Marchioni, D. M., … Moreno, L. A. (2024). Association between adherence to the EAT-Lancet sustainable reference diet and cardiovascular health among European adolescents: The HELENA study. *European Journal of Clinical Nutrition*, *78*(3), 202–208. https://doi.org/10.1038/s41430-023-01379-4

Cena, H., & Calder, P. C. (2020). Defining a Healthy Diet: Evidence for The Role of Contemporary Dietary Patterns in Health and Disease. *Nutrients*, *12*(2), 334. https://doi.org/10.3390/nu12020334

Chalupa-Krebzdak, S., Long, C. J., & Bohrer, B. M. (2018). Nutrient density and nutritional value of milk and plant-based milk alternatives. *International Dairy Journal*, *87*, 84–92. https://doi.org/10.1016/j.idairyj.2018.07.018

Chang, K., Khandpur, N., Neri, D., Touvier, M., Huybrechts, I., Millett, C., & Vamos, E. P. (2021). Association Between Childhood Consumption of Ultraprocessed Food and Adiposity Trajectories in the Avon Longitudinal Study of Parents and Children Birth Cohort. *JAMA Pediatrics*, *175*(9), e211573. https://doi.org/10.1001/jamapediatrics.2021.1573

Chatelan, A., Castetbon, K., Pasquier, J., Allemann, C., Zuber, A., Camenzind-Frey, E., Zuberbuehler, C. A., & Bochud, M. (2018). Association between breakfast composition and abdominal obesity in the Swiss adult population eating breakfast regularly. *International Journal of Behavioral Nutrition and Physical Activity*, *15*(1), 115. https://doi.org/10.1186/s12966-018-0752-7

Chatelan, A., Gaillard, P., Kruseman, M., & Keller, A. (2019). Total, Added, and Free Sugar Consumption and Adherence to Guidelines in Switzerland: Results from the First National Nutrition Survey menuCH. *Nutrients*, *11*(5), Article 5. https://doi.org/10.3390/nu11051117

Collese, T. S., Nascimento-Ferreira, M. V., de Moraes, A. C. F., Rendo-Urteaga, T., Bel-Serrat, S., Moreno, L. A., & Carvalho, H. B. (2017). Role of fruits and vegetables in adolescent cardiovascular health: A systematic review. *Nutrition Reviews*, *75*(5), 339–349. https://doi.org/10.1093/nutrit/nux002

Conti, M. V., Vincenti, A., Beretta, A., Calcaterra, V., Taranto, S., Diotti, M., Zuccotti, G., & Cena, H. (2024). Planetary Health Diet for Childhood Obesity Prevention: Integrating Nutritional Health with Environmental Stewardship. *Nutrients*, *16*(24), Article 24. https://doi.org/10.3390/nu16244316

Costa, C. S., Del-Ponte, B., Assunção, M. C. F., & Santos, I. S. (2018). Consumption of ultra-processed foods and body fat during childhood and adolescence: A systematic review. *Public Health Nutrition*, *21*(1), 148–159. https://doi.org/10.1017/S1368980017001331

Costa-Catala, J., Toro-Funes, N., Comas-Basté, O., Hernández-Macias, S., Sánchez-Pérez, S., Latorre-Moratalla, M. L., Veciana-Nogués, M. T., Castell-Garralda, V., & Vidal-Carou, M. C. (2023). Comparative Assessment of the Nutritional Profile of Meat Products and Their Plant-Based Analogues. *Nutrients*, *15*(12), Article 12. https://doi.org/10.3390/nu15122807

Costantino, A., Maiese, A., Lazzari, J., Casula, C., Turillazzi, E., Frati, P., & Fineschi, V. (2023). The Dark Side of Energy Drinks: A Comprehensive Review of Their Impact on the Human Body. *Nutrients*, *15*(18), 3922. https://doi.org/10.3390/nu15183922

Crowe-White, K., O'Neil, C. E., Parrott, J. S., Benson-Davies, S., Droke, E., Gutschall, M., Stote, K. S., Wolfram, T., & Ziegler, P. (2016). Impact of 100% Fruit Juice Consumption on Diet and Weight Status of Children: An Evidence-based Review. *Critical Reviews in Food Science and Nutrition*, *56*(5), 871–884. https://doi.org/10.1080/10408398.2015.1061475

De Amicis, R., Mambrini, S. P., Pellizzari, M., Foppiani, A., Bertoli, S., Battezzati, A., & Leone, A. (2022). Ultra-processed foods and obesity and adiposity parameters among children and adolescents: A systematic review. *European Journal of Nutrition*, *61*(5), 2297–2311. https://doi.org/10.1007/s00394-022-02873-4

de Oliveira, P. G., de Sousa, J. M., Assunção, D. G. F., de Araujo, E. K. S., Bezerra, D. S., Dametto, J. F. D. S., & Ribeiro, K. D. da S. (2022). Impacts of Consumption of Ultra-Processed Foods on the Maternal-Child Health: A Systematic Review. *Frontiers in Nutrition*, *9*, 821657. https://doi.org/10.3389/fnut.2022.821657

Derbyshire, E. (2019). Are all 'ultra-processed' foods nutritional demons? A commentary and nutritional profiling analysis. *Trends in Food Science & Technology*, *94*, 98–104. https://doi.org/10.1016/j.tifs.2019.08.023

Derbyshire, E., & Ruxton, C. H. S. (2025). A Systematic Review of Evidence on the Role of Ready-to-Eat Cereals in Diet and Non-Communicable Disease Prevention. *Nutrients*, *17*(10), 1680. https://doi.org/10.3390/nu17101680

Dobrek, L. (2025). The Review on Adverse Effects of Energy Drinks and Their Potential Drug Interactions. *Nutrients*, *17*(15), 2435. https://doi.org/10.3390/nu17152435

Doepker, C., Franke, K., Myers, E., Goldberger, J. J., Lieberman, H. R., O'Brien, C., Peck, J., Tenenbein, M., Weaver, C., & Wikoff, D. (2018). Key Findings and Implications of a Recent Systematic Review of the Potential Adverse Effects of

Caffeine Consumption in Healthy Adults, Pregnant Women, Adolescents, and Children. *Nutrients*, *10*(10), 1536. https://doi.org/10.3390/nu10101536
Dougkas, A., Barr, S., Reddy, S., & Summerbell, C. D. (2019). A critical review of the role of milk and other dairy products in the development of obesity in children and adolescents. *Nutrition Research Reviews*, *32*(1), 106–127. https://doi.org/10.1017/S0954422418000227
Dror, D. K. (2014). Dairy consumption and pre-school, school-age and adolescent obesity in developed countries: A systematic review and meta-analysis. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *15*(6), 516–527. https://doi.org/10.1111/obr.12158
EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA). (2010). Scientific Opinion on Dietary Reference Values for water. *EFSA Journal*, *8*(3), 1459. https://doi.org/10.2903/j.efsa.2010.1459
EFSA Panel on Dietetic Products, Nutrition and Allergies (NDA). (2015). Scientific Opinion on the safety of caffeine. *EFSA Journal*, *13*(5), 4102. https://doi.org/10.2903/j.efsa.2015.4102
Eggenschwiler, M., Linzmajer, M., Stoll, M., & Bally, L. (o. J.). *Planetary Health Diet in der Schweiz 2024*.
English, L. K., Obbagy, J. E., Wong, Y. P., Psota, T. L., Nadaud, P., Johns, K., Terry, N., Butte, N. F., Dewey, K. G., Fleischer, D. M., Fox, M. K., Greer, F. R., Krebs, N. F., Scanlon, K. S., Casavale, K. O., Spahn, J. M., & Stoody, E. (2019). *Types and Amounts of Complementary Foods and Beverages and Growth, Size, and Body Composition: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK582295/
Espinosa, A., Mendoza, K., Laviada-Molina, H., Rangel-Méndez, J. A., Molina-Segui, F., Sun, Q., Tobias, D. K., Willett, W. C., & Mattei, J. (2024). Effects of Nonnutritive Sweeteners on the BMI of Children and Adolescents: A Systematic Review and Meta-Analysis of Randomized Controlled Trials and Prospective Cohort Studies. *Advances in Nutrition (Bethesda, Md.)*, *15*(12), 100292. https://doi.org/10.1016/j.advnut.2024.100292
FAO. (o. J.). *Dietary guidelines*. https://www.fao.org/nutrition/education/dietary-guidelines/regions/europe/en
FAO and WHO. (2019). *Sustainable healthy diets: Guiding principles*. Food and Agriculture Organization of the United Nations : World Health Organization.
Farhangi, M. A., Nikniaz, L., & Khodarahmi, M. (2020). Sugar-sweetened beverages increases the risk of hypertension among children and adolescence: A systematic review and dose-response meta-analysis. *Journal of Translational Medicine*, *18*(1), 344. https://doi.org/10.1186/s12967-020-02511-9
Fayet-Moore, F. (2016). Effect of flavored milk vs plain milk on total milk intake and nutrient provision in children. *Nutrition Reviews*, *74*(1), 1–17. https://doi.org/10.1093/nutrit/nuv031
Fedde, S., Büttner-Koch, S., Plähn, V., & Bosy-Westphal, A. (2022). Implementation of the Nutri-Score. *Peer Review*.
Ferrari, G. G., & Eng, P. A. (2011). IgE-mediated food allergies in Swiss infants and children. *Swiss Medical Weekly*, *141*, w13269. https://doi.org/10.4414/smw.2011.13269
Fiore, G., Scapaticci, S., Neri, C. R., Azaryah, H., Escudero-Marín, M., Pascuzzi, M. C., La Mendola, A., Mameli, C., Chiarelli, F., Campoy, C., Zuccotti, G., & Verduci, E. (2024). Chrononutrition and metabolic health in children and adolescents: A systematic review and meta-analysis. *Nutrition Reviews*, *82*(10), 1309–1354. https://doi.org/10.1093/nutrit/nuad122
Fisberg, M., Gioia, N., & Maximino, P. (2024). Transgenerational transmission of eating habits. *Jornal de Pediatria*, *100*, S82–S87. https://doi.org/10.1016/j.jped.2023.11.007
Frantsve-Hawley, J., Bader, J. D., Welsh, J. A., & Wright, J. T. (2017). A systematic review of the association between consumption of sugar-containing beverages and excess weight gain among children under age 12. *Journal of Public Health Dentistry*, *77 Suppl 1*, S43–S66. https://doi.org/10.1111/jphd.12222
Frías, J. R. G., Cadena, L. H., Villarreal, A. B., Piña, B. G. B., Mejía, M. C., Cerros, L. A. D., Gil, G. B., & Montes, J. O. A. (2023). Effect of ultra-processed food intake on metabolic syndrome components and body fat in children and adolescents: A systematic review based on cohort studies. *Nutrition (Burbank, Los Angeles County, Calif.)*, *111*, 112038. https://doi.org/10.1016/j.nut.2023.112038
FSVO. (o. J.). *The Swiss Food Composition Database*. The Swiss Food Composition Database. Abgerufen 21. August 2025, von https://webapp.prod.blv.foodcase-services.com/en/
Garcia-Iborra, M., Castanys-Munoz, E., Oliveros, E., & Ramirez, M. (2023). Optimal Protein Intake in Healthy Children and Adolescents: Evaluating Current Evidence. *Nutrients*, *15*(7), 1683. https://doi.org/10.3390/nu15071683
Gasser, C. E., Mensah, F. K., Russell, M., Dunn, S. E., & Wake, M. (2016). Confectionery consumption and overweight, obesity, and related outcomes in children and adolescents: A systematic review and meta-analysis. *The American Journal of Clinical Nutrition*, *103*(5), 1344–1356. https://doi.org/10.3945/ajcn.115.119883
GBD 2021 Risk Factors Collaborators. (2024). Global burden and strength of evidence for 88 risk factors in 204 countries and 811 subnational locations, 1990-2021: A systematic analysis for the Global Burden of Disease Study 2021. *Lancet (London, England)*, *403*(10440), 2162–2203. https://doi.org/10.1016/S0140-6736(24)00933-4
Gebrelibanos, M., Tesfaye, D., Raghavendra, Y., & Sintayeyu, B. (2013). Nutritional and Health Implications of Legumes. *. . ISSN*, *4*.
Giovannucci, E., Taylor, C. A., Deierlein, A. L., Raynor, H. A., Hoelscher, D. M., Anderson, C. A. M., Booth, S. L., Fung, T. T., Gardner, C. D., Stanford, F. C., Talegawkar, S. A., Tobias, D. K., Cole, N. C., Kingshipp, B. J., Webster, A., Higgins, M., Butera, G., Terry, N., & Obbagy, J. (2024a). *Low- and No-Calorie Sweetened Beverages and Risk of Type 2 Diabetes: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK611217/
Giovannucci, E., Taylor, C. A., Deierlein, A. L., Raynor, H. A., Hoelscher, D. M., Anderson, C. A. M., Booth, S. L., Fung, T. T., Gardner, C. D., Stanford, F. C., Talegawkar, S. A., Tobias, D. K., Cole, N. C., Kingshipp, B. J., Webster, A., Higgins, M., Butera, G., Terry, N., & Obbagy, J. (2024b). *Sugar-Sweetened Beverages and Risk of Type 2 Diabetes: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK611079/
Grimes, C. A., Bolton, K. A., Booth, A. B., Khokhar, D., Service, C., He, F. H., & Nowson, C. A. (2021). The association between dietary sodium intake, adiposity and sugar-sweetened beverages in children and adults: A systematic review and meta-analysis. *British Journal of Nutrition*, *126*(3), 409–427. https://doi.org/10.1017/S0007114520004122
Herter-Aeberli, I., Osuna, E., Sarnovská, Z., & Zimmermann, M. B. (2019). Significant Decrease in Childhood Obesity and Waist Circumference over 15 Years in Switzerland: A Repeated Cross-Sectional Study. *Nutrients*, *11*(8), 1922. https://doi.org/10.3390/nu11081922
Hoare, E., Varsamis, P., Owen, N., Dunstan, D. W., Jennings, G. L., & Kingwell, B. A. (2017). Sugar- and Intense-Sweetened Drinks in Australia: A Systematic Review on Cardiometabolic Risk. *Nutrients*, *9*(10), 1075. https://doi.org/10.3390/nu9101075

Hodder, R. K., O'Brien, K. M., Wyse, R. J., Tzelepis, F., Yoong, S., Stacey, F. G., & Wolfenden, L. (2024). Interventions for increasing fruit and vegetable consumption in children aged five years and under. *The Cochrane Database of Systematic Reviews*, *9*(9), CD008552. https://doi.org/10.1002/14651858.CD008552.pub8
Hörnell, A., Lagström, H., Lande, B., & Thorsdottir, I. (2013). Protein intake from 0 to 18 years of age and its relation to health: A systematic literature review for the 5th Nordic Nutrition Recommendations. *Food & Nutrition Research*. https://doi.org/10.3402/fnr.v57i0.21083
Hosseini, S. H., Jones, J. M., & Vatanparast, H. (2019). Association between Grain Intake, Nutrient Intake, and Diet Quality of Canadians: Evidence from the Canadian Community Health Survey–Nutrition 2015. *Nutrients*, *11*(8), 1937. https://doi.org/10.3390/nu11081937
Jakobsen, D. D., Brader, L., & Bruun, J. M. (2023a). Association between Food, Beverages and Overweight/Obesity in Children and Adolescents-A Systematic Review and Meta-Analysis of Observational Studies. *Nutrients*, *15*(3), 764. https://doi.org/10.3390/nu15030764
Jakobsen, D. D., Brader, L., & Bruun, J. M. (2023b). Effects of foods, beverages and macronutrients on BMI z-score and body composition in children and adolescents: A systematic review and meta-analysis of randomized controlled trials. *European Journal of Nutrition*, *62*(1), 1–15. https://doi.org/10.1007/s00394-022-02966-0
Jia, P., Luo, M., Li, Y., Zheng, J.-S., Xiao, Q., & Luo, J. (2021). Fast-food restaurant, unhealthy eating, and childhood obesity: A systematic review and meta-analysis. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *22 Suppl 1*(Suppl 1), e12944. https://doi.org/10.1111/obr.12944
Jungbluth, N., Eggenberger, S., & Keller, R. (2015). *Ökoprofil von Ernährungsstilen* (S. 26) [Projektbericht]. ESU-Services. https://www.wwf.ch/sites/default/files/doc-2021-05/jungbluth-2015-Ernaehrungsstile-WWF.pdf
Karalexi, M. A., Mitrogiorgou, M., Georgantzi, G. G., Papaevangelou, V., & Fessatou, S. (2018). Non-Nutritive Sweeteners and Metabolic Health Outcomes in Children: A Systematic Review and Meta-Analysis. *The Journal of Pediatrics*, *197*, 128-133.e2. https://doi.org/10.1016/j.jpeds.2018.01.081
Kersting, M., Kalhoff, H., Zahn, K., Belgardt, A., Cacau, L. T., Moreno, L. A., Sinningen, K., & Lücke, T. (2024). How to improve sustainability of nutrient dense diets for children and adolescents: An exemplary assessment in Germany. *European Journal of Nutrition*, *64*(1), 11. https://doi.org/10.1007/s00394-024-03530-8
Killion, K., Harris, J. L., & Duffy, V. B. (2023). Caregiver perceptions of snacks for young children: A thematic synthesis of qualitative research. *Appetite*, *188*, 106628. https://doi.org/10.1016/j.appet.2023.106628
Koller, A., Rohrmann, S., Wakolbinger, M., Gojda, J., Selinger, E., Cahova, M., Světnička, M., Haider, S., Schlesinger, S., Kühn, T., & Keller, J. W. (2024). Health aspects of vegan diets among children and adolescents: A systematic review and meta-analyses. *Critical Reviews in Food Science and Nutrition*, *64*(33), 13247–13258. https://doi.org/10.1080/10408398.2023.2263574
Kramer, G. F., Tyszler, M., Veer, P. van't, & Blonk, H. (2017). Decreasing the overall environmental impact of the Dutch diet: How to find healthy and sustainable diets with limited changes. *Public Health Nutrition*, *20*(9), 1699–1709. https://doi.org/10.1017/S1368980017000349
Krieger, J.-P., Pestoni, G., Cabaset, S., Brombach, C., Sych, J., Schader, C., Faeh, D., & Rohrmann, S. (2019). Dietary Patterns and Their Sociodemographic and Lifestyle Determinants in Switzerland: Results from the National Nutrition Survey menuCH. *Nutrients*, *11*(1), 62. https://doi.org/10.3390/nu11010062
Kristjansson, A. L., Sigfusdottir, I. D., Mann, M. J., & James, J. E. (2014). Caffeinated sugar-sweetened beverages and common physical complaints in Icelandic children aged 10–12 years. *Preventive Medicine*, *58*, 40–44. https://doi.org/10.1016/j.ypmed.2013.10.011
Kudlová, E., & Schneidrová, D. (2012). Dietary Patterns and Their Changes in Early Childhood. *Central European Journal of Public Health*, *20*(2), 126–134. https://doi.org/10.21101/cejph.a3703
Larrosa, S., Luque, V., Grote, V., Closa-Monasterolo, R., Ferré, N., Koletzko, B., Verduci, E., Gruszfeld, D., Xhonneux, A., & Escribano, J. (2021). Fibre Intake Is Associated with Cardiovascular Health in European Children. *Nutrients*, *13*(1), Article 1. https://doi.org/10.3390/nu13010012
Larson, E. A., Zhao, Z., Bader-Larsen, K. S., & Magkos, F. (2024). Egg consumption and growth in children: A meta-analysis of interventional trials. *Frontiers in Nutrition*, *10*. https://doi.org/10.3389/fnut.2023.1278753
Ledoux, T. A., Hingle, M. D., & Baranowski, T. (2011). Relationship of fruit and vegetable intake with adiposity: A systematic review. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *12*(5), e143-150. https://doi.org/10.1111/j.1467-789X.2010.00786.x
Leed, A., Sheridan, E., Baker, B., Bamford, S., Emmanouilidis, E., Stewart, F., Ostafe, K., Sarwari, M., Lim, K., Zheng, M., Islam, S. M. S., Bolton, K. A., & Grimes, C. A. (2023). Dietary Intake and Arterial Stiffness in Children and Adolescents: A Systematic Review. *Nutrients*, *15*(9), 2092. https://doi.org/10.3390/nu15092092
Li, A., Han, X., Liu, L., Zhang, G., Du, P., Zhang, C., Li, C., & Chen, B. (2024). Dairy products and constituents: A review of their effects on obesity and related metabolic diseases. *Critical Reviews in Food Science and Nutrition*, *64*(33), 12820–12840. https://doi.org/10.1080/10408398.2023.2257782
Liberali, R., Kupek, E., & Assis, M. A. A. de. (2020). Dietary Patterns and Childhood Obesity Risk: A Systematic Review. *Childhood Obesity (Print)*, *16*(2), 70–85. https://doi.org/10.1089/chi.2019.0059
Liu, X.-T., Wang, Y.-D., Xu, Y.-J., Wang, X.-Y., Shan, S.-F., Xiong, J.-Y., & Cheng, G. (2024). The divergent association of diet intake, parental education, and nutrition policy with childhood overweight and obesity from low- to high-income countries: A meta-analysis. *Journal of Global Health*, *14*, 04215. https://doi.org/10.7189/jogh.14.04215
Louie, J. C. Y. (2025). Are all ultra-processed foods bad? A critical review of the NOVA classification system. *Proceedings of the Nutrition Society*, 1–9. https://doi.org/10.1017/S0029665125100645
Louie, J. C. Y., Flood, V. M., Hector, D. J., Rangan, A. M., & Gill, T. P. (2011). Dairy consumption and overweight and obesity: A systematic review of prospective cohort studies. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *12*(7), e582-592. https://doi.org/10.1111/j.1467-789X.2011.00881.x
Lu, L., Xun, P., Wan, Y., He, K., & Cai, W. (2016). Long-term association between dairy consumption and risk of childhood obesity: A systematic review and meta-analysis of prospective cohort studies. *European Journal of Clinical Nutrition*, *70*(4), 414–423. https://doi.org/10.1038/ejcn.2015.226
Luger, M., Lafontan, M., Bes-Rastrollo, M., Winzer, E., Yumuk, V., & Farpour-Lambert, N. (2017). Sugar-Sweetened Beverages and Weight Gain in Children and Adults: A Systematic Review from 2013 to 2015 and a Comparison with Previous Studies. *Obesity Facts*, *10*(6), 674–693. https://doi.org/10.1159/000484566
Mahmood, L., Flores-Barrantes, P., Moreno, L. A., Manios, Y., & Gonzalez-Gil, E. M. (2021). The Influence of Parental Dietary Behaviors and Practices on Children's Eating Habits. *Nutrients*, *13*(4), 1138. https://doi.org/10.3390/nu13041138

Mann, K. D., Pearce, M. S., McKevith, B., Thielecke, F., & Seal, C. J. (2015). Low whole grain intake in the UK: Results from the National Diet and Nutrition Survey rolling programme 2008–11. *British Journal of Nutrition*, *113*(10), 1643–1651. https://doi.org/10.1017/S0007114515000422

Marino, M., Puppo, F., Del Bo', C., Vinelli, V., Riso, P., Porrini, M., & Martini, D. (2021). A Systematic Review of Worldwide Consumption of Ultra-Processed Foods: Findings and Criticisms. *Nutrients*, *13*(8), 2778. https://doi.org/10.3390/nu13082778

Markey, O., Pradeilles, R., Goudet, S., Griffiths, P. L., Boxer, B., Carroll, C., & Rousham, E. K. (2023). Unhealthy Food and Beverage Consumption during Childhood and Risk of Cardiometabolic Disease: A Systematic Review of Prospective Cohort Studies. *The Journal of Nutrition*, *153*(1), 176–189. https://doi.org/10.1016/j.tjnut.2022.11.013

Marques-Vidal, P., Infanger, E., Baumer, B., Van er Horst, K., Lehmann, U., Bender, N., Pannen, S., Karavasiloglou, N., Rohrmann, S., El Maohub, Y., Speranza, C., Suggs, S., Alig, M., Sangin, C., Frei, S., & Meier, M. (2022). *Swiss dietary recommendations: Scientific background* (S. 217) [BLV commission]. CHUV. https://www.blv.admin.ch/blv/de/home/lebensmittel-und-ernaehrung/ernaehrung/empfehlungen-informationen/schweizer-ernaehrungsempfehlungen.html

Mayer-Davis, E., Leidy, H., Mattes, R., Naimi, T., Novotny, R., Schneeman, B., Kingshipp, B. J., Spill, M., Cole, N. C., Bahnfleth, C. L., Butera, G., Terry, N., & Obbagy, J. (2020). *Beverage Consumption and Growth, Size, Body Composition, and Risk of Overweight and Obesity: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK579053/

Mazzocchi, A., De Cosmi, V., Scaglioni, S., & Agostoni, C. (2021). Towards a More Sustainable Nutrition: Complementary Feeding and Early Taste Experiences as a Basis for Future Food Choices. *Nutrients*, *13*(8), 2695. https://doi.org/10.3390/nu13082695

McCarthy, R., Kehoe, L., Flynn, A., & Walton, J. (2020). The role of fruit and vegetables in the diets of children in Europe: Current state of knowledge on dietary recommendations, intakes and contribution to energy and nutrient intakes. *Proceedings of the Nutrition Society*, *79*(4), 479–486. https://doi.org/10.1017/S0029665120007090

McClements, D. J., & Grossmann, L. (2021). The science of plant-based foods: Constructing next-generation meat, fish, milk, and egg analogs. *Comprehensive Reviews in Food Science and Food Safety*, *20*(4), 4049–4100. https://doi.org/10.1111/1541-4337.12771

Mesana, M. I., Hilbig, A., Androutsos, O., Cuenca-García, M., Dallongeville, J., Huybrechts, I., De Henauw, S., Widhalm, K., Kafatos, A., Nova, E., Marcos, A., González-Gross, M., Molnar, D., Gottrand, F., & Moreno, L. A. (2018). Dietary sources of sugars in adolescents' diet: The HELENA study. *European Journal of Nutrition*, *57*(2), 629–641. https://doi.org/10.1007/s00394-016-1349-z

Messina, M., Rogero, M. M., Fisberg, M., & Waitzberg, D. (2017). Health impact of childhood and adolescent soy consumption. *Nutrition Reviews*, *75*(7), 500–515. https://doi.org/10.1093/nutrit/nux016

Michels, N., De Henauw, S., Beghin, L., Cuenca-García, M., Gonzalez-Gross, M., Hallstrom, L., Kafatos, A., Kersting, M., Manios, Y., Marcos, A., Molnar, D., Roccaldo, R., Santaliestra-Pasías, A. M., Sjostrom, M., Reye, B., Thielecke, F., Widhalm, K., & Claessens, M. (2016). Ready-to-eat cereals improve nutrient, milk and fruit intake at breakfast in European adolescents. *European Journal of Nutrition*, *55*(2), 771–779. https://doi.org/10.1007/s00394-015-0898-x

Monteiro, C. A., Cannon, G., Levy, R. B., Moubarac, J.-C., Louzada, M. L., Rauber, F., Khandpur, N., Cediel, G., Neri, D., Martinez-Steele, E., Baraldi, L. G., & Jaime, P. C. (2019). Ultra-processed foods: What they are and how to identify them. *Public Health Nutrition*, *22*(5), 936–941. https://doi.org/10.1017/S1368980018003762

Montejano Vallejo, R., Schulz, C.-A., van de Locht, K., Oluwagbemigun, K., Alexy, U., & Nöthlings, U. (2022). Associations of Adherence to a Dietary Index Based on the EAT-Lancet Reference Diet with Nutritional, Anthropometric, and Ecological Sustainability Parameters: Results from the German DONALD Cohort Study. *The Journal of Nutrition*, *152*(7), 1763–1772. https://doi.org/10.1093/jn/nxac094

Montenegro-Bethancourt, G., Johner, S. A., & Remer, T. (2013). Contribution of fruit and vegetable intake to hydration status in schoolchildren. *The American Journal of Clinical Nutrition*, *98*(4), 1103–1112. https://doi.org/10.3945/ajcn.112.051490

Muckelbauer, R., Barbosa, C. L., Mittag, T., Burkhardt, K., Mikelaishvili, N., & Müller-Nordhorn, J. (2014). Association between water consumption and body weight outcomes in children and adolescents: A systematic review. *Obesity (Silver Spring, Md.)*, *22*(12), 2462–2475. https://doi.org/10.1002/oby.20911

Mulligan, F., & Doherty, M. (2008). Production diseases: A major health, welfare and economic problem on dairy farms. *The Veterinary Journal*, *176*(1), 1–2. https://doi.org/10.1016/j.tvjl.2007.12.006

Musaiger, A. O. (2011). Overweight and Obesity in Eastern Mediterranean Region: Prevalence and Possible Causes. *Journal of Obesity*, *2011*, 1–17. https://doi.org/10.1155/2011/407237

Nandan, A., Koirala, P., Dutt Tripathi, A., Vikranta, U., Shah, K., Gupta, A. J., Agarwal, A., & Nirmal, N. (2024). Nutrition al and functional perspectives of pseudocereals. *Food Chemistry*, *448*, 139072. https://doi.org/10.1016/j.foodchem.2024.139072

Nawrot, P., Jordan, S., Eastwood, J., Rotstein, J., Hugenholtz, A., & Feeley, M. (2003). Effects of caffeine on human health. *Food Additives & Contaminants*, *20*(1), 1–30. https://doi.org/10.1080/0265203021000007840

Nguyen, M., Jarvis, S. E., Chiavaroli, L., Mejia, S. B., Zurbau, A., Khan, T. A., Tobias, D. K., Willett, W. C., Hu, F. B., Hanley, A. J., Birken, C. S., Sievenpiper, J. L., & Malik, V. S. (2024). Consumption of 100% Fruit Juice and Body Weight in Children and Adults: A Systematic Review and Meta-Analysis. *JAMA Pediatrics*, *178*(3), 237–246. https://doi.org/10.1001/jamapediatrics.2023.6124

Nguyen, M., Jarvis, S. E., Tinajero, M. G., Yu, J., Chiavaroli, L., Mejia, S. B., Khan, T. A., Tobias, D. K., Willett, W. C., Hu, F. B., Hanley, A. J., Birken, C. S., Sievenpiper, J. L., & Malik, V. S. (2023). Sugar-sweetened beverage consumption and weight gain in children and adults: A systematic review and meta-analysis of prospective cohort studies and randomized controlled trials. *The American Journal of Clinical Nutrition*, *117*(1), 160–174. https://doi.org/10.1016/j.ajcnut.2022.11.008

Nordic Council of Ministers. (2023). *Nordic Nutrition Recommendations 2023*. https://doi.org/10.6027/nord2023-003

O'Sullivan, T. A., Schmidt, K. A., & Kratz, M. (2020). Whole-Fat or Reduced-Fat Dairy Product Intake, Adiposity, and Cardiometabolic Health in Children: A Systematic Review. *Advances in Nutrition (Bethesda, Md.)*, *11*(4), 928–950. https://doi.org/10.1093/advances/nmaa011

Park, M. H., Falconer, C., Viner, R. M., & Kinra, S. (2012). The impact of childhood obesity on morbidity and mortality in adulthood: A systematic review. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *13*(11), 985–1000. https://doi.org/10.1111/j.1467-789X.2012.01015.x

Petridi, E., Karatzi, K., Magriplis, E., Charidemou, E., Philippou, E., & Zampelas, A. (2024). The impact of ultra-processed foods on obesity and cardiometabolic comorbidities in children and adolescents: A systematic review. *Nutrition Reviews*, *82*(7), 913–928. https://doi.org/10.1093/nutrit/nuad095
Petrus, R. R., do Amaral Sobral, P. J., Tadini, C. C., & Gonçalves, C. B. (2021). The NOVA classification system: A critical perspective in food science. *Trends in Food Science & Technology*, *116*, 603–608. https://doi.org/10.1016/j.tifs.2021.08.010
Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987–992. https://doi.org/10.1126/science.aaq0216
Poorolajal, J., Sahraei, F., Mohamdadi, Y., Doosti-Irani, A., & Moradi, L. (2020). Behavioral factors influencing childhood obesity: A systematic review and meta-analysis. *Obesity Research & Clinical Practice*, *14*(2), 109–118. https://doi.org/10.1016/j.orcp.2020.03.002
Priebe, M. G., & McMonagle, J. R. (2016). Effects of Ready-to-Eat-Cereals on Key Nutritional and Health Outcomes: A Systematic Review. *PLOS ONE*, *11*(10), e0164931. https://doi.org/10.1371/journal.pone.0164931
Raj S, V., Ismail, M., Chan, W.-K., & Majid, H. A. (2023). A systematic review on factors associated with non-alcoholic fatty liver disease (NAFLD) among adolescents. *Clinical Nutrition ESPEN*, *57*, 131–137. https://doi.org/10.1016/j.clnesp.2023.06.014
Raynor, H. A., Deierlein, A. L., Gardner, C. D., Giovannucci, E., Taylor, C. A., Hoelscher, D. M., Anderson, C. A. M., Booth, S. L., Fung, T. T., Stanford, F. C., Talegawkar, S. A., Tobias, D. K., Webster, A., Kingshipp, B. J., Cole, N. C., Higgins, M., Butera, G., Terry, N., & Obbagy, J. (2024). *Low- and No-Calorie Sweetened Beverages and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK611640/
Raynor, H., Deierlein, H., Gardner, Giovannucci, E., Taylor, C., & Hoelscher, D. (2024). *Dairy Milk and Milk Alternatives and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. U.S. Department of Agriculture, Food and Nutrition Service, Center for Nutrition Policy and Promotion, Nutrition Evidence Systematic Review. https://doi.org/10.52570/NESR.DGAC2025.SR03
Reid, A. E., Chauhan, B. F., Rabbani, R., Lys, J., Copstein, L., Mann, A., Abou-Setta, A. M., Fiander, M., MacKay, D. S., McGavock, J., Wicklow, B., Zarychanski, R., & Azad, M. B. (2016). Early Exposure to Nonnutritive Sweeteners and Long-term Metabolic Health: A Systematic Review. *Pediatrics*, *137*(3), e20153603. https://doi.org/10.1542/peds.2015-3603
Reilly, J. J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in adulthood: Systematic review. *International Journal of Obesity (2005)*, *35*(7), 891–898. https://doi.org/10.1038/ijo.2010.222
Reynolds, A. N., Diep Pham, H. T., Montez, J., & Mann, J. (2020). Dietary fibre intake in childhood or adolescence and subsequent health outcomes: A systematic review of prospective observational studies. *Diabetes, Obesity and Metabolism*, *22*(12), 2460–2467. https://doi.org/10.1111/dom.14176
Richonnet, C., Mosser, F., Favre, E., Robert, M., Martin, F., & Thiebaut, I. (2021). Nutritional Quality and Degree of Processing of Children's Foods Assessment on the French Market. *Nutrients*, *14*(1), 171. https://doi.org/10.3390/nu14010171
Rios-Leyvraz, M., Bochud, M., Tabin, R., Genin, B., Russo, M., Rossier, M. F., Eap, C. B., Bovet, P., & Chiolero, A. (2020). Monitoring caffeine intake in children with a questionnaire and urine collection: A cross-sectional study in a convenience sample in Switzerland. *European Journal of Nutrition*, *59*(8), 3537–3543. https://doi.org/10.1007/s00394-020-02187-3
Rivera del Rio, A., Boom, R. M., & Janssen, A. E. M. (2022). Effect of Fractionation and Processing Conditions on the Digestibility of Plant Proteins as Food Ingredients. *Foods*, *11*(6), 870. https://doi.org/10.3390/foods11060870
Robles, B., Mota-Bertran, A., Saez, M., & Solans, M. (2024). Association between ultraprocessed food consumption and excess adiposity in children and adolescents: A systematic review. *Obesity Reviews: An Official Journal of the International Association for the Study of Obesity*, *25*(10), e13796. https://doi.org/10.1111/obr.13796
Rohrmann, S., & Linseisen, J. (2016). Processed meat: The real villain? *Proceedings of the Nutrition Society*, *75*(3), 233–241. https://doi.org/10.1017/S0029665115004255
Rossi, L., Berni Canani, S., Censi, L., Gennaro, L., Leclercq, C., Scognamiglio, U., Sette, S., & Ghiselli, A. (2022). The 2018 Revision of Italian Dietary Guidelines: Development Process, Novelties, Main Recommendations, and Policy Implications. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.861526
Rossi, L., Martone, D., Piccinelli, R., Buonocore, P., Ghiselli, A., the Working Group on Pediatric Nutrition of Italian Dietary Guidelines, Caroli, M., Giovannini, M., Morino, G., Scaglioni, S., Vania, A., & Verduci, E. (2022). Considerations for the translation of nutrient recommendations as dietary plans for infants, children, and adolescents as reported in Italian Guidelines for healthy eating. *Frontiers in Nutrition*, *9*. https://doi.org/10.3389/fnut.2022.935963
Rousham, E. K., Goudet, S., Markey, O., Griffiths, P., Boxer, B., Carroll, C., Petherick, E. S., & Pradeilles, R. (2022). Unhealthy Food and Beverage Consumption in Children and Risk of Overweight and Obesity: A Systematic Review and Meta-Analysis. *Advances in Nutrition (Bethesda, Md.)*, *13*(5), 1669–1696. https://doi.org/10.1093/advances/nmac032
Sá, A. G. A., Moreno, Y. M. F., & Carciofi, B. A. M. (2020). Food processing for the improvement of plant proteins digestibility. *Critical Reviews in Food Science and Nutrition*, *60*(20), 3367–3386. https://doi.org/10.1080/10408398.2019.1688249
Saltaouras, G., Kyrkili, A., Bathrellou, E., Georgoulis, M., Yannakoulia, M., Bountziouka, V., Smrke, U., Dimitrakopoulos, G., & Kontogianni, M. D. (2024). Associations between Meal Patterns and Risk of Overweight/Obesity in Children and Adolescents in Western Countries: A Systematic Review of Longitudinal Studies and Randomised Controlled Trials. *Children (Basel, Switzerland)*, *11*(9), 1100. https://doi.org/10.3390/children11091100
Sanders, L. M., Dicklin, M. R., Zhu, Y., & Maki, K. C. (2022). The Impact of Ready-to-Eat Cereal Intake on Body Weight and Body Composition in Children and Adolescents: A Systematic Review of Observational Studies and Controlled Trials. *Advances in Nutrition*, *14*(1), 161–172. https://doi.org/10.1016/j.advnut.2022.11.003
Schäfer, A. C., Boeing, H., Conrad, J., & Watzl, B. (2024). Wissenschaftliche Grundlagen der lebensmittelbezogenen Ernährungsempfehlungen für Deutschland. *Ernährungs Umschau*, *71*(3), 158–166. https://doi.org/10.4455/eu.2024.009
Schneider, B. C., Dumith, S. C., Orlandi, S. P., & Assunção, M. C. F. (2017). Diet and body fat in adolescence and early adulthood: A systematic review of longitudinal studies. *Ciencia & Saude Coletiva*, *22*(5), 1539–1552. https://doi.org/10.1590/1413-81232017225.13972015
Sethi, S., Tyagi, S. K., & Anurag, R. K. (2016). Plant-based milk alternatives an emerging segment of functional beverages: A review. *Journal of Food Science and Technology*, *53*(9), 3408–3423. https://doi.org/10.1007/s13197-016-2328-3

SGE. (o. J.). *SGE Swiss food pyramid*. https://www.sge-ssn.ch/de/empfehlungen/offizielle-empfehlungen/ernaehrungsempfehlungen/
SGE. (2024a). *Ernährung von Kindern*. https://www.sge-ssn.ch/de/lebensphasen/kindheit/ernaehrungsscheibe/
SGE. (2024b). *Schweizer Ernährungsempfehlungen für Erwachsene*.
SGE. (2025). *Jugend | Schweizerische Gesellschaft für Ernährung SGE*. https://www.sge-ssn.ch/de/lebensphasen/jugend/jugend/
Silano, V., Bolognesi, C., Castle, L., Cravedi, J., Engel, K., Fowler, P., Franz, R., Grob, K., Gürtler, R., Husøy, T., Kärenlampi, S., Milana, M. R., Penninks, A., Tavares Poças, M. de F., Smith, A., Tlustos, C., Wölfle, D., Zorn, H., Zugravu, C., … Mennes, W. (2017). Scientific Opinion on Flavouring Group Evaluation 49, Revision 1 (FGE.49Rev1): Xanthine alkaloids from the priority list. *EFSA Journal*, *15*(4), e04729. https://doi.org/10.2903/j.efsa.2017.4729
Slavin, J. L., & Lloyd, B. (2012). Health Benefits of Fruits and Vegetables. *Advances in Nutrition*, *3*(4), 506–516. https://doi.org/10.3945/an.112.002154
Snetselaar, L., Bailey, R., Sabaté, J., Van Horn, L., Schneeman, B., Kim, J. H., Spahn, J., Bahnfleth, C., Butera, G., Terry, N., & Obbagy, J. (2020). *Seafood Consumption during Childhood and Adolescence and Cardiovascular Disease: A Systematic Review*. http://www.ncbi.nlm.nih.gov/books/NBK579444/
Soczynska, I., da Costa, B. R., O'Connor, D. L., Jenkins, D. J., Birken, C. S., Keown-Stoneman, C. D., D'Hollander, C., Calleja, S., & Maguire, J. L. (2024). A Systematic Review on the Impact of Plant-Based Milk Consumption on Growth and Nutrition in Children and Adolescents. *The Journal of Nutrition*, *154*(11), 3446–3456. https://doi.org/10.1016/j.tjnut.2024.09.010
Stadt Zürich. (2025). *Ernährungsrichtlinien für die Schulen der Stadt Zürich*. https://www.stadt-zuerich.ch/de/aktuell/publikationen/2025/ernaehrungsrichtlinien-schulen-zuerich.html
Stanford, F. C., Taylor, C., Booth, S., Hoelscher, D. M., Anderson, C. A. M., Deierlein, A., Fung, T., Gardner, C., Giovannucci, E., Raynor, H., Talegawkar, S., Tobias, D., English, L. K., Higgins, M., Callahan, E., Reigh, N., Raghavan, R., Butera, G., Terry, N., & Obbagy, J. (2024). *Dietary Patterns with Ultra-Processed Foods and Growth, Body Composition, and Risk of Obesity: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK611035/
Stokes, A., Campbell, K. J., Yu, H.-J., Szymlek-Gay, E. A., Abbott, G., He, Q.-Q., & Zheng, M. (2021). Protein Intake from Birth to 2 Years and Obesity Outcomes in Later Childhood and Adolescence: A Systematic Review of Prospective Cohort Studies. *Advances in Nutrition (Bethesda, Md.)*, *12*(5), 1863–1876. https://doi.org/10.1093/advances/nmab034
Swedish Food Agency. (o. J.). *Swedish Food Agency*. Abgerufen 27. Oktober 2025, von https://www.livsmedelsverket.se/en/
Talegawkar, S., Tobias, D., Fung, T., Giovannucci, E., Hoelscher, D. M., Anderson, C. A. M., Booth, S., Deierlein, A., Gardner, C., Raynor, H., Stanford, F. C., Taylor, C., English, L. K., Reigh, N., Higgins, M., Butera, G., Callahan, E., Huang, S., Raghavan, R., … Obbagy, J. (2024a). *Dietary Patterns and Risk of Type 2 Diabetes: A Systematic Review*. http://www.ncbi.nlm.nih.gov/books/NBK611067/
Talegawkar, S., Tobias, D., Fung, T., Giovannucci, E., Hoelscher, D. M., Anderson, C. A. M., Booth, S., Deierlein, A., Gardner, C., Raynor, H., Stanford, F. C., Taylor, C., English, L. K., Reigh, N., Higgins, M., Butera, G., Callahan, E., Huang, S., Raghavan, R., … Obbagy, J. (2024b). *Dietary Patterns and Risk of Type 2 Diabetes: A Systematic Review*. USDA Nutrition Evidence Systematic Review. http://www.ncbi.nlm.nih.gov/books/NBK611067/
Temme, E. H. M., Bakker, H. M. E., Seves, S. M., Verkaik-Kloosterman, J., Dekkers, A. L., van Raaij, J. M. A., & Ocké, M. C. (2015). How may a shift towards a more sustainable food consumption pattern affect nutrient intakes of Dutch children? *Public Health Nutrition*, *18*(13), 2468–2478. https://doi.org/10.1017/S1368980015002426
Temple, J. L. (2019). Review: Trends, Safety, and Recommendations for Caffeine Use in Children and Adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *58*(1), 36–45. https://doi.org/10.1016/j.jaac.2018.06.030
Thorning, T. K., Bertram, H. C., Bonjour, J.-P., de Groot, L., Dupont, D., Feeney, E., Ipsen, R., Lecerf, J. M., Mackie, A., McKinley, M. C., Michalski, M.-C., Rémond, D., Risérus, U., Soedamah-Muthu, S. S., Tholstrup, T., Weaver, C., Astrup, A., & Givens, I. (2017). Whole dairy matrix or single nutrients in assessment of health effects: Current evidence and knowledge gaps. *The American Journal of Clinical Nutrition*, *105*(5), 1033–1045. https://doi.org/10.3945/ajcn.116.151548
Tian, Y., Su, L., Wang, J., Duan, X., & Jiang, X. (2018). Fruit and vegetable consumption and risk of the metabolic syndrome: A meta-analysis. *Public Health Nutrition*, *21*(4), 756–765. https://doi.org/10.1017/S136898001700310X
Torres-Ugalde, Y. C., Romero-Palencia, A., Román-Gutiérrez, A. D., Ojeda-Ramírez, D., & Guzmán-Saldaña, R. M. E. (2020). Caffeine Consumption in Children: Innocuous or Deleterious? A Systematic Review. *International Journal of Environmental Research and Public Health*, *17*(7), Article 7. https://doi.org/10.3390/ijerph17072489
Trumbo, P. R., & Rivers, C. R. (2014). Systematic review of the evidence for an association between sugar-sweetened beverage consumption and risk of obesity. *Nutrition Reviews*, *72*(9), 566–574. https://doi.org/10.1111/nure.12128
USDA Nutrition Evidence Systematic Review Branch. (o. J.). *Methodology Overview | Nutrition Evidence Systematic Review*. Abgerufen 14. November 2025, von https://nesr.usda.gov/methodology-overview
Van Dam, R. M., Hu, F. B., & Willett, W. C. (2020). Coffee, Caffeine, and Health. *New England Journal of Medicine*, *383*(4), 369–378. https://doi.org/10.1056/NEJMra1816604
Vanderhout, S. M., Aglipay, M., Torabi, N., Jüni, P., da Costa, B. R., Birken, C. S., O'Connor, D. L., Thorpe, K. E., & Maguire, J. L. (2020). Whole milk compared with reduced-fat milk and childhood overweight: A systematic review and meta-analysis. *The American Journal of Clinical Nutrition*, *111*(2), 266–279. https://doi.org/10.1093/ajcn/nqz276
Verduci, E., Bronsky, J., Embleton, N., Gerasimidis, K., Indrio, F., Köglmeier, J., de Koning, B., Lapillonne, A., Moltu, S. J., Norsa, L., Domellöf, M., & ESPGHAN Committee on Nutrition. (2021). Role of Dietary Factors, Food Habits, and Lifestyle in Childhood Obesity Development: A Position Paper From the European Society for Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *Journal of Pediatric Gastroenterology and Nutrition*, *72*(5), 769–783. https://doi.org/10.1097/MPG.0000000000003075
Verordnung des EDI betreffend die Information über Lebensmittel (LIV), SR 817.022.16. Abgerufen 24. Oktober 2025, von https://www.fedlex.admin.ch/eli/cc/2017/158/de
Verordnung des EDI über Lebensmittel pflanzlicher Herkunft, Pilze und Speisesalz (VLpH), SR 817.022.17. Abgerufen 21. Oktober 2025, von https://www.fedlex.admin.ch/eli/cc/2017/181/de
Verordnung des EDI über Lebensmittel tierischer Herkunft (VLtH), SR 817.022.108 (2016). https://www.fedlex.admin.ch/eli/cc/2017/152/de#fn-d7e251
Walker, C., Gibney, E. R., & Hellweg, S. (2018). Comparison of Environmental Impact and Nutritional Quality among a European Sample Population – findings from the Food4Me study. *Scientific Reports*, *8*(1), 2330. https://doi.org/10.1038/s41598-018-20391-4

Wang, F., Zhang, P., Ren, Y., Huang, D., Xu, F., Ma, J., Luo, S., & Liang, X. (2024). The estimated effect of increasing fruit interventions on controlling body weight in children and adolescents: A meta-analysis. *Preventive Medicine*, *179*, 107785. https://doi.org/10.1016/j.ypmed.2023.107785
WHO. (o. J.-a). *Implementing school food and nutrition policies: A review of contextual factors*. Abgerufen 23. Oktober 2025, von https://www.who.int/publications/i/item/9789240035072
WHO. (o. J.-b). *Obesity and overweight*. Abgerufen 15. Oktober 2025, von https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight
WHO. (2013). *Global action plan for the prevention and control of noncommunicable diseases 2013-2020*. World Health Organization. https://iris.who.int/handle/10665/94384
WHO. (2014). *Global status report on noncommunicable diseases 2014*. World Health Organization. https://iris.who.int/handle/10665/148114
WHO. (2019). *Sustainable healthy diets*. https://www.who.int/publications/i/item/9789241516648
WHO. (2023). *WHO recommends stronger policies to protect children from the harmful impact of food marketing*. https://www.who.int/news/item/03-07-2023-who-recommends-stronger-policies-to-protect-children-from-the-harmful-impact-of-food-marketing
WHO Europe. (2023). *WHO Regional Office for Europe nutrient profile model: Second edition*. https://www.who.int/europe/publications/i/item/WHO-EURO-2023-6894-46660-68492
Wikoff, D., Welsh, B. T., Henderson, R., Brorby, G. P., Britt, J., Myers, E., Goldberger, J., Lieberman, H. R., O'Brien, C., Peck, J., Tenenbein, M., Weaver, C., Harvey, S., Urban, J., & Doepker, C. (2017). Systematic review of the potential adverse effects of caffeine consumption in healthy adults, pregnant women, adolescents, and children. *Food and Chemical Toxicology: An International Journal Published for the British Industrial Biological Research Association*, *109*(Pt 1), 585–648. https://doi.org/10.1016/j.fct.2017.04.002
Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S., Garnett, T., Tilman, D., DeClerck, F., Wood, A., Jonell, M., Clark, M., Gordon, L., Fanzo, J., Hawkes, C., Zurayk, R., Rivera, J., De Fries, W., Sibanda, L., … Murray, C. (2019). Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447–492.
World Health Organization. (2023). *Use of non-sugar sweeteners: WHO guideline*. World Health Organization.
Xue, H., Maguire, R. L., Liu, J., Kollins, S. H., Murphy, S. K., Hoyo, C., & Fuemmeler, B. F. (2019). Snacking frequency and dietary intake in toddlers and preschool children. *Appetite*, *142*, 104369. https://doi.org/10.1016/j.appet.2019.104369
Zaugg, S. (2023, September 27). Plant-Based Drinks – an Alternative to Milk? *Agrarforschung Schweiz*. https://www.agrarforschungschweiz.ch/en/2023/09/plant-based-drinks-an-alternative-to-milk/

Appendix A Search Strings

NCD outcomes:

(1) search string #1: ("Body Mass Index"[Mesh] OR "Body Mass Index"[tiab] OR "Pediatric Obesity"[MeSH Terms] OR "Pediatric Obesity"[tiab] OR "Childhood Obesity"[tiab] OR "obesity"[tiab] OR "adiposity"[tiab] OR "Fatty Liver" [Mesh] OR "fatty liver" [tiab:~0])
(2) search string #2: ("diabetes mellitus, type 2"[Mesh] OR "Glucose Intolerance"[Mesh] OR "Metabolic Syndrome"[Mesh] OR "blood glucose" [Mesh] OR "blood sugar"[tiab] OR "diab*"[tiab])
(3) Search string #3 ("Cardiovascular Diseases"[Mesh] OR "Hypertension"[Mesh] OR "Prehypertension"[Mesh] OR "Atherosclerosis"[Mesh] OR "cardiovascular" [tiab] OR "Ischemic heart disease" [tiab] OR "cardiovascular"[tiab] OR "hypertension" [tiab])
(4) Search string #4 = #1 + #2 + #3
(5) Search string #5 ("child"[Mesh] OR "Adolescent"[Mesh] OR "Child, Preschool"[Mesh] OR Child* [tiab] OR adolescen*[tiab])
(6) Search string # 6 ("systematic review" [tiab] OR "meta-analysis" [tiab] OR "systematic mixed studies review"[tiab] OR "systematic mapping review"[tiab] OR "systematic cochrane review"[tiab] OR "systematic narrative review"[tiab])
(7) General search string: generated #7 = #4 AND #5 AND #6
(8) ("Body Mass Index"[MeSH Terms] OR "Body Mass Index"[Title/Abstract] OR "Pediatric Obesity"[MeSH Terms] OR "Pediatric Obesity"[Title/Abstract] OR "Childhood Obesity"[Title/Abstract] OR "obesity"[Title/Abstract] OR "adiposity"[Title/Abstract] OR "Fatty Liver"[MeSH Terms] OR "Fatty Liver"[Title/Abstract:~0] OR ("diabetes mellitus, type 2"[MeSH Terms] OR "Glucose Intolerance"[MeSH Terms] OR "Metabolic Syndrome"[MeSH Terms] OR "blood glucose"[MeSH Terms] OR "blood sugar"[Title/Abstract] OR "diab*"[Title/Abstract]) OR ("Cardiovascular Diseases"[MeSH Terms] OR "Hypertension"[MeSH Terms] OR "Prehypertension"[MeSH Terms] OR "Atherosclerosis"[MeSH Terms] OR "cardiovascular"[Title/Abstract] OR "Ischemic heart disease"[Title/Abstract] OR "cardiovascular"[Title/Abstract] OR "Hypertension"[Title/Abstract])) AND ("child"[MeSH Terms] OR "Adolescent"[MeSH Terms] OR "child, preschool"[MeSH Terms] OR "child*"[Title/Abstract] OR "adolescen*"[Title/Abstract]) AND ("systematic review"[Title/Abstract] OR "meta-analysis"[Title/Abstract] OR "systematic mixed studies review"[Title/Abstract] OR "systematic mapping review"[Title/Abstract] OR "systematic cochrane review"[Title/Abstract] OR "systematic narrative review"[Title/Abstract])

1. Water

Search String PubMed: ("hydration" OR "water"[MeSH Terms] OR "water"[All Fields] OR "watering"[All Fields] OR "water s"[All Fields] OR "watered"[All Fields] OR "waterer"[All Fields] OR "waterers"[All Fields] OR "waterings"[All Fields] OR "waters"[All Fields] OR ("carbonated water"[MeSH Terms] OR ("carbonated"[All Fields] AND "water"[All Fields]) OR "carbonated water"[All Fields] OR ("sparkling"[All Fields] AND "water"[All Fields]) OR "sparkling water"[All Fields])) NOT "sugar-sweetened"[All Fields]
Search String Cochrane: (hydration OR water OR watering OR water* OR watered OR waterer OR waterers OR waterings OR waters OR "carbonated water" OR (carbonated AND water) OR (sparkling AND water) OR "sparkling water") NOT "sugar-sweetened"

2. Sugar-containing beverages (SCBs)

Search String PubMed: ("sugar-sweetened"[All Fields] AND "beverage*"[All Fields]) OR ("carbonated beverages"[MeSH Terms] OR ("carbonated"[All Fields] AND "beverages"[All Fields]) OR "carbonated beverages"[All Fields] OR ("soft"[All Fields] AND "drinks"[All Fields]) OR "soft drinks"[All Fields]) OR ("lemonade"[All Fields] OR "lemonades"[All Fields]) OR "SSB"[All Fields] OR (("sweeten"[All Fields] OR "sweetened"[All Fields] OR "sweetening agents"[Pharmacological Action] OR "sweetening agents"[MeSH Terms] OR ("sweetening"[All Fields] AND "agents"[All Fields]) OR "sweetening agents"[All Fields] OR "sweetener"[All Fields] OR "sweeteners"[All Fields] OR "sweetening"[All Fields]) AND ("surg open dig adv"[Journal] OR "proc annu acm siam symp discret algorithms"[Journal] OR "soda"[All Fields])) OR ("pop"[All Fields] AND "drink*"[All Fields]) OR (("carbon"[MeSH Terms] OR "carbon"[All Fields] OR "carbons"[All Fields] OR "carbon s"[All Fields] OR "carbonates"[MeSH Terms] OR "carbonates"[All Fields] OR "carbonate"[All Fields] OR "carbonated"[All Fields] OR "carbonating"[All Fields] OR "carbonation"[All Fields] OR "carboneous"[All Fields] OR "carbonization"[All Fields] OR "carbonizations"[All Fields] OR "carbonize"[All Fields] OR "carbonized"[All Fields] OR "carbonizing"[All Fields] OR "carbonous"[All Fields] OR "fizzy"[All Fields]) AND "drink*"[All Fields]) OR ("coke"[MeSH Terms] OR "coke"[All Fields]) OR "fruit and vegetable juices"[MeSH Terms] OR ("fruit"[All Fields] AND "vegetable"[All Fields] AND "juices"[All Fields]) OR "fruit and vegetable juices"[All Fields] OR ("fruit"[All Fields] AND "juice"[All Fields]) OR "fruit juice"[All Fields] OR ("fruit and vegetable juices"[MeSH Terms] OR ("fruit"[All Fields] AND "vegetable"[All Fields] AND "juices"[All Fields]) OR "fruit and vegetable juices"[All Fields] OR ("vegetable"[All Fields] AND "juice"[All Fields]) OR "vegetable juice"[All Fields]) OR "juice*"[All Fields] OR ("smoothie"[All Fields] OR "smoothies"[All Fields])
Search String Cochrane: ("sugar-sweetened" AND beverage*) OR "carbonated beverages" OR (carbonated AND beverages) OR (soft AND drinks) OR "soft drinks" OR lemonade OR lemonades OR SSB OR ((sweeten OR sweetened OR "sweetening agents" OR sweetening OR sweetener OR sweeteners) AND soda) OR (pop AND drink*) OR ((carbon OR carbons OR "carbon s" OR carbonate OR carbonated OR carbonating OR carbonation OR carboneous OR carbonization OR carbonizations OR carbonize OR carbonized OR carbonizing OR carbonous OR fizzy) AND drink*) OR coke OR ("fruit and vegetable juices") OR (fruit AND vegetable AND juices) OR (fruit AND juice) OR (vegetable AND juice) OR "fruit juice" OR "vegetable juice" OR juice* OR smoothie OR smoothies

3. Caffeine-containing beverages

Search String PubMed: ((((("Energy drinks"[MeSH Terms] OR "Coffee"[MeSH Terms] OR "Caffeine"[MeSH Terms] OR "Tea"[MeSH Terms] OR "Caffeine"[All Fields] OR "energy drink"[All Fields] OR "caffeinated"[All Fields] OR "black tea"[All Fields] OR "green tea"[All Fields] OR "white tea"[All Fields]) AND 2010/01/01:3000/12/12[Date - Publication]) OR "mate"[All Fields] OR ("mate"[All Fields] AND ("beverage s"[All Fields] OR "beverages"[MeSH Terms] OR "beverages"[All Fields] OR "beverage"[All Fields])) OR ("paullinia"[MeSH Terms] OR "paullinia"[All Fields] OR "guarana"[All Fields]) OR (("ice"[MeSH Terms] OR "ice"[All Fields]) AND ("Tea"[MeSH Terms] OR "Tea"[All Fields]))) AND 2010/01/01:3000/12/12[Date - Publication]) OR (("ilex"[MeSH Terms] OR "ilex"[All Fields]) AND "paraguensis"[All Fields])) AND (2010/1/1:3000/12/12[pdat])
Search String Cochrane: ("energy drink" OR caffeine OR caffeinated OR "black tea" OR "green tea" OR "white tea" OR coffee OR tea OR mate OR (mate AND ("beverage s" OR beverages OR beverage)) OR paullinia OR guarana OR (ice AND tea))

4. Artificially sweetened beverages

"artificially sweetened beverages"[MeSH Terms] OR ("artificially"[All Fields] AND "sweetened"[All Fields] AND "beverages"[All Fields]) OR "artificially sweetened beverages"[All Fields] OR "ASB"[All Fields] OR ("acesulphame"[All Fields] OR "acetosulfame"[Supplementary Concept] OR "acetosulfame"[All Fields] OR "acesulfame"[All Fields]) OR ("sweeten"[All Fields] OR "sweetened"[All Fields] OR "sweetening agents"[Pharmacological Action] OR "sweetening agents"[Supplementary Concept] OR "sweetening agents"[All Fields] OR "sweetener"[All Fields] OR "sweetening agents"[MeSH Terms] OR ("sweetening"[All Fields] AND "agents"[All Fields]) OR "sweeteners"[All Fields] OR "sweetening"[All Fields]) OR ("non-caloric"[All Fields] AND ("beverage s"[All Fields] OR "beverages"[MeSH Terms] OR "beverages"[All Fields] OR "beverage"[All Fields])) OR ("non-caloric"[All Fields] AND ("carbonated beverages"[MeSH Terms] OR ("carbonated"[All Fields] AND "beverages"[All Fields]) OR "carbonated beverages"[All Fields] OR ("soft"[All Fields] AND "drink"[All Fields]) OR "soft drink"[All Fields])) OR (("diet"[MeSH Terms] OR "diet"[All Fields]) AND ("surg open dig adv"[Journal] OR "proc annu acm siam symp discret algorithms"[Journal] OR "soda"[All Fields])) OR (("diet"[MeSH Terms] OR "diet"[All Fields]) AND ("carbonated beverages"[MeSH Terms] OR ("carbonated"[All Fields] AND "beverages"[All Fields]) OR "carbonated beverages"[All Fields] OR ("soft"[All Fields] AND "drink"[All Fields]) OR "soft drink"[All Fields])) OR ("sugar-free"[All Fields] AND ("drink"[All Fields] OR "drinking"[MeSH Terms] OR "drinking"[All Fields] OR "alcohol drinking"[MeSH Terms] OR ("alcohol"[All Fields] AND "drinking"[All Fields]) OR "alcohol drinking"[All Fields] OR "drinkings"[All Fields] OR "drinks"[All Fields])) OR ("aspartame"[Supplementary Concept] OR "aspartame"[All Fields] OR "aspartam"[All Fields] OR "aspartame"[MeSH Terms] OR "aspartame s"[All Fields]) OR ("stevia"[MeSH Terms] OR "stevia"[All Fields] OR "stevias"[All Fields]) OR ("trichlorosucrose"[Supplementary Concept] OR "trichlorosucrose"[All Fields] OR "sucralose"[All Fields]) OR ("saccharin"[Supplementary Concept] OR "saccharin"[All Fields] OR "saccharin"[MeSH Terms] OR "saccharine"[All Fields] OR "saccharins"[All Fields]) OR ("low-calorie"[All Fields] AND ("sweeten"[All Fields] OR "sweetened"[All Fields] OR "sweetening agents"[Pharmacological Action] OR "sweetening agents"[Supplementary Concept] OR "sweetening agents"[All Fields] OR "sweetener"[All Fields] OR "sweetening agents"[MeSH Terms] OR ("sweetening"[All Fields] AND "agents"[All Fields]) OR "sweeteners"[All Fields] OR "sweetening"[All Fields]))

5. Fruit and Vegetables

Search String PubMed: "fruit"[MeSH Terms] OR "fruit*"[All Fields] OR "vegetables"[MeSH Terms] OR "vegetable*"[All Fields]
Search String Cochrane: (fruit OR fruits OR fruited OR fruiting OR vegetable OR vegetables)

6. Whole-meal based products

Search String PubMed: "whole grains"[MeSH Terms] OR "whole-grain"[All Fields] OR "whole-grain"[All Fields] OR "wholemeal"[All Fields] OR "whole-meal"[All Fields] OR "whole-wheat"[All Fields] OR "whole-wheat"[All Fields] OR "wheat flour"[All Fields] OR "whole grain wheat"[All Fields] OR "refined wheat"[All Fields] OR "white flour"[All Fields] OR "refined flour"[All Fields] OR "fiber-rich"[All Fields] OR "fibre-rich"[All Fields] OR "multi-grain"[All Fields] OR "multigrain"[All Fields] OR "cereal-based"[All Fields] OR "cereal-based"[All Fields] OR "wheat-based"[All Fields] OR "wheat-based"[All Fields] OR "bread"[MeSH Terms] OR "bread"[All Fields] OR "breads"[All Fields] OR "bread s"[All Fields] OR "breaded"[All Fields] OR "breading"[All Fields]
Search String Cochrane: ("whole grain":ti,ab,kw OR "whole-grain":ti,ab,kw OR "wholemeal":ti,ab,kw OR "whole-meal":ti,ab,kw OR "whole wheat":ti,ab,kw OR "whole-wheat":ti,ab,kw OR "wheat flour":ti,ab,kw OR "whole grain wheat":ti,ab,kw OR "refined wheat":ti,ab,kw OR "white flour":ti,ab,kw OR "refined flour":ti,ab,kw OR "fiber-rich":ti,ab,kw OR "fibre-rich":ti,ab,kw OR "multi-grain":ti,ab,kw OR "multigrain":ti,ab,kw OR "cereal-based":ti,ab,kw OR "cereal based":ti,ab,kw OR "wheat-based":ti,ab,kw OR "wheat based":ti,ab,kw)

7. Sugar-containing breakfast cereals

Search String PubMed: (("Edible Grain"[MeSH Terms] OR "Whole Grains"[MeSH Terms] OR "dietary fiber"[MeSH Terms] OR "Breakfast"[MeSH Terms] OR "cereal*"[All Fields] OR "grain*"[All Fields]) AND ("Dietary Sugars"[MeSH Terms] OR "Sugars"[MeSH Terms] OR "sugar sweetened"[All Fields])) OR "ready to eat cereals"[All Fields]
Search String Cochrane: ((cereal* OR grain* OR "dietary fiber" OR breakfast) AND ("dietary sugars" OR sugars OR "sugar sweetened")) OR "ready to eat cereals"

8. Other cereals, pseudocereals and starchy tubers

Search String PubMed: "oryza"[MeSH Terms] OR "oryza"[All Fields] OR "rice"[All Fields] OR ("maize s"[All Fields] OR "maizes"[All Fields] OR "zea mays"[MeSH Terms] OR ("zea"[All Fields] AND "mays"[All Fields]) OR "zea mays"[All Fields] OR "corn"[All Fields] OR "maize"[All Fields]) OR ("maize s"[All Fields] OR "maizes"[All Fields] OR "zea mays"[MeSH Terms] OR ("zea"[All Fields] AND "mays"[All Fields]) OR "zea mays"[All Fields] OR "corn"[All Fields] OR "maize"[All Fields]) OR ("chenopodium quinoa"[MeSH Terms] OR ("chenopodium"[All Fields] AND "quinoa"[All Fields]) OR "chenopodium quinoa"[All Fields] OR "quinoa"[All Fields] OR "quinoas"[All Fields]) OR ("fagopyrum"[MeSH Terms] OR "fagopyrum"[All Fields] OR "buckwheat"[All Fields] OR "buckwheats"[All Fields]) OR "potato*"[All Fields] OR ("barley s"[All Fields] OR "hordeum"[MeSH Terms] OR "hordeum"[All Fields] OR "barley"[All Fields] OR "barleys"[All Fields]) OR "oat"[All Fields] OR ("manihot"[MeSH Terms] OR "manihot"[All Fields] OR "manioc"[All Fields]) OR ("sorghum"[MeSH Terms] OR "sorghum"[All Fields] OR "sorghums"[All Fields] OR "sorghum s"[All Fields]) OR ("millets"[MeSH Terms] OR "millets"[All Fields] OR "millet"[All Fields]) OR (("parboiled"[All Fields] OR "parboiling"[All Fields]) AND ("oryza"[MeSH Terms] OR "oryza"[All Fields] OR "rice"[All Fields])) OR ("amaranth dye"[MeSH Terms] OR ("amaranth"[All Fields] AND "dye"[All Fields]) OR "amaranth dye"[All Fields] OR "amaranth"[All Fields] OR "amaranths"[All Fields]) OR ("pseudocereal"[All Fields] OR "pseudocereals"[All Fields]) OR ("non-gluten"[All Fields] AND "cereal*"[All Fields])
Search String Cochrane: oryza OR rice OR maize OR maizes OR maize* OR "zea mays" OR (zea AND mays) OR corn OR chenopodium OR quinoa OR quinoas OR fagopyrum OR buckwheat OR buckwheats OR potato* OR barley OR hordeum OR barleys OR oat OR manihot OR manioc OR sorghum OR sorghums OR millet OR millets OR ((parboiled OR parboiling) AND (oryza OR rice)) OR "amaranth dye" OR (amaranth AND dye) OR amaranth OR amaranths OR pseudocereal OR pseudocereals OR ("non-gluten" AND cereal*)

9. Meat, Fish, Eggs

Meat
Search String PubMed: "red meat"[MeSH Terms] OR ("red"[All Fields] AND "meat"[All Fields]) OR "red meat"[All Fields] OR ("meat"[MeSH Terms] OR "meat"[All Fields]) OR (("process"[All Fields] OR "process"[All Fields] OR "processed"[All Fields] OR "processes"[All Fields] OR "processing"[All Fields] OR "processings"[All Fields]) AND ("meat"[MeSH Terms] OR "meat"[All Fields])) OR ("pork meat"[MeSH Terms] OR ("pork"[All Fields] AND "meat"[All Fields]) OR "pork meat"[All Fields] OR "pork"[All Fields]) OR "ham"[All Fields] OR ("sausage"[All Fields] OR "sausages"[All Fields]) OR ("poultry"[MeSH Terms] OR "poultry"[All Fields] OR "poultries"[All Fields] OR "poultrys"[All Fields]) OR ("chickens"[All Fields] OR "chickens"[MeSH Terms] OR "chickens"[All Fields] OR "chicken"[All Fields]) OR ("turkey"[MeSH Terms] OR "turkey"[All Fields] OR "turkeys"[All Fields] OR "turkeys"[MeSH Terms] OR "turkeys"[All Fields])
Search String Cochrane: ("red meat":ti,ab OR "meat":ti,ab OR ("processed":ti,ab OR "processing":ti,ab OR "processes":ti,ab) AND "meat":ti,ab OR "pork meat":ti,ab OR "pork":ti,ab OR "ham":ti,ab OR "sausage":ti,ab OR "sausages":ti,ab OR "poultry":ti,ab OR "chicken":ti,ab OR "chickens":ti,ab OR "turkey":ti,ab OR "turkeys":ti,ab)
Fish
Search String PubMed: (“seafood” [Mesh] OR “fish products” [Mesh] OR “seafood” OR “fish” OR “fish products” OR "processed fish" OR "breaded fish" OR “mollusc*”)
Search String Cochrane: ("seafood":ti,ab OR "fish products":ti,ab OR "seafood":ti,ab OR "fish":ti,ab OR "fish products":ti,ab OR "processed fish":ti,ab OR "breaded fish":ti,ab)
Eggs
Search String PubMed: ("egg"[Tiab] OR "eggs"[Tiab] OR "eggs"[MeSH Terms])
Search String Cochrane: ("egg":ti,ab OR "eggs":ti,ab)

10. Milk, dairy products and cheese

Search String PubMed: ((("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR "milk"[All Fields] OR "milk"[MeSH Terms] OR (("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR "milk"[All Fields] OR "milk"[MeSH Terms]) AND ("economics"[MeSH Terms] OR "economics"[All Fields] OR "production"[All Fields] OR "productions"[All Fields] OR "efficiency"[MeSH Terms] OR "efficiency"[All Fields] OR "productivity"[All Fields] OR "product"[All Fields] OR "product s"[All Fields] OR "productive"[All Fields] OR "productively"[All Fields] OR "productivities"[All Fields] OR "products"[All Fields])) OR ("dairies"[All Fields] OR "dairy"[All Fields] OR "dairy s"[All Fields] OR "dairying"[MeSH Terms] OR "dairying"[All Fields]) OR ("dairy products"[MeSH Terms] OR ("dairy"[All Fields] AND "products"[All Fields]) OR "dairy products"[All Fields]) OR ("yoghurts"[All Fields] OR "yogurt"[MeSH Terms] OR "yogurt"[All Fields] OR "yoghurt"[All Fields] OR "yogurts"[All Fields]) OR ("cheese"[MeSH Terms] OR "cheese"[All Fields] OR "cheeses"[All Fields] OR "cheese s"[All Fields]) OR (("process"[All Fields] OR "processe"[All Fields] OR "processed"[All Fields] OR "processes"[All Fields] OR "processing"[All Fields] OR "processings"[All Fields]) AND ("cheese"[MeSH Terms] OR "cheese"[All Fields] OR "cheeses"[All Fields] OR "cheese s"[All Fields])) OR ("kefir"[MeSH Terms] OR "kefir"[All Fields] OR "kefirs"[All Fields]) OR ("quark"[All Fields] OR "quarks"[All Fields]) OR ("fresh"[All Fields] AND ("cheese"[MeSH Terms] OR "cheese"[All Fields] OR "cheeses"[All Fields] OR "cheese s"[All Fields])) OR (("acidified"[All Fields] OR "acidifier"[All Fields] OR "acidifiers"[All Fields] OR "acidifies"[All Fields] OR "acidify"[All Fields] OR "acidifying"[All Fields]) AND ("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR "milk"[All Fields] OR "milk"[MeSH Terms])) OR (("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR "milk"[All Fields] OR "milk"[MeSH Terms]) AND ("beverage s"[All Fields] OR "beverages"[MeSH Terms] OR "beverages"[All Fields] OR "beverage"[All Fields]))) AND 2010/01/01:3000/12/12[Date - Publication]**) NOT (("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR ("human"[All Fields] AND "milk"[All Fields]) OR ("milk, human"[MeSH Terms] OR ("milk"[All Fields] AND "human"[All Fields]) OR "human milk"[All Fields] OR ("breast"[All Fields] AND "milk"[All Fields]) OR "breast milk"[All Fields]) OR ("breast feeding"[MeSH**

Terms] OR ("breast"[All Fields] AND "feeding"[All Fields]) OR "breast feeding"[All Fields])) AND 2010/01/01:3000/12/12[Date - Publication])) AND (2010/1/1:3000/12/12[pdat])
Search String Cochrane: (milk OR "human milk" OR (milk AND human) OR ((milk OR "human milk" OR (milk AND human)) AND (economics OR production OR productions OR efficiency OR productivity OR product OR productive OR productively OR productivities OR products)) OR dairies OR dairy OR dairying OR "dairy products" OR (dairy AND products) OR yoghurts OR yogurt OR yoghurt OR yogurts OR cheese OR cheeses OR ((process OR processe OR processed OR processes OR processing OR processings) AND (cheese OR cheeses)) OR kefir OR kefirs OR quark OR quarks OR (fresh AND (cheese OR cheeses)) OR ((acidified OR acidifier OR acidifiers OR acidifies OR acidify OR acidifying) AND (milk OR "human milk" OR (milk AND human))) OR ((milk OR "human milk" OR (milk AND human)) AND (beverages OR beverage))) NOT (milk OR "human milk" OR (milk AND human) OR (human AND milk) OR ("breast milk") OR (breast AND milk) OR ("breast feeding") OR (breast AND feeding))

11. Grain legumes (Pulses)

Search String PubMed: ("Fabaceae"[Mesh] OR "legumes" [tiab] OR "pulses" [tiab] OR "beans" [tiab] OR "lentils" [tiab] OR "chickpeas" [tiab] OR "peas" [tiab] OR "soybeans" [tiab] OR "soy" [tiab] OR "peanuts" [tiab])
Search String Cochrane: ("Fabaceae":ti,ab OR "legumes":ti,ab OR "pulses":ti,ab OR "beans":ti,ab OR "lentils":ti,ab OR "chickpeas":ti,ab OR "peas":ti,ab OR "soybeans":ti,ab OR "soy":ti,ab OR "peanuts":ti,ab)

12. Plant-based milk alternatives

Search String PubMed: "plant-based milk" [tiab] OR "plant milk" [tiab] OR "non-dairy milk" [tiab] OR "milk alternative" [tiab] OR "dairy alternative" [tiab] OR "vegan milk"[tiab] OR "vegetable milk"[tiab] OR "milk substitute"[tiab] OR "almond milk"[tiab] OR "soy milk"[tiab] OR "oat milk"[tiab] OR "rice milk"[tiab] OR "coconut milk"[tiab] OR "cashew milk"[tiab] OR "pea milk"[tiab] OR "hemp milk"[tiab] OR "flax milk"[tiab] OR "hazelnut milk"[tiab] OR "quinoa milk"[tiab] OR "tigernut milk"[tiab]
Search String Cochrane: ("plant-based milk":ti,ab,kw OR "plant milk":ti,ab,kw OR "non-dairy milk":ti,ab,kw OR "milk alternative":ti,ab,kw OR "dairy alternative":ti,ab,kw OR "vegan milk":ti,ab,kw OR "vegetable milk":ti,ab,kw OR "milk substitute":ti,ab,kw OR "almond milk":ti,ab,kw OR "soy milk":ti,ab,kw OR "oat milk":ti,ab,kw OR "rice milk":ti,ab,kw OR "coconut milk":ti,ab,kw OR "cashew milk":ti,ab,kw OR "pea milk":ti,ab,kw OR "hemp milk":ti,ab,kw OR "flax milk":ti,ab,kw OR "hazelnut milk":ti,ab,kw OR "quinoa milk":ti,ab,kw OR "tigernut milk":ti,ab,kw)

13. Plant-based meat, fish and egg analogues

Search String PubMed: ((("plant-based"[All Fields] OR "plant derived"[All Fields] OR "vegan"[All Fields] OR "vegetarian"[All Fields] OR "alternative protein"[All Fields] OR "plant protein"[All Fields] OR "alternative"[All Fields] OR "substitute"[All Fields] OR "analogue"[All Fields] OR "replacement"[All Fields] OR "imitation"[All Fields]) AND ("meat"[All Fields] OR "fish"[All Fields] OR "seafood"[All Fields] OR "egg"[All Fields] OR "poultry"[All Fields] OR "chicken"[All Fields] OR "beef"[All Fields] OR "pork"[All Fields] OR "proteins"[MeSH Terms])) OR ("tofu"[All Fields] OR "tempeh"[All Fields] OR "seitan"[All Fields] OR "jackfruit"[All Fields] OR "pea protein"[All Fields] OR "soy protein"[All Fields] OR "oat protein"[All Fields] OR "rice protein"[All Fields] OR "fermented protein"[All Fields] OR "mycoprotein"[All Fields] OR "fungal protein"[All Fields] OR "algae protein"[All Fields] OR "vegetable protein"[All Fields]))
Search String Cochrane: (("plant-based" OR "plant derived" OR "vegan" OR "vegetarian" OR "alternative protein" OR "plant protein" OR "alternative" OR "substitute" OR "analogue" OR "replacement" OR "imitation") AND ("meat" OR "fish" OR "seafood" OR "egg" OR "poultry" OR "chicken" OR "beef" OR "pork" OR "protein")) OR ("tofu" OR "tempeh" OR "seitan" OR "jackfruit" OR "pea protein" OR "soy protein" OR "oat protein" OR "rice protein" OR "fermented protein" OR "mycoprotein" OR "fungal protein" OR "algae protein" OR "vegetable protein")

14. Nuts and seeds

Search String PubMed: ("nuts"[Mesh] OR "seeds" [Mesh] OR "nut"[Title/Abstract] OR "nuts" [Title/Abstract] OR "seed*" [Title/Abstract] OR "kernel*" [Title/Abstract] OR "avocado*" [Title/Abstract] OR "walnut*" [Title/Abstract] OR "cashew*" [Title/Abstract] OR "chia*" [Title/Abstract] OR "chestnut*" [Title/Abstract] OR "peanut*" [Title/Abstract] OR "hazelnut*" [Title/Abstract] OR "coconut*" [Title/Abstract] OR "almond*" [Title/Abstract] OR "olive*" [Title/Abstract] OR "pistachio*" [Title/Abstract] OR "sesame*" [Title/Abstract] OR "flaxseed*" [Title/Abstract]OR "linseed*" [Title/Abstract])
Search String Cochrane: nut:ti,ab,kw OR nuts:ti,ab,kw OR seed*:ti,ab,kw OR kernel*:ti,ab,kw OR avocado*:ti,ab,kw OR walnut*:ti,ab,kw OR cashew*:ti,ab,kw OR chia*:ti,ab,kw OR chestnut*:ti,ab,kw OR peanut*:ti,ab,kw OR hazelnut*:ti,ab,kw OR coconut*:ti,ab,kw OR almond*:ti,ab,kw OR olive*:ti,ab,kw OR pistachio*:ti,ab,kw OR sesame*:ti,ab,kw OR flaxseed*:ti,ab,kw OR linseed*:ti,ab,kw

15. Oils and fats

Search String PubMed: ("oils"[Mesh] OR "fats" [Mesh] OR "oil"[Title/Abstract] OR "oils*" [Title/Abstract] OR "fat" [Title/Abstract] OR "fats*" [Title/Abstract] OR "butter*" [Title/Abstract] OR "margarine*" [Title/Abstract])
Search String Cochrane: oil:ti,ab,kw OR oils*:ti,ab,kw OR fat:ti,ab,kw OR fats*:ti,ab,kw OR butter*:ti,ab,kw OR margarine*:ti,ab,kw

16. Sweets / sweet snacks

Search String PubMed: "confectionar*"[All Fields] OR "cake"[All Fields] OR "tart"[All Fields] OR ("muffin"[All Fields] OR "muffins"[All Fields]) OR ("cupcake"[All Fields] OR "cupcakes"[All Fields]) OR (("hardness"[MeSH Terms] OR "hardness"[All Fields] OR "hard"[All Fields]) AND ("candy"[MeSH Terms] OR "candy"[All Fields] OR "candied"[All Fields] OR "candies"[All Fields] OR "confectionery"[All Fields] OR "confectioneries"[All Fields])) OR ("soft"[All Fields] AND ("candy"[MeSH Terms] OR "candy"[All Fields] OR "candied"[All Fields] OR "candies"[All Fields] OR "confectionery"[All Fields] OR "confectioneries"[All Fields])) OR (("fruit"[MeSH Terms] OR "fruit"[All Fields] OR "fruits"[All Fields] OR "fruit s"[All Fields] OR "fruited"[All Fields] OR "fruiting"[All Fields]) AND "gum"[All Fields]) OR (("chewings"[All Fields] OR "chews"[All Fields] OR "mastication"[MeSH Terms] OR "mastication"[All Fields] OR "chewed"[All Fields] OR "chewing"[All Fields]) AND "gum"[All Fields]) OR "chocolate*"[All Fields] OR ("chocolate"[MeSH Terms] OR "chocolate"[All Fields] OR "cocoa"[All Fields] OR "cacao"[MeSH Terms] OR "cacao"[All Fields] OR "cocoa s"[All Fields] OR "cocoas"[All Fields]) OR ("cookie"[All Fields] OR "cookies"[All Fields]) OR ("biscuit"[All Fields] OR "biscuits"[All Fields]) OR ("cream"[All Fields] OR "creamed"[All Fields] OR "creaming"[All Fields] OR "creams"[All Fields]) OR ("pudding"[All Fields] OR "puddings"[All Fields]) OR ("custard"[All Fields] OR "custards"[All Fields]) OR ("j appl math"[Journal] OR "j addict med"[Journal] OR "jam"[All Fields]) OR ("marmalade"[All Fields] OR "marmalades"[All Fields]) OR (("sweet"[All Fields] OR "sweetness"[All Fields] OR "sweets"[All Fields]) AND ("spread"[All Fields] OR "spreaded"[All Fields] OR "spreading"[All Fields] OR "spreadings"[All Fields] OR "spreads"[All Fields])) OR ("ice cream"[MeSH Terms] OR ("ice"[All Fields] AND "cream"[All Fields]) OR "ice cream"[All Fields]) OR "icecream"[All Fields] OR ("pastries"[All Fields] OR "pastry"[All Fields]) OR ("glycyrrhiza"[MeSH Terms] OR "glycyrrhiza"[All Fields] OR "licorices"[All Fields] OR "liquorices"[All Fields] OR "liquorice"[All Fields] OR "licorice"[All Fields]) OR "marzipan"[All Fields] OR (("cereale"[All Fields] OR "edible grain"[MeSH Terms] OR ("edible"[All Fields] AND "grain"[All Fields]) OR "edible grain"[All Fields] OR "cereal"[All Fields] OR "cereals"[All Fields]) AND "bar"[All Fields]) OR (("energie"[All Fields] OR "energies"[All Fields] OR "energy"[All Fields]) AND "bar"[All Fields]) OR ("toffee"[All Fields] OR "toffees"[All Fields]) OR ("caramel"[All Fields] OR "caramelization"[All Fields] OR "caramelized"[All Fields] OR "caramels"[All Fields]) OR ("althaea"[MeSH Terms] OR "althaea"[All Fields] OR "marshmallow"[All Fields] OR "marshmallows"[All Fields]) OR ("gels"[MeSH Terms] OR "gels"[All Fields] OR "jellies"[All Fields] OR "jelly"[All Fields] OR "jelly s"[All Fields]) OR ("gels"[MeSH Terms] OR "gels"[All Fields] OR "jellies"[All Fields] OR "jelly"[All Fields] OR "jelly s"[All Fields]) OR ("lollies"[All Fields] OR "lolly"[All Fields]) OR ("lollies"[All Fields] OR "lolly"[All Fields])
Search String Cochrane: confectionar* OR cake OR tart OR muffin OR muffins OR cupcake OR cupcakes OR ((hard OR hardness) AND (candy OR candied OR candies OR confectionery OR confectioneries)) OR (soft AND (candy OR candied OR candies OR confectionery OR confectioneries)) OR ((fruit OR fruits OR fruited OR fruiting) AND gum) OR ((chewings OR chews OR mastication OR chewed OR chewing) AND gum) OR chocolate* OR chocolate OR cocoa OR cacao OR "cocoa s" OR cocoas OR cookie OR cookies OR biscuit OR biscuits OR cream OR creamed OR creaming OR creams OR pudding OR puddings OR custard OR custards OR jam OR marmalade OR marmalades OR ((sweet OR sweetness OR sweets) AND (spread OR spreaded OR spreading OR spreadings OR spreads)) OR "ice cream" OR (ice AND cream) OR icecream OR pastry OR pastries OR glycyrrhiza OR licorices OR liquorices OR liquorice OR licorice OR marzipan OR ((cereale OR "edible grain" OR (edible AND grain) OR cereal OR cereals) AND bar) OR ((energie OR energies OR energy) AND bar) OR toffee OR toffees OR caramel OR caramelization OR caramelized OR caramels OR althaea OR marshmallow OR marshmallows OR gels OR jellies OR jelly OR lollies OR lolly

17. Savoury snacks

Search String PubMed: ("snacks"[Mesh] OR "snack*"[Title/Abstract] OR "between meal*"[Title/Abstract] OR "in-between meal*"[Title/Abstract] OR "chip*"[Title/Abstract] OR "crisp*"[Title/Abstract] OR "popcorn" [Title/Abstract] OR "cracker*" [Title/Abstract] OR "peanut*" [Title/Abstract])
Search String Cochrane: ("snack":ti,ab OR "in-between meals":ti,ab OR "between meal":ti,ab OR "chip":ti,ab OR "crisp":ti,ab OR "popcorn":ti,ab OR "cracker":ti,ab OR "peanut":ti,ab)

18. Ultra-processed foods

Search String PubMed: ((("food, processed"[MeSH Terms] OR "ultraprocessed food*"[Title/Abstract] OR "ultra processed food*"[Title/Abstract] OR "packaged food*"[Title/Abstract] OR "convenience food*"[Title/Abstract] OR "highly processed food*"[Title/Abstract] OR "ready to eat*"[Title/Abstract] OR "junk food*"[Title/Abstract] OR "fast food*"[Title/Abstract] OR "industrialized food*"[Title/Abstract] OR "industrial food*"[Title/Abstract] OR "processed meal*"[Title/Abstract] OR "NOVA"[All Fields]) AND ("2015/03/11 00:00":"3000/01/01 05:00"[Date - Publication] AND "review"[Publication Type])) OR ("fast foods"[MeSH Terms] OR ("fast"[All Fields] AND "foods"[All Fields]) OR "fast foods"[All Fields] OR ("fast"[All Fields] AND "food"[All Fields]) OR "fast food"[All Fields])) AND ((y_10[Filter]) AND (review[Filter]))
Search String Cochrane: (ultraprocessed NEXT food*) OR (ultra NEXT processed NEXT food*) OR (packaged NEXT food*) OR (convenience NEXT food*) OR (highly NEXT processed NEXT food*) OR (ready NEXT to NEXT eat*) OR (junk NEXT food*) OR (fast NEXT food*) OR (industrialized NEXT food*) OR (industrial NEXT food*) OR (processed NEXT meal*) OR NOVA OR (fast NEXT foods) OR (fast AND foods) OR (fast AND food)

Appendix B

(excel spreadsheet submitted separately to the FSVO)