ASSESSING THE EXISTING EVIDENCE BASE ON SCHOOL FOOD AND NUTRITION POLICIES:
A SCOPING REVIEW

World Health Organization

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ISBN 978-92-4-002564-6 (electronic version)
ISBN 978-92-4-002565-3 (print version)

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Suggested citation. Assessing the existing evidence base on school food and nutrition policies: a scoping review. Geneva: World Health Organization; 2021. Licence: CC BY-NC-SA 3.0 IGO.

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Contents

Acknowledgements

This scoping review was prepared by Solange Durão, Jenna Patterson, Tamara Kredo and Eugene Lee Davids from Cochrane South Africa, South African Medical Research Council.

The development and implementation of the search strategies for this scoping review was undertaken by Joy Oliver (Cochrane SA, SA Medical Research Council). Comments on the protocol were provided by Lisa Bero (Senior Editor, Cochrane Public Health and Health Systems Network), Luke Wolfenden (Joint Coordinating Editor, Cochrane Public Health) and Vivian Welch (Editor in Chief, Campbell Collaboration). External peer review was provided by Dr Daniela Küllenberg de Gaudry (Nutritional Scientist, Cochrane) and Prof. Ernesta Kunneke (Head of Department, Department of Dietetics, Faculty of Community and Health Sciences, University of the Western Cape, South Africa). Neither reviewer had any conflicts of interest related to this publication to declare.

The scoping review was commissioned by the Safe, Healthy and Sustainable Diet Unit of the Department of Nutrition and Food Safety (NFS) under the guidance of Dr Chizuru Nishida and Dr Katrin Engelhardt. The review was presented to the WHO Nutrition Guidance Expert Advisory Group (NUGAG) Subgroup on Policy Actions at their second meeting held in December 2019. Subsequent to the NUGAG meeting, and drawing on the scoping review's findings, the Expert Advisory Group developed a set of research questions relating to school food and nutrition policies that remain to be answered by future systematic reviews.

Technical editing of the document was undertaken by Ann Morgan, and cover design and formatting of the document was undertaken by Sue Hobbs.

Solange Durão and Tamara Kredo are partly supported by the Research, Evidence and Development Initiative (READ-It) project. READ-It (project number 300342-104) is funded by the UK government; however, the views expressed do not necessarily reflect the UK government's official policies.

Executive summary

The prevalence of overweight and obesity among children and adolescents is rising globally, with more than two thirds of overweight children now living in low-and middle-income countries (LMICs). School food and nutrition policies that address key areas such as the school community, curriculum, food and nutrition environment and/or nutrition and health services have the potential to address the rise in prevalence of overweight, obesity and diabetes, as well as to prevent and reduce undernutrition.

This report presents the results of a scoping review conducted in 2019 to identify and map existing evidence on the effects of school food and nutrition policies on health-related outcomes in children of school age. For the purposes of this exercise, and in order to align with WHO's Nutrition-friendly Schools Initiative (NFSI) framework, school-based food and nutrition interventions were assessed in terms of the impacts in all four key policy areas, namely – the school community, the school curriculum, the school food and nutrition environment, and school nutrition and health services.

Three electronic databases were searched for systematic reviews meeting the eligibility criteria: the Cochrane Library, Epistemonikos and PubMed. All systematic reviews published since 2012 in English on school food and nutrition policies that promote healthy diets among learners in primary and secondary school through interventions that address either the school community, the curriculum, the food environment or nutrition and health services were considered. Inclusion criteria relating to outcomes were kept deliberately wide and included both health outcomes (e.g. BMI) and non-health outcomes (e.g. consumption and purchasing behaviour). All titles and abstracts of records identified through the database searches were screened by one reviewer against the eligibility criteria. One reviewer was also responsible for screening all the potentially eligible full texts and for charting the data for the included studies using a pre-specified and piloted form. Results were tabulated and described narratively.

After excluding duplicates and obviously irrelevant titles, the titles and abstracts of 2,569 records, and then 258 full texts, were screened. A total of 173 records were excluded at the full-text screening stage, leaving 69 reviews to form the basis of the scoping review – including 64 completed systematic reviews and two systematic review protocols which assessed the effectiveness of policies or interventions, and three completed systematic reviews that focused on strategies for implementing policies or interventions. Most of the effectiveness reviews reported on children aged between 5 and 18 years (n = 20/66) or children under 5 up to the age of 18 years (n = 17/66), that is, pre-schoolers as well as primary- and secondary-school-aged children. Approximately half of the effectiveness reviews assessed nutrition interventions only (n = 28/66), and a roughly equal proportion assessed the impact of a broader set of interventions, for example, interventions which addressed physical activity as well as nutrition (n = 31/66). The effectiveness of interventions which addressed the school curriculum was assessed in 48 reviews, while interventions that focused on modifying the school food and nutrition environment were the subject of 39 reviews. The most reported outcomes were anthropometric (in 47 of 66 reviews) and diet-related (in 40 of 66 reviews).

This scoping review identified and mapped the evidence provided by existing reviews on the topic of school food and nutrition policies. This work has helped to outline the scope of new WHO guidelines on school food and nutrition policies, which are currently under development. By identifying the types of interventions that the new guidelines will need to address, the scoping review has fulfilled one of its main aims. It has also identified key gaps in the existing evidence base on school food and nutrition policies, in terms of both primary and synthesized research. The main primary research needs have been identified as: more studies in lower income countries; greater inclusion of theoretical models to support the implementation of interventions; more studies which make comparisons between interventions with and without parental participation, as well as across socioeconomic divides; extension of outcomes of interest beyond physical outcomes to include cognitive and academic outcomes, as well as environmental determinants; and more studies which assess the cost-effectiveness and sustainability of interventions. Longer term follow-up studies were also identified as a research need going forward. Finally, this scoping review identified a set of research questions relating to school food and nutrition policies which remain to be addressed by future systematic reviews.

1. Background

Currently, millions of children worldwide are not reaching optimal growth and development, and there is evidence that the prevalence of delays in children's cognitive, language, social and emotional development is rising almost everywhere *(1)*. These developmental delays have been shown to have profound implications for health and well-being later in life.

Nutrition is at the cornerstone of optimal growth and development during childhood and adolescence *(2–4)*. Poor nutrition and unhealthy diets have been associated with diminished outcomes in both children and adolescents *(3, 4)*, and are major risk factors for mortality and morbidity *(5)*. While global efforts to address undernutrition have led to declines in the prevalence of stunting and wasting, rates remain high in many low-income settings *(2, 4, 5)*. Estimates for 2019 suggest that, globally, 38.3 million children under the age of 5 are overweight or obese, an increase of 8 million since 2000. Almost half of all overweight children under 5 live in Asia and one quarter in Africa *(6)*.

The school setting provides an environment in which the health of children, as well as that of the wider school community, can be protected and promoted. In terms of implementing interventions to address all forms of malnutrition in children and adolescents, the school setting is therefore an important one to consider.

Where they have been introduced, school food and nutrition policies often address one or more of the following areas or "elements":

- the school community,
- the school curriculum,
- the school food and nutrition environment, and
- the school nutrition and health services *(7, 8)*.

Within each of these elements, different types of interventions or actions may be implemented to improve nutrition (Table 1). These interventions or actions, when implemented as part of comprehensive school food and nutrition policies, have the potential to address the rise in prevalence of overweight, obesity and diet-related noncommunicable diseases (NCDs), as well as to prevent and reduce undernutrition. Implementing food and nutrition policies within the school setting offers the additional benefit of providing more equitable access to improved health outcomes for children from various socioeconomic backgrounds *(9)*.

Fig. 1 depicts the pathways through which school-based nutrition interventions may improve health and educational outcomes in children and adolescents. Outputs associated with these interventions include changes in knowledge, attitudes and behaviours about healthy diets at the individual level; changes in norms, policies and food environment at the school level; and changes in norms and access to healthier foods at the family and community level. These changes would then influence behaviours related to diet, hygiene, cooking and food hygiene skills, as well as concentration and participation in the school environment. These behaviour changes would ultimately result in desirable health and educational outcomes, such a reduction of all forms of malnutrition and improved academic performance, among others.

Recognizing the importance of schools in promoting population health, WHO launched its Global School Health Initiative in 1995 with the aim of improving the health of students and

Table 1. School food and nutrition policy elements and examples of interventions/actions

Policy elements	Examples of interventions/actions
School community	Education of teachers, parents and larger community on healthy eating
School curriculum	Nutrition education included in the school curriculum Provision of extracurricular nutrition education (e.g. workshops) School vegetable gardens
School food and nutrition environment	Standards and rules for foods and beverages available at school or sold in schools (i.e. through school canteens or vending machines) School food procurement policy, including policies to restrict provision and/or sales of foods and non-alcoholic beverages in schools (underpinned by school food standards) Pricing policies (e.g. policies to promote healthier alternatives; may include reducing the price of healthier options/ increasing price of less healthy options) Policies to restrict marketing of foods and non-alcoholic beverages in and around schools Standards for the marketing of foods and non-alcoholic beverages in schools Provision of food at school (e.g. school meals, fruit and vegetable schemes, milk schemes)
School nutrition and health services	Growth monitoring Deworming Water and sanitation programmes (e.g. safe drinking water available free of charge) Micronutrient supplementation

The *school community* element refers to the education of all agents who are part of the school system (i.e. students, parents, teachers, supporting staff and the wider school community) with regards to healthy nutrition. The *school curriculum* element refers to the provision of nutrition education to children and adolescents attending school, either as part of the school curriculum or through extracurricular activities, and which aims to improve their nutritional and diet choices. The *school food and nutrition environment* element refers to the quality of food and drink available in the school setting. The *school nutrition and health services* element encompasses the support services that enable detection of nutrition problems or that provide a channel to deliver specific nutrition interventions in the school setting.

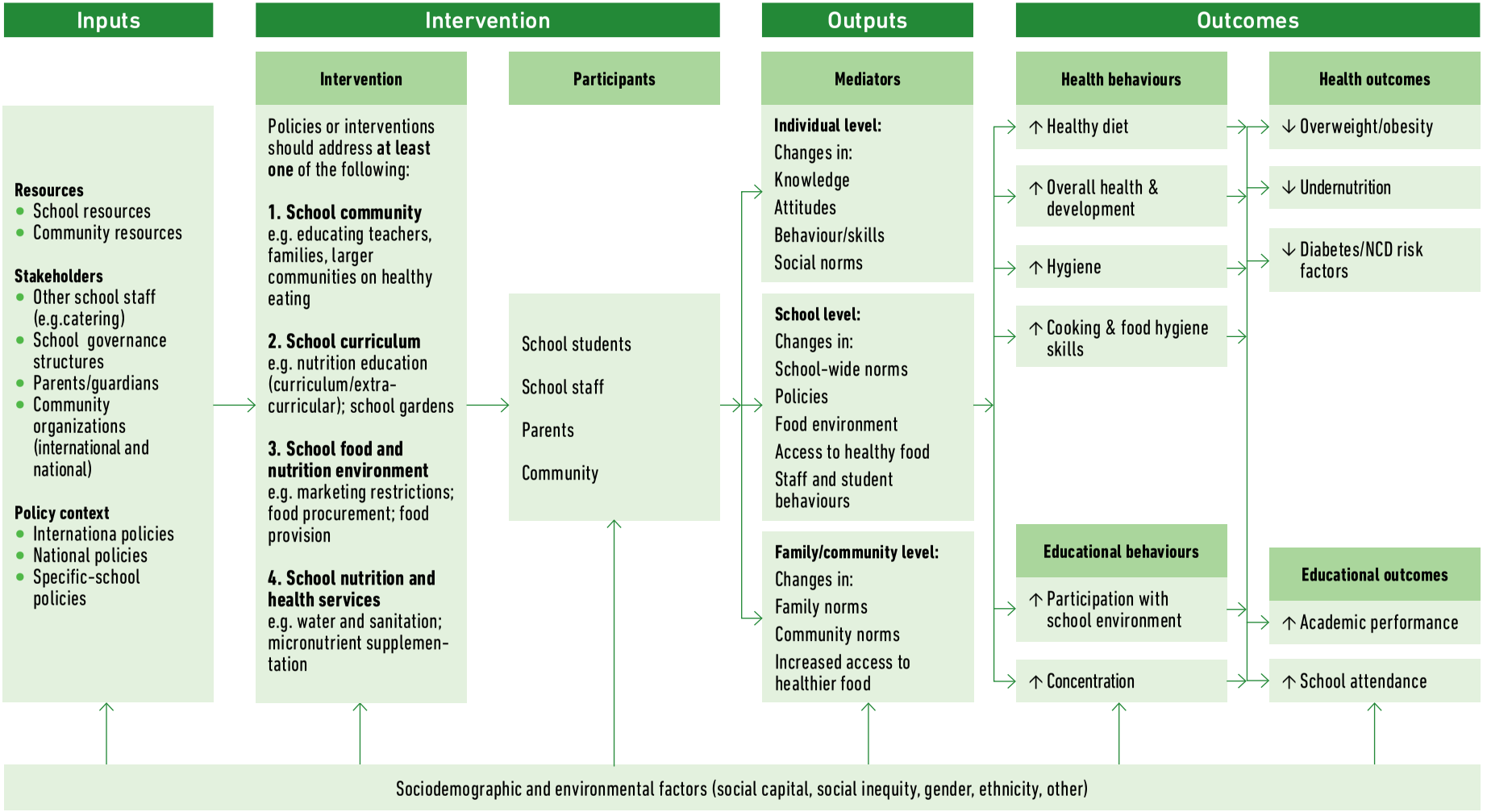
Sources: adapted from WHO, 2018 *(7)* and WHO Regional Office for Europe, 2006 *(8)*.

the school community through strengthened health promotion and educational activities. This initiative established healthy nutrition as an essential element of a "health-promoting school" *(11)*, a concept that was further championed by WHO's Global Strategy on Diet, Physical Activity and Health, published in 2004 *(12)*. Launched in 2006, the Nutrition-friendly School Initiative (NFSI) reaffirmed the pivotal role of nutrition in the context of health-promoting schools and took a further step towards the development of integrated policy action by providing a framework for ensuring that school-based programmes address the double burden of malnutrition, namely overweight and obesity, and undernutrition. The importance of policy actions in schools was reiterated in the report of the WHO Commission on Ending Childhood Obesity *(13)*.

Building on the above-mentioned work, the Second Joint WHO/FAO International Conference on Nutrition (ICN2), held in 2014, called for healthy diets to be fostered in preschools and schools *(14)*. More specifically, a recommendation was made to "implement nutrition education and information interventions based on national dietary guidelines and coherent policies related to food and diets, through improved school curricula".

Despite the numerous calls to action to protect, promote and support good nutrition and healthy diets in the school environment and despite evidence supporting the efficacy of the NFSI, there has been a notable weakening in programming for school health and nutrition over the past decade. Comparisons between the reported outcomes of the second Global Nutrition Policy Review (GNPR2), conducted 2016–2017, and those of the first GNPR (2009–

Fig. 1 Logic model depicting pathways from school food and nutrition policies to health and educational outcomes



NCD, noncommunicable disease

Source: adapted from Langford et al., 2014 *(10)*.

2010) supports this negative trend *(7)*. This situation suggests that here is an underused opportunity to create enabling school food environments and underscores the urgent need for evidence-informed guidelines in this important public health policy area.

To meet this need, WHO's Nutrition Guidance Expert Advisory Group (NUGAG) Subgroup on Policy Actions is currently working towards developing a new set of WHO guidelines on school food and nutrition policies. These guidelines are designed to help more countries to accelerate policy actions to protect, promote and support healthy diets in schools.[1] WHO has been actively engaged in, and committed to, developing more robust evidence-informed policy guidelines through its guideline development process, a process which it first introduced in 2010.

The present scoping review was conducted to inform NUGAG's discussion and support its guideline development work by assessing the extent of the existing evidence base on school-based food and nutrition policies. Scoping reviews are a type of knowledge synthesis that follow a systematic approach in order to map evidence on a given topic and to identify the main concepts, theories, information sources and knowledge gaps *(15)*. From the perspective of guideline development, scoping reviews are valuable in a number of ways, including the identification of the key questions for new systematic review(s) that may need to be conducted in order to support guideline development *(16)*.

[1] See: (https://www.who.int/nutrition/topics/guideline-development/nugag_policyactions/en/).

2. Rationale and objectives

The rationale for conducting a scoping review at this time is to inform the development of WHO's proposed guidelines on school food and nutrition policies, in particular, by identifying critical gaps in the evidence base. The objectives of this scoping review may be specified as follows:

1. to identify and map the scope of available evidence from systematic literature reviews on the effects of school food and nutrition policies on important health-related outcomes;
2. to identify gaps in the existing evidence base and to identify new systematic review questions that would need to be answered in order to support the development of the planned WHO guidelines on school-based food and nutrition policies; and
3. to identify existing systematic reviews that may be used to inform the planned WHO guidelines, if available.

3. Methods

A systematic approach, based on the PRISMA Extension for Scoping Reviews (PRISMA-ScR) reporting guidelines *(15)*, was used to conduct and report this scoping review. The review protocol was developed a priori.

3.1 Inclusion and exclusion criteria

Inclusion and exclusion criteria for the scoping review were developed based on the recommended PICOS elements (**P**opulation, **I**ntervention, **C**omparator, **O**utcomes, **S**tudy design) for systematic and scoping reviews *(17)* and are outlined in Table 2. Any published systematic review, as well as any systematic review protocol, published between 2012 and 2019 that met these eligibility criteria was considered for inclusion. For the purposes of this scoping review, a systematic review was defined as a review of primary studies that had pre-determined objectives and pre-determined criteria for inclusion, had searched at least two data sources (at least one of which was an electronic database), and had performed data extraction and a risk of bias assessment *(18)*.

Systematic reviews (and protocols) that assessed either the effectiveness of policies or of policy implementation strategies were considered eligible for inclusion. Reviews of the latter type typically employ implementation research, which studies strategies designed to integrate health policies, practices or programmes within specific settings, for example, continuous quality improvement, educational materials, performance monitoring, local consensus processes and educational outreach visits.

As this review aimed to explore and map the scope of the existing evidence base relating to school-based food and nutrition policies, the definition of a "policy" was kept intentionally broad. Thus, any review that included interventions that were either specifically referred to as policies, or that addressed at least one of the policy elements listed in Table 1 and could thus, in theory, be incorporated into school policy, was considered eligible. No reviews were excluded on the basis of the type of comparison group used to assess the effectiveness of interventions (see Table 2).

While reviews that included studies from any geographic region were deemed eligible for inclusion, the scoping review only considered systematic reviews that were published in English.

3.2 Information sources and search strategy

Three electronic databases – the Cochrane Library, Epistemoniko and PubMed – were searched for potentially relevant systematic reviews published in the last eight years (2012–2019), using a comprehensive search strategy. The search period was defined to ensure maximum coverage within practical limits due to time restrictions for carrying out the scoping review. The search strategy was developed by a Cochrane information specialist with input from researchers with relevant expertise. The search strategy was developed in the first instance for use in PubMed, and then refined and adapted for conducting searches in the other two databases (see Annex 1).

Table 2. Scoping review eligibility criteria for systematic reviews and review protocols

Item	Inclusion criteria	Exclusion criteria
Population	Learners in primary and/or secondary school	Reviews involving policies/interventions aimed at school-age children but applied exclusively outside of a school setting
Interventions, approaches or exposures of interest	School food and nutrition policies that promote healthy diets and lifestyles through interventions/activities Interventions which address one or more of the policy elements listed in Table 1 (i.e. the school community, curriculum, food environment, nutrition and health services) Policies implemented at national, subnational (e.g. district, province) or school level were eligible for inclusion Reviews that assessed the effectiveness of the policies or of policy implementation strategies were eligible	Policies linked to "physical activity programmes", unless this was an integrated component of the school food and nutrition policy being evaluated
Comparison	Systematic reviews that compared the intervention/ policy with any relevant control group, including comparisons with no policy or a less comprehensive policy	Not applicable
Outcomes	Any health (e.g. BMI) and non-health (e.g. consumption and purchasing behaviour) outcomes measured in primary/secondary school learners	Not applicable
Study design	Systematic reviews and systematic review protocols assessing the effectiveness of school food and nutrition policies published since 2012 in English	Primary studies Systematic reviews of qualitative studies

3.3 Study selection and data charting

All titles and abstracts of records identified through the database searches, and then all potential full texts, were screened by one reviewer against the eligibility criteria (see Table 2). Title and abstract screening was performed using the Rayyan platform.[1] Endnote software was used for full-text screening, as well as for reference management. Reasons for the exclusion of any potential reviews at the full-text screening stage were documented. A second author checked a 10% random sample of the records excluded at both screening stages for quality control, and any disagreements were resolved through discussion.

Data charting of the eligible systematic reviews (or systematic review protocols) was performed by one reviewer. Relevant data were charted using a pre-specified and piloted data charting form, using Excel software. Charted data included: author(s), publication date (year), countries in which the included primary studies were conducted, and the number of primary studies included in the systematic review and their study design(s) (including information on comparator or control groups, if available). In addition, for each eligible systematic review included in the scoping review, details of the study question under investigation and the pre-defined PICOS elements (including the duration of the interventions) were also extracted. Finally, an adapted version of the EPICOT framework (**E**vidence, **P**opulation, **I**ntervention, **C**omparison, **O**utcome, **T**imestamp), which is widely used for making research recommendations, was used to extract information on research gaps that were identified and reported in the included systematic reviews *(19)*.

[1] https://rayyan.qcri.org/welcome

Given that this review is aimed at assessing the scope of the existing evidence base relating to the effectiveness of school-based food and nutrition policies as opposed to assessing the evidence itself, data was largely extracted from the Methods sections of the included systematic reviews. Where the information in the Methods section was missing or unclear, information was extracted from elsewhere in the systematic review. This was typically the case for information relating to the number of included primary studies, participant populations and the duration of the interventions. If included systematic reviews described studies in which interventions were applied in a range of settings, extracted data were limited to school-based interventions; information relating to interventions applied in other settings was not extracted and analysed as part of this scoping review, except in cases where this information was not reported separately for different settings included in a systematic review.

3.4 Assessment of methodological quality

Since this scoping review did not aim to determine the effects of school-based interventions on nutrition-related outcomes in school-aged children, the methodological quality of the included systematic reviews was not assessed.

3.5 Synthesis of results

The charted data were analysed descriptively, using tabulations or graphs where appropriate, in order to present a synthesis of key findings according to the scoping review objectives outlined in Section 2.

The narrative synthesis of the extracted data was based on the five PICOS items (population, interventions, comparators, outcomes and study design), as well as a number of other characteristics related to each of these elements, including as geographic location of primary studies, schooling level and duration of interventions. Information relating to the interventions was summarized in accordance with the policy elements and examples of interventions/actions listed in Table 1.

Results of the systematic reviews that assessed the effectiveness of policy implementation strategies were summarized separately.

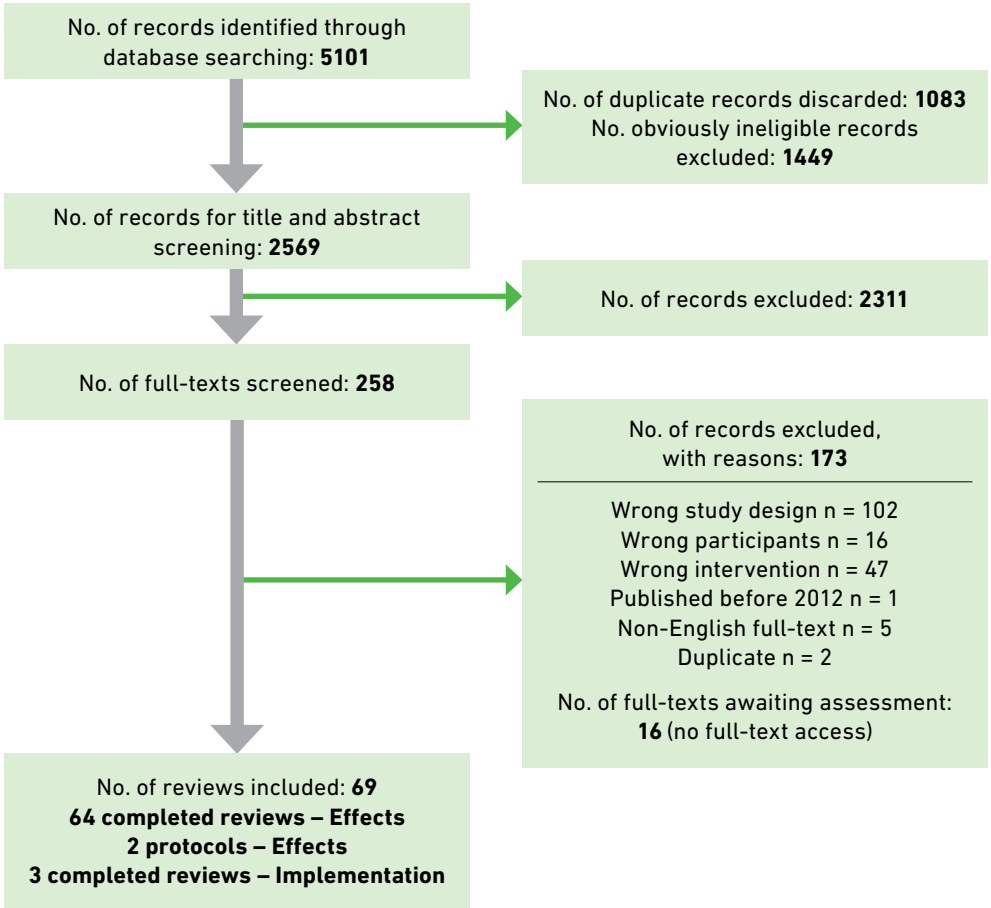
4. Results

4.1 Search results

Fig. 2 describes the study selection process. The database searches retrieved a total of 5,101 records, of which 1,083 were duplicates and thus excluded. A further 1,449 records were discarded after title screening, a step which excluded obviously irrelevant records that were not in any way related to the topic of interest, for example, reviews of physical exercise in people with cirrhosis, and reviews of multiple micronutrient supplementation in breastfeeding women.

After these exclusions, 2,569 deduplicated records were available for title and abstract screening against the eligibility criteria, after which a further 2,311 records were excluded. The full texts of 258 potentially relevant records were then screened, of which 69 met all the eligibility criteria for inclusion in the scoping review. Of these, 67 were completed systematic reviews and two were systematic review protocols. A random selection of 10% of the studies that had been excluded at the title and abstract screening stage were checked by a second reviewer; only one review that had been excluded was subsequently included. A 10% random

Fig. 2 PRISMA flowchart of study selection process



sample of excluded full texts (n = 14) was likewise checked, and this time there were no disagreements.

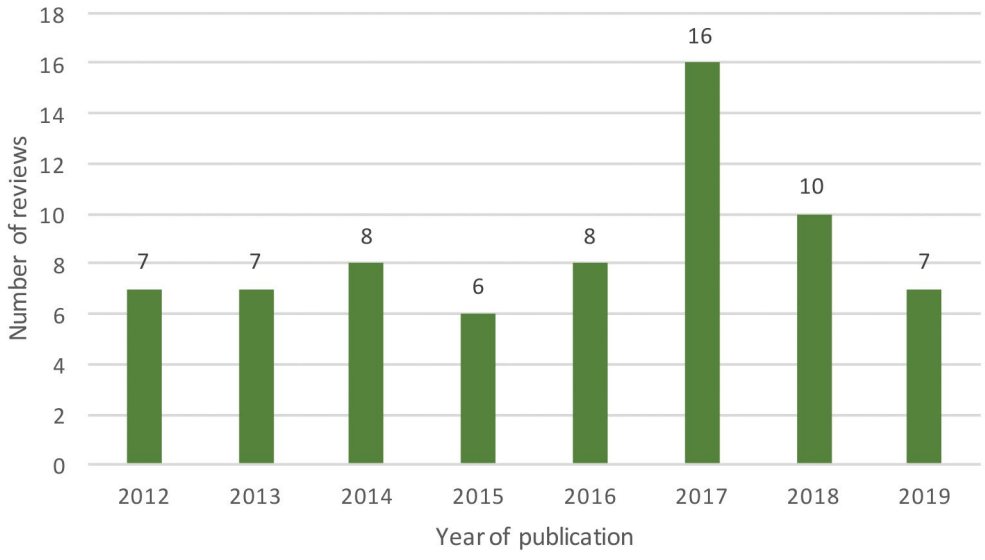
Annex 2 summarizes the key characteristics of the 69 included systematic reviews and systematic review protocols *(10, 20–87)*, detailing the author(s), the year of publication, the stated aim and the pre-specified PICOS items for the review. Annex 3 lists the studies that were excluded at the full-text screening stage and the reasons for their exclusion. Of these 173 excluded reviews, 102 were excluded on account of not having the right study design (i.e. did not meet the definition of a systematic review), 47 were excluded because they did not address an eligible intervention, and another 16 were rejected because they did not include eligible participants (i.e. schoolchildren). Five were excluded because the full text was not in English, two were identified as duplicates during the data extraction process, and one review was published before 2012. A further 16 reviews were classified as awaiting assessment, as the full-text versions could not be readily accessed (Annex 4).

4.2 Description of included studies

Of the 69 included reviews (67 completed systematic reviews and two protocols), 66 (96%) assessed the effects of school-based policies or interventions *(10, 20–84)* and three (4%) assessed the factors influencing the implementation of interventions *(85–87)* (see Annex 2). A total of 41 studies were published during the latter years covered by this scoping review (2016–2019); this compares with a total of 28 for the four-year period, 2012–2015, and suggests a strong and continuing interest in this area of research (Fig. 3).

The focus of the narrative synthesis presented here is on the 66 studies which assess the effect of policies and interventions on health-related outcomes and behaviours in school-aged children. Of these, 64 are completed systematic reviews and two are systematic review protocols. The three systematic reviews which address implementation are discussed separately (see section 4.2.9)

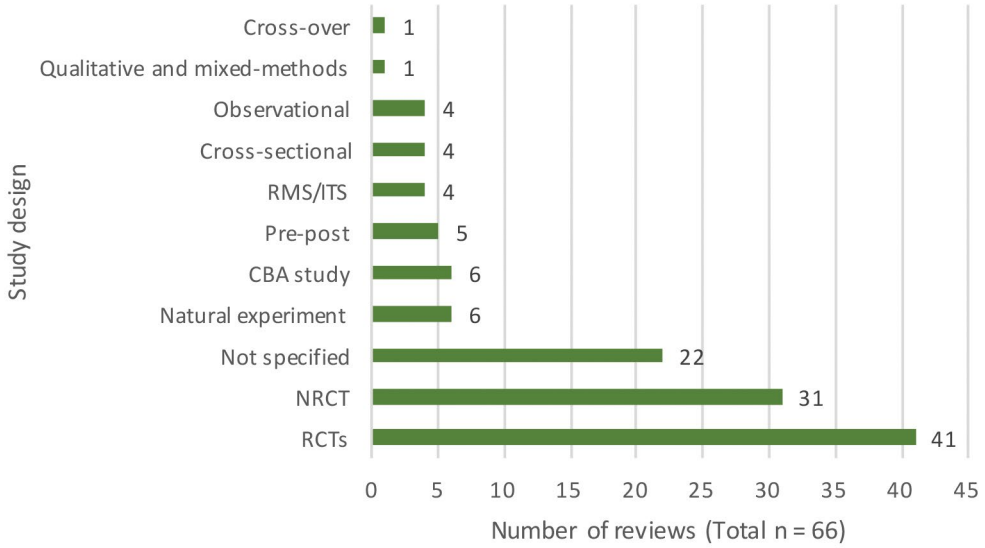
Fig. 3 Year of publication of included systematic reviews (total number of reviews = 69)



4.2.1 Study design

While most systematic reviews specified which types of primary studies would be considered for inclusion (as part of their eligibility criteria), a third (n = 22) did not provide a clear description of their study design inclusion criteria as part of their Methods (Fig. 4). Among the 66 included reviews of effects, the most commonly-specified study design was a randomized controlled trial (RCT) (n = 41/66), followed by non-RCTs or "quasi-randomized" designs (n = 31/66). Ten reviews limited their inclusion criteria to RCTs only and 15 permitted either RCTs or non-RCTs. Other types of study designs that were specified included natural experiments (n = 6/66), controlled before-and-after studies (n = 6/66), pre- and-post designs (n = 5/66), repeated measures or interrupted time series studies (n = 4/66), cross-sectional studies (n = 4/66), observational studies (n = 4/66), qualitative and mixed methods studies (n = 1/66) and cross-over designs (n = 1/66).

Fig. 4 Types of study design specified as part of the inclusion criteria of included reviews (total number of reviews = 66) CBA, controlled before-and-after; non-RCT non-randomized controlled trial; RCT, randomized controlled trial; RMS/ITS, repeated measures or interrupted time series



4.2.2 Number of included primary studies

Of the 64 completed reviews which assessed the effectiveness of school-based food and nutrition policies and interventions (i.e. excluding the two included protocols), none were based on less than five primary studies. The majority (n = 43/64 or 67%) included between 10 and 40 primary studies. Very few reviews were based on more than 50 primary studies (n =1 0/64 or 16%). In most cases, not all the included primary studies were conducted exclusively in the relevant setting (i.e. schools) and included a nutrition-related intervention (Table 3). For instance, 24 reviews were based on between 10 and 20 primary studies, but of these just 11 – less than half – were reviews in which all the included primary studies were conducted in a school setting and involved a nutrition intervention. Thus, a significant proportion of the reviews included in this scoping review addressed broader questions, involving other settings and other types of interventions, typically those aimed at addressing physical activity or other behaviours such as alcohol and tobacco consumption.

Table 3. Distribution of the number of primary studies included in the subset of 64 completed reviews

Number of primary studies included	Total number of reviews	Number of reviews in which all primary studies were conducted in the school setting and involved a nutrition intervention
5–10	8	3
10–20	24	11
20–30	8	6
30–40	11	6
40–50	2	2
50–60	3	0
60–70	1	0
70–80	2	0
80–90	1	1
>90	3	1

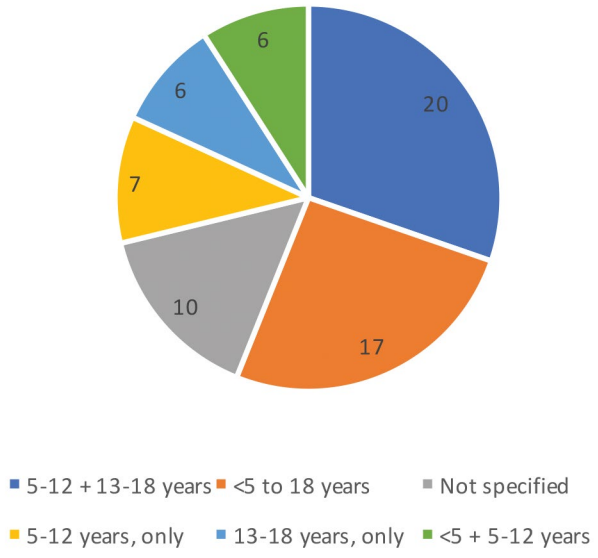
4.2.3 Population and setting

Participant characteristics

Most reviews identified their population of interest as children aged between 5 and 18 years (n = 20/66) or children aged up to 18 years of age, that is, schoolchildren as well as children enrolled in pre-school educational settings such as nurseries (n = 17/66) (Fig. 5). Ten reviews did not specify an age-based criterion; these reviews merely mentioned children of "all age groups", "schoolchildren" or did not mention the age of participants as part of their eligibility criteria.

The majority of the 66 included reviews did not specify any other characteristics beyond the age of participants, save for the four that had ethnicity-based inclusion criteria and nine that stipulated the health status of their would-be eligible participants (Table 4). For those reviews

Fig. 5 Age categories of participants in included reviews (total number of reviews = 66)



that specified ethnicity, two restricted their participants to Latino/Hispanic populations, one to African populations, and one to Chinese participants. Of those that specified the health status of their participants (n = 9/66), most stipulated "healthy populations" (n = 6), while just two restricted their participants to overweight or obese children. One review specified children who were "overweight, obese or of normal weight" as part of its participant inclusion criteria.

Table 4. Ethnicity and health status of participants

Ethnicity	Number of reviews	Health status	Number of reviews
Not specified	62	Not specified	57
Hispanic/Latino	2	"Healthy"/"good health"	6
African	1	Overweight/obese	2
Chinese	1	Normal/overweight/obese	1
Total	**66**		**66**

Number of participants in the included primary studies

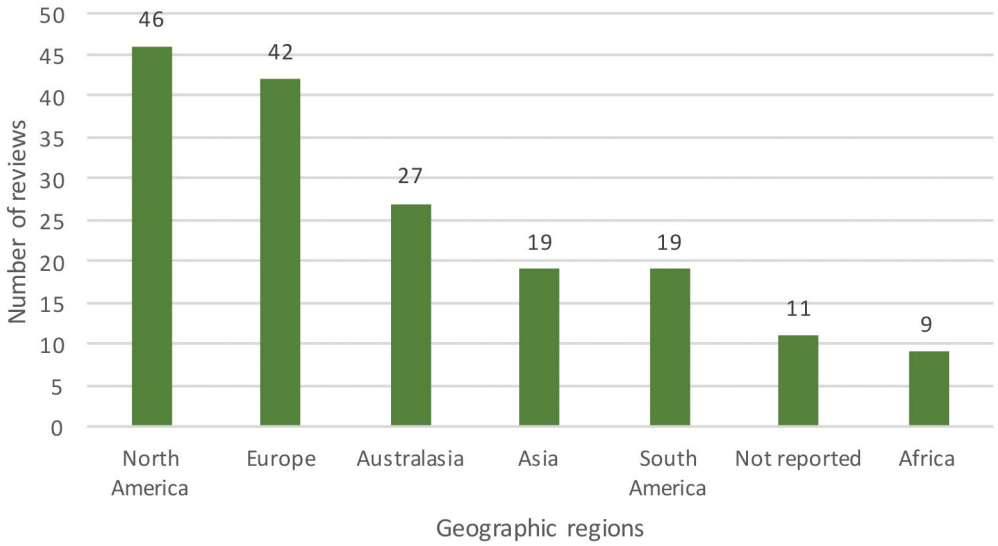
The level of detail in the reporting of the participant numbers in each of the included primary studies varied across the 64 included completed reviews. Some reviews reported numbers of pupils in each included primary study, while others only provided this information for some included primary studies; some studies only reported the numbers of schools involved. Overall, two thirds of the included completed reviews did not clearly report participant numbers (n = 44/64). Based on an analysis of the 20 completed reviews in which this type of information was provided as part of the reporting of the key characteristics of the included primary studies, it is evident that there is a large variation in participant numbers across the primary studies. Nine of these 20 reviews reported an average sample size, which ranged from 2,384 to 152,001 participants. The remaining 11 reviews, which provided more detailed information on participant numbers, were based on primary studies which included as few as 20 to 238 participants at the lower end of the scale, up as many as 416 to 20,166 at the upper end.

Geographical location of the included primary studies

Fig. 6 shows to what extent the major world regions are represented in the 64 completed reviews that were analysed as part of this scoping review. More than two thirds of the completed reviews (n = 46/64) included at least one primary study that was conducted in North America (i.e. in Canada, Mexico or the United States of America), and two thirds (n = 42/64) included at least one primary study from Europe. Of the 42 systematic reviews that included primary studies from European countries, 19 included at least one study from the United Kingdom. Perhaps unsurprisingly, the other world regions were generally less well represented (Fig. 6). Studies conducted in Australia dominated the group of 27 reviews which included one or more primary study(ies) from the Australasian region (n = 20/27); six of these 27 reviews included at least one primary study from New Zealand. It is evident from these breakdowns that the majority of included primary studies are conducted in high-income countries (HICs), suggesting a developed country bias in the evidence base.

Despite clear guidance from PRISMA to the contrary, around one fifth of completed systematic reviews did not clearly identify the countries in which their included primary studies were conducted (n = 11/64), neither in the main publication nor in the supplementary material.

Fig. 6 Representation of major world regions in the completed included reviews (total number of reviews = 64)

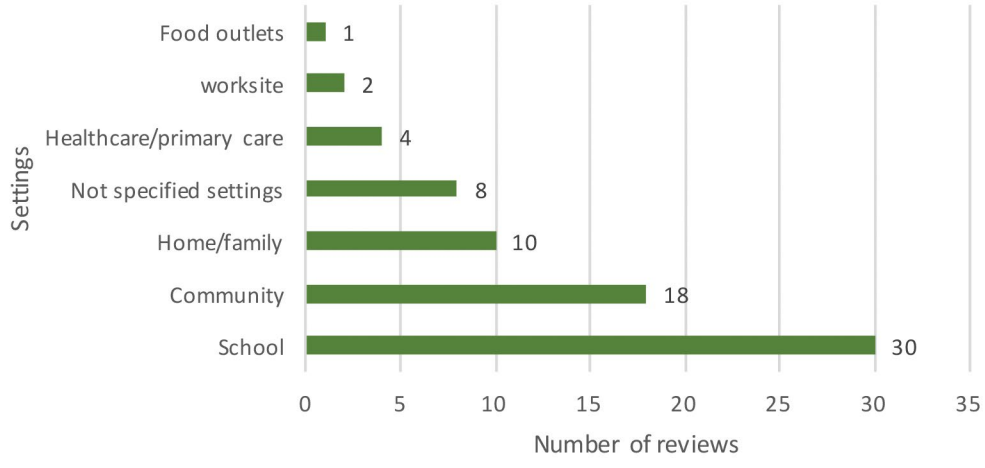


Settings and schooling level

Just over half (n = 36) of the 66 systematic reviews and systematic review protocols which assessed the effectiveness of food and nutrition policies were based exclusively on primary studies in which interventions were delivered in the school setting only. The remaining reviews (n = 30) used broader eligibility criteria which allowed primary studies conducted in multiple settings, i.e. beyond schools, to be included.

In this latter group of 30 reviews, the community setting was the most frequently specified non-school setting (n = 18/30), followed by the home or family (n = 10/30) (Fig. 7). Community settings were typically defined as recreation centres, out-of-school youth groups, as well as church, village and counselling groups. A small number of reviews specified the healthcare or primary care setting (n = 4/30); two mentioned the workplace, and one included food outlets (supermarkets, restaurants, cafes) in their eligibility criteria. Eight reviews did not clearly

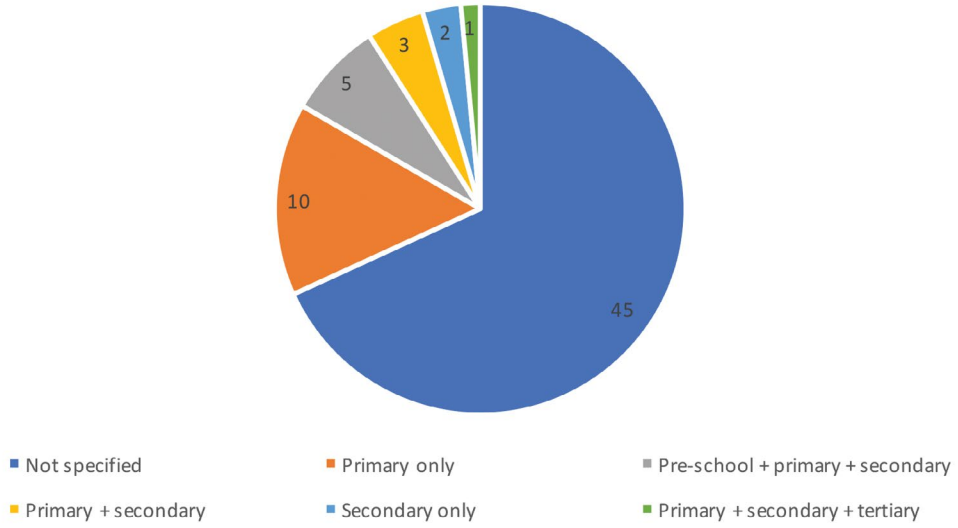
Fig. 7 Types of settings in included reviews which also considered non-school settings, i.e. multiple settings (total number of reviews = 30)



specify which non-school settings would be considered eligible in their Methods section but as these reviews were based on primary studies which also included the school setting, they were considered eligible for inclusion in this scoping review.

At least two thirds of the included reviews did not mention schooling level as part of their eligibility criteria (n = 45/66 or 67%). Of those that did apply such eligibility criteria (n = 20), half specified the primary school setting only (n = 10) and just two reviews focused solely on the impact of food and nutrition polices in secondary schools (see Fig. 8). The remaining eight reviews included both primary and secondary school settings as part of their inclusion criteria; only one review specified the highest level of education (i.e. tertiary).

Fig. 8 Specification of schooling level in included reviews (total number of reviews = 66)



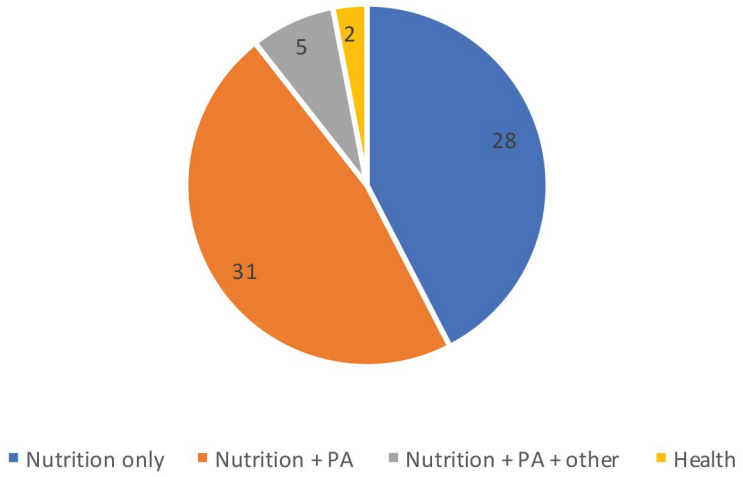
4.2.4 Types of interventions

Just under half (42%) of the 66 included systematic reviews and protocols set out to address the effectiveness of nutrition policies or interventions on obesity-related outcomes in schoolchildren in isolation. The remaining reviews (n = 38/66) aimed to assess the impact of a wider set of policies or interventions, predominantly those which simultaneously address nutrition and physical activity (PA) (n = 31/38) or less commonly, interventions designed to address diet, physical activity and other health-related NCD risk factors such as mental health, tobacco and alcohol consumption (n = 5/38). Two reviews addressed handwashing interventions (Fig. 9).

Of the 66 included reviews, only five specifically assessed policies, that is the term "policy" was mentioned in the review title or its objectives. The other 61 reviews did not necessarily assess policies per se but addressed interventions that could be part of a comprehensive nutrition policy, such as menu labelling in school cafeterias. In the analysis that follows, no distinction has been made between reviews assessing policies (in the strict sense) and those that assess interventions, i.e. the results of the five reviews of policies have been combined with the results of the 61 identified reviews on interventions.

Fig. 10 categorizes all of the 66 included reviews in terms of the four key food and nutrition policy elements they address (see Table 1). Most, 48 out of 66, set out to assess policies

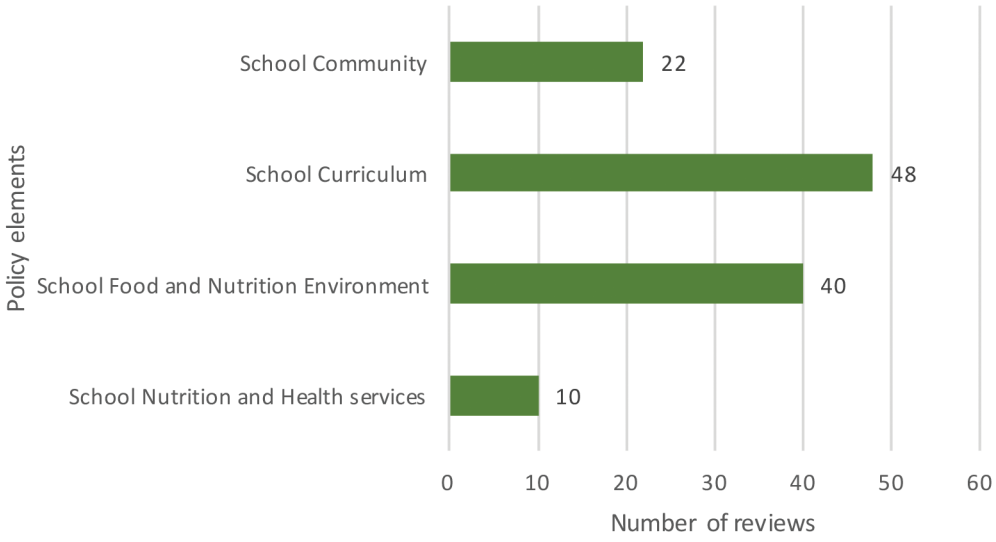
Fig. 9 Types of interventions addressed by included reviews: nutrition-only versus multiple intervention types (total number of reviews = 66)



PA, physical activity

or interventions that addressed the school curriculum (i.e. nutrition education); a similar number (n = 39/66) examined policies or interventions designed to influence the school food and nutrition environment. Roughly a third of the included reviews (n = 22/66) assessed the impact of policies or interventions aimed at the wider school community. All policies or interventions that addressed the school community were part of a broader approach addressing the school curriculum, where parent and community outreach was part of the nutrition education intervention component. Fewer reviews, just 10 out of the total of 66, addressed the fourth policy area, namely school nutrition and health services, of which only two were policy reviews.

Fig. 10 Policy elements addressed in included reviews (total number of reviews = 66)



Reviews either addressed a single or multiple policy elements; the data reflect the total number of reviews addressing a given policy element, either alone or in combination.

Some included reviews focused their attention on a single policy element (data not shown). Of those with a single policy element focus, most chose to assess policies or interventions that addressed the school curriculum, that is, the provision of nutrition education to school children (n = 15). Ten reviews focused exclusively on policies or interventions aimed at modifying the school food and nutrition environment. Nearly a fifth of reviews (n = 13/66) addressed three policy elements (the school community, school curriculum, and the school food and nutrition environment). Reviews that addressed both the school curriculum and the food nutrition environment policy elements were also relatively common (n = 11/66).

Table 5 summarizes the charted information on the types of interventions assessed by the 66 included reviews, categorized according to the key policy element addressed. This tabulation shows that nutrition education interventions were delivered in many different ways. Of the 48 reviews which addressed aspects of the school curriculum, 18 described a range of educational activities aimed at schoolchildren which formed part of the formal school curriculum; a much larger proportion (n = 34/66 or 52%) mentioned nutrition education interventions but without specifying if they were included in the formal school curriculum. A relatively small number of reviews assessed the impact of school garden programmes (n = 7/66). Of the group of reviews which addressed the food and nutrition environment (n = 39/66), around half examined interventions related to the direct provision of food in the school setting (n = 21/40). A similar proportion of reviews were concerned with food procurement policy actions, i.e. changing the quality of the food available in the school setting (n = 19/40). In contrast, other nutrition policy options, including the use of food and nutrient standards and pricing policies, were the subject of only a handful of reviews.

Table 5. Types of interventions assessed in included reviews (total number of reviews = 66)

Policy element	No. of reviews	Examples of interventions
School community	**22**	
Parent education	22	School newsletters, pamphlets and posters aimed at increasing parent knowledge Homework tasks Workshops for parents/parent outreach School Nutrition Policy Initiative[a]
Teacher education	8	Staff/teacher education/training School Nutrition Policy Initiative[a]
Wider community involvement	3	School Nutrition Policy Initiative[a]
School curriculum	**48**	
Nutrition education in the curriculum	18	Educational games and classroom activities introduced as part of the curriculum Health/well-being topics included in the curriculum Nutrition education through videos, computer modules, games or activities School gardening interventions combined with curriculum components Curriculum strategies including health/nutrition classes, body image and healthy eating Fostering linkages between nutrition-related curriculum activities and school catering services

Policy element	No. of reviews	Examples of interventions
Nutrition education unspecified (i.e. nutrition education mentioned but not that it was incorporated into the curriculum)	34	Education component for children involving videos, games, curriculum or activities Provision of nutrition information/education to children (e.g. in the classroom with or without tasks) Theatre with inclusion of technology in education (e.g. SMS messages) Nutrition instruction using hand puppets and focusing on the education of the food pyramid Nutrition classes delivered by experts (in person or web or Internet-based)
School gardens	7	School gardening interventions/programmes Multicomponent interventions which combined gardening with cooking classes and nutrition education integrated within the wider curriculum, and promoted the use of garden produce in school catering and promoted community involvement Wellness projects that included growing gardens
Social marketing	6	Social marketing interventions or approaches used to design and implement interventions
Food and nutrition environment	**39**	
Standards and rules for food and beverages	5	Nutrition standards for competitive foods/beverages and school meals Food-based and nutrient-based standards
Procurement	19	Increased availability of healthier food options in canteens/vending machines (e.g. more nutrient-dense) Reduced availability of unhealthier options (e.g. sugar-sweetened beverages, including fruit juice, energy-dense foods, desserts) in canteens/vending machines Modification/improvement of menus or approved by nutritionists in canteens/ cafeterias Reduced availability of hot food take-ways in/around schools Competitive food sales
Pricing	3	Lower prices for water bottled in canteens and vending machines Pricing strategies for cafeteria sales of fruit and vegetables Free/reduced-price for healthful foods or beverages outside of usual school meals
Direct food provision	21	Food and drink provision in schools outside of usual school meals including clean drinking water (e.g. installing coolers; hand out water bottles) or other canned non-sugar sweetened beverages; distribution of free vegetables; breakfast programme (e.g. distribution of ready to eat cereal); school fruit programme; free school and vegetable distribution; school lunch/breakfast programmes
Not specified	3	"Policies targeting school food services" "Changes to school environment" or "environmental components"
Nutrition & health services	**10**	
Health checks	3	Regular physical examinations Communication about the health status of children
WASH[b]	2	Hand hygiene interventions
Not specified	2	Child nutrition services component "Nutrition and health services"

Policy element	No. of reviews	Examples of interventions
Counselling	2	Provision of one-on-one counselling (mostly by home visits, or telephone counselling) Dietetic consultations
Growth monitoring	1	BMI screening

[a] The School Nutrition Policy Initiative (SNPI) is a multicomponent programme aimed at preventing overweight and obesity among children in aged between 8 and 10 years over a two-year period. Components include training teachers and other staff to integrate interactive nutrition education into regular subjects in the curriculum, ensuring all food sold at school meets healthy food requirements, promoting consumption of healthy snacks, and involvement of families and local community groups in nutrition education activities.

[b] Water sanitation and hygiene.

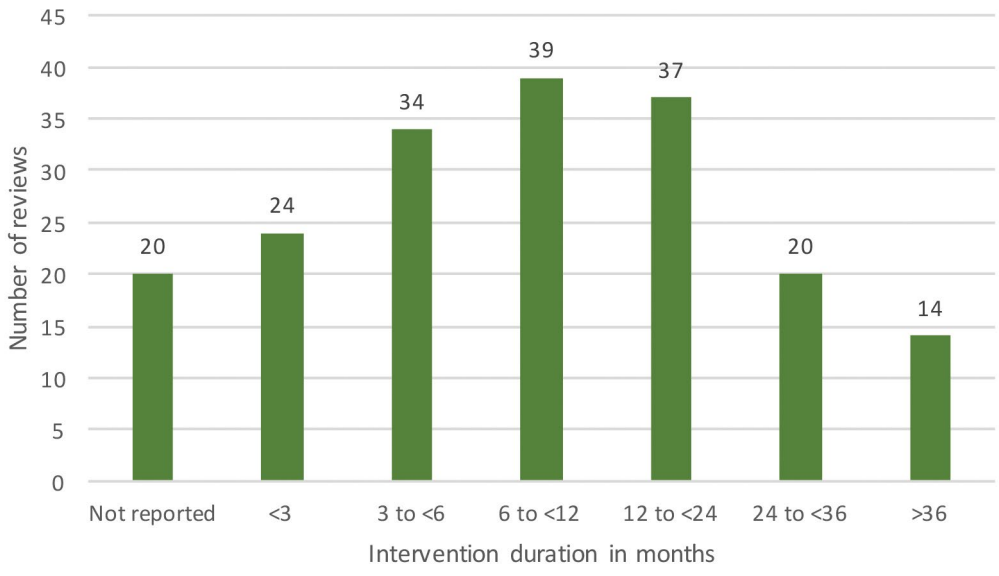
Intervention duration

Twenty, or around one third, of the 64 completed reviews (i.e. not considering the two protocols) included in this scoping review did not report information about the duration of interventions (Fig. 11). Among the remaining 44 reviews which did report this information, there was evidence of a wide range of intervention durations. Twenty-four reviews included at least one primary study in which the duration of the interventions was less than 3 months; at the other end of the scale, 14 reviews included one or more primary studies in which the duration of the interventions examined exceeded 3 years.

Among the 24 systematic reviews that included primary studies involving interventions of less than 3 months duration, the shortest reported duration was 1 week; one review included a primary study which described an intervention with a duration of just 1 hour. Of the subset of 14 reviews which included at least one primary study describing a longer-term intervention (i.e. longer than 3 years), the longest reported intervention duration was 10 years.

A total of three reviews investigated the effectiveness of cooking and other culinary interventions and reported intervention duration in terms of the number of classes attended. One of these reviews included primary studies which assessed the impact of at least two

Fig. 11 Duration of interventions in included reviews (total number of reviews = 64)



cooking classes; the other was based on a set of primary studies that had a median of 10 structured sessions (range: 2–12 sessions); and the third included primary studies in which intervention "length" ranged from 1 to 15 lessons, delivered over a period that ranged from 1 day up to 36 months.

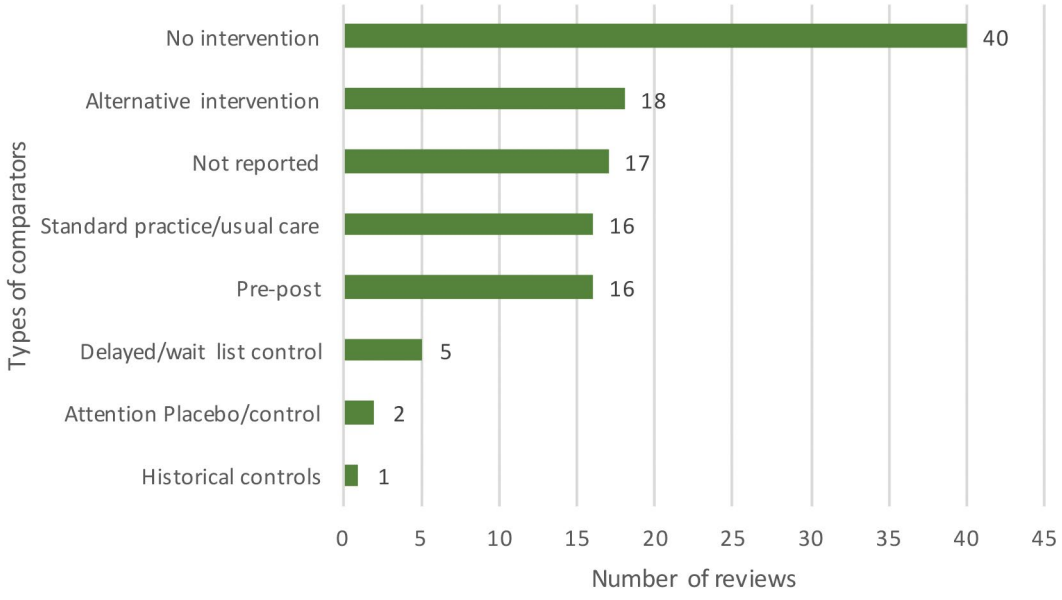
The two included protocols did not specify intervention duration as part of their eligibility criteria.

4.2.5 Comparators

The type of comparator or control group was specified by the majority of reviews, that is to say, 49 (75%) of the 66 included reviews and protocols that assessed the effectiveness of interventions stipulated the nature of the comparator as part of their eligibility criteria. The remaining 17 reviews (25%) did not specify clear eligibility criteria for comparator groups in their Methods section; in this subset of reviews, comparator groups were either not mentioned at all, or the specification of criteria was limited to "had to have a control group" but without additional information describing which type(s) of control group was deemed acceptable (Fig. 12). Those reviews which were restricted to certain study designs (e.g. only considered RCTs or non-RCTs/quasi-experimental designs) were more likely to also specify comparator group eligibility criteria.

Among the 49 reviews that clearly specified eligible comparator groups, many listed more than one type of control. By far the most common type of control specified was "no intervention", which was cited by 40 reviews. Other types of controls that were specified by included reviews were "alternative interventions" (n = 18), "standard practice" (n = 16) and "same group pre-and-post intervention comparisons" (n = 16). Five reviews specified "delayed" or "wait list" controls, two "attention controls" or placebo, and one review included historical controls as part of its list of acceptable comparator groups (Fig. 12).

Fig. 12 Types of comparisons in included reviews (total number of reviews = 66)



4.2.6 Outcomes

All but one of the 66 included reviews and protocols assessing effectiveness clearly identified the outcomes of interest as part of their eligibility criteria. For the purposes of this scoping review, specified outcomes have been divided into five broad categories: anthropometric measures (e.g. body mass index or BMI), diet-related outcomes (e.g. fruit and vegetable intake), biochemical measures (e.g. blood lipids), clinical outcomes (e.g. diabetes) and "other" outcomes (e.g. physical activity). Anthropometric measures were a specified outcome in a large proportion of reviews (n = 46/66), as were the diet-related outcomes (n = 39/66). Clinical outcomes were investigated by nearly a third of all reviews (n = 19/66), but very few reviews reported on the effectiveness of food and nutrition interventions on biochemical outcomes (n = 4/66) (see Fig. 13).

Fig.13 Types of outcomes reported in included reviews (total number of reviews = 66)

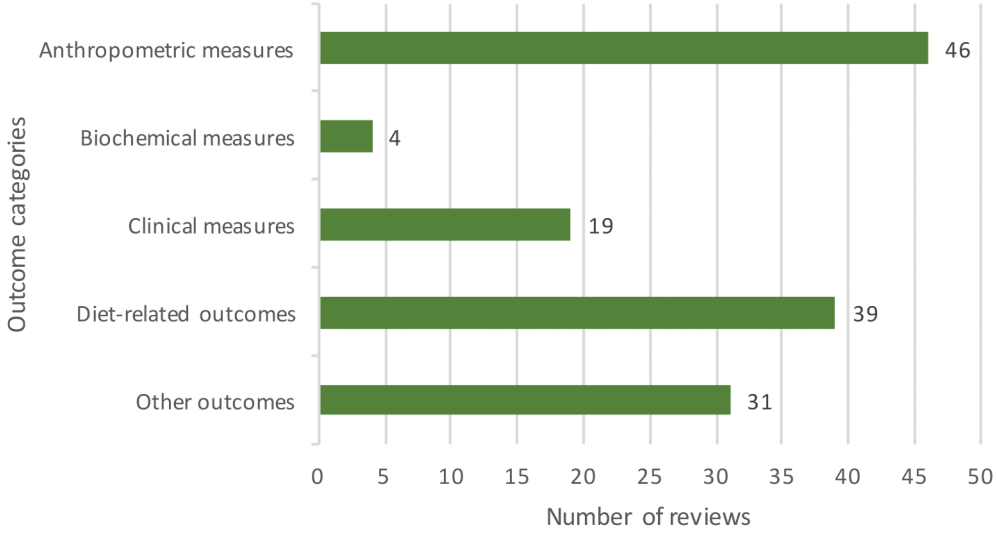


Table 6 provides further details and examples of the types of outcomes investigated by the included reviews. Among the 47 reviews which set out to assess the impact of interventions on anthropometric measures, 31 included BMI as an outcome of interest, and 21 included measures of overweight or obesity (e.g. prevalence of overweight and/or obesity in the target population). BMI was included as the primary outcome of interest in 24 of these 47 reviews.

Among the reviews which investigated diet-related outcomes (n = 40/66) around half listed diet-related knowledge, practices, attitudes and behaviour among their outcomes of interest (n = 18/40) while nearly three quarters focused on various dietary intake measures (n = 29/40). Within this latter category, fruit and vegetable intake and consumption of sugar-sweetened beverages (SSBs) ranked among the most commonly studied diet-related outcomes, specified by 11 and 8 reviews, respectively. Levels of physical activity was a frequently-mentioned outcome of interest among the group of reviews reporting on "other outcomes", investigated in 16 reviews in total. Adverse or unintentioned outcomes such as stigmatization was a stated outcome of interest in seven reviews, and acceptability of interventions was explored in five reviews.

Of the wide range of clinical outcomes mentioned, mental health was listed as an outcome of interest by seven reviews; six reviews specified health risk factor prevention (three

mentioned blood pressure) and two purported to be interested in oral health outcomes (Table 6). Impacts on biochemical outcomes were evaluated in only four reviews, where the focus of interest was on blood lipids (n = 4/4); only one systematic review specified blood glucose levels as a possible outcome of interest.

Table 6. Summary of outcomes reported in included reviews (total number of reviews = 66)

Outcomes	No. of reviews	Examples (where applicable)
Anthropometric measures	**46**	
Body mass index (BMI)	31	BMI, BMI z-score, BMI percentiles
Overweight/obesity	21	Prevalence of overweight, obesity, overweight/obesity combined
Waist circumference	12	
Weight	8	
Skin-fold thickness	6	
Malnutrition	1	Prevalence of wasting, stunting
Percent body fat	1	
Biochemical measures	**4**	
Blood lipids	4	Total cholesterol, low density lipoprotein-cholesterol, high density lipoprotein-cholesterol and/or triglycerides
Blood glucose	1	
Clinical outcomes	**19**	
Mental and emotional health	7	Prevalence of anxiety, depression, suicide or self-harm, body image disorders, low self-esteem Other psychosocial variables
Morbidity	9	Physical health measures and outcomes (e.g. type II diabetes) Health status measures (morbidity, premature mortality, mortality, hospital admissions) Standardized measures of physical health Cardiovascular disease risk factors and health risk factors
Blood pressure	3	
Infectious diseases	3	Incidence of diarrhoea, gastrointestinal infections Incidence of respiratory illnesses Hand cleanliness (e.g. number of microorganisms on the hands)
Quality of life	2	Health-related quality of life Quality of life indicators
Oral health	2	Prevalence of dental caries
Developmental	2	Child growth and development measures Cognitive function
Iron-deficiency anaemia	1	

Outcomes	No. of reviews	Examples (where applicable)
Diet-related outcomes	**39**	
Knowledge, attitudes and behaviours	18	Dietary/food consumption behaviours or change Nutritional knowledge Fruit, vegetable and sugar preferences or attitudes Changes in attitude towards healthy eating Awareness of nutrition information on menus and menu boards Self-reported use of labels when purchasing food Menu-labelling format preferences Cooking and food-related knowledge Food literacy
Dietary intake	29	Nutrient intakes (e.g. fat intake) Caloric/energy intake Change in serving portions Reduced sugar consumption or preference Dietary change/changes in food consumption (e.g. intakes of fruit & vegetables, consumption of sugar-sweetened beverages)
Food purchasing	3	Purchasing and consumption patterns Sales data
Meal nutrient content	2	In-school meal nutrient content Mean calories selected per participant Total fat content of food
Food environment	2	Food and vegetable supply Change in food environment (e.g fruit and vegetable disappearance/food transition) Environmental measures such as food availability
Other outcomes	**31**	
Physical activity	16	Physical activity and sedentary behaviours Screen time
Adverse outcomes	7	Adverse/unintended events Stigmatization, dependency Decreased total family expenditure on food
Intervention acceptability	5	Attitudes or level of public approval Themes, concepts and metaphors relating to the experience and meaning of school gardens Target group perceptions and views of the intervention Attitudes and perceptions of food literacy programmes aimed at students and teachers
Educational	4	School absenteeism Educational attainment and employment Future success
Substance use	2	Alcohol misuse Tobacco use Substance use
Economic	2	Measures of financial and economic viability Socioeconomic effects

4.2.7 Conflict of interests and funding

Of the 66 included reviews and protocols which examined the effectiveness of school-based nutrition policies and interventions, 55 (83%) provided a conflict of interest (COI) statement. In the majority of cases where COI information was reported (in 48 reviews), authors stated that they had no conflicts of interest to disclose; in only seven of 55 reviews did authors declare any conflicts of interest. In this latter group, the authors of three reviews reported receiving funding or payments from, or belonging to advisory boards of, commercial organizations such as Unilever UK, companies making consumer products, drug companies producing slimming products, Nestle, Danone and Sugar Nutrition UK. In the remaining four cases where COIs were declared, the authors reported affiliations to academic or government institutions.

A similarly high proportion of reviews provided information relating to funding sources; authors of 51 reviews (77%) detailed the source of the funding for their work. In the majority of cases where authors listed their funding sources, funding was received from a governmental, nongovernmental or institutional source (n = 41/51).

4.2.8 Gaps in the evidence base

Most of the completed intervention reviews included in this scoping review commented on gaps in the primary research base and made recommendations for the direction of future research studies. These identified gaps are presented in Table 7, according to the items included in the EPICOT framework.

The need for more well designed and well implemented RCTs, with long-term follow-up periods which also assessed the cost-effectiveness and sustainability of school-based food and nutrition interventions, was highlighted by many included reviews. Calls for studies which extended their outcomes of interest beyond the physical outcomes to include cognitive outcomes, academic outcomes and environmental determinants were also made by a significant proportion of the reviews. Many of the included systematic reviews commented on the paucity of theoretical modelling in primary research studies and identified this shortcoming as an impediment to the development and implementation of effective school-based nutritional interventions.

Table 7. Description of gaps reported in included reviews according to the EPICOT framework (total number of reviews = 66)

EPICOT items	Description of gaps reported in reviews
Evidence	There is a paucity of high-quality evidence on the effectiveness of school-based nutritional interventions and policies
Population	Need for research in lower-income countries, beyond North America and Europe
Intervention	Need for inclusion of theoretical models to support implementation of interventions
Comparison	Need to include comparisons between interventions with and without parental participation as well as across socio-economic divides
Outcomes	Need to extend outcomes of interest beyond physical outcomes to include cognitive outcomes, academic outcomes and environmental determinants as well as the cost-effectiveness and sustainability of interventions
Timestamp	Longer-term follow-up studies are needed

4.2.9 Implementation reviews

Three of the 69 included reviews did not address the question of the effectiveness of school food and nutrition policies or interventions but instead focused on the strategies for implementing such policies and interventions *(85–87)*. The stated aim of one of these three implementation reviews was to "identify current methods used to operationalise, measure and report measures of fidelity" of school-based obesity prevention programmes. Another sought to "examine the effectiveness of strategies aiming to improve the implementation of school-based policies, programmes or practices to address child diet, physical activity, obesity, tobacco or alcohol use". The objective of the third review in this category was to assess the engagement of children and youth in interventions that address lifestyle-related childhood obesity that have been designed through child or youth efforts and involvement.

All three implementation reviews specified a relatively wide age range for their target population, that is, children and adolescents from the age of 4 or 5 years up to 18 years or until "college-age". All reviews considered the implementation of policies and interventions within the school setting. Primary outcomes ranged from an assessment of the fidelity of the interventions, policy and intervention uptake, as well as changes in weight, dietary behaviours and physical activity. Changes in health behaviours and attitudes were assessed in one review, as a secondary outcome. The duration of the interventions described in the primary studies covered by these three reviews ranged from 5 weeks up to 4 years.

One set of authors declared that they had no conflicts of interest, while the authors of other two implementation reviews made no mention of COIs. Two of these reviews were funded by governmental institutions and one did not report their funding source.

5. Discussion

This scoping review identified a total of 69 systematic reviews and protocols on the topic of school-based food and nutrition policies and interventions. The volume of identified evidence suggests that there exists a solid base of primary studies that have been conducted in the school setting, involving the population that is the target of WHO's planned guidelines on school food and nutrition policies, namely schoolchildren.

Few systematic reviews could be described as addressing food and nutrition policies specifically – that is to say, the word "policy" was not mentioned in either the title or the stated objectives. However, many identified reviews that examined school-based food and nutrition interventions or programmes included primary studies which assessed policies. On this basis, when formulating the criteria for future systematic reviews on the theme of food and nutrition policies aimed at children, it does not seem advisable to employ strict search criteria based on the term "policies", as the likelihood of retrieving studies based on a such a narrow definition may be low. Use of a broader definition, as was the strategy adopted in this scoping review (see Methods), will likely lead to the identification of a much greater pool of relevant studies and so generate a robust body of evidence regarding the range of interventions that could form part of a comprehensive school food and nutrition policy. Further support for adopting a wider search strategy (i.e. not limited to "policies"), comes from the recently published overview of the Nutrition-friendly School Initiative (NFSI), which returned only one systematic review that met essential criterion 1.1 ("having a written policy addressing the five components" *(88)*.

Interventions addressing the school food and nutrition environment fall into several categories, which for the most part have been covered by the existing body of work identified by this scoping review. While it might seem desirable to conduct separate systematic reviews to assess each category or type of intervention, this scoping review has found that many primary studies address multicomponent interventions. For example, interventions related to the school community almost invariably went hand in hand with those that addressed the school curriculum. In other words, no intervention or policy which was directed at parents, teachers or the wider school community was implemented without also involving educating schoolchildren about healthy eating and/or other behaviours. Therefore, any future systematic review, and indeed policy initiative, should address these components together and consider parents as well as the wider school community as part of the population of interest, in addition to the children themselves. Likewise, it would be prudent to assess the role and impact of the introduction of nutrient- or food-based standards in the school setting alongside procurement policies, as the latter are often underpinned by the former.

This scoping review exercise also revealed that many programmes and interventions are aimed at preventing unhealthy lifestyles and habits that lead to overweight and obesity, and as such also include interventions which address physical activity. This should be taken into consideration when defining the eligibility criteria for both the "intervention" and "outcome" elements of future systematic reviews; these criteria will need to reflect the high likelihood that many programmes and interventions address physical activity as well as nutrition.

In terms of gaps in the evidence base, this scoping review found relatively few reviews of policies or interventions that addressed school nutrition and health services, such as nutrient supplementation, growth monitoring or deworming. However, this may be a consequence not so much of a paucity of primary research in this area (studies and reviews have addressed these topics) but rather more of the fact that nutrient supplementation, growth monitoring and other health services tend not to be studied in the school context but in broader contexts and settings, such as primary care and community outreach clinics. We found just two policy reviews which addressed the health services element (out of a total of five (20–24), but neither of these reviews included primary studies which assessed the impact of food and nutrition policies per se, but rather assessed the health interventions on their own and not as part of an overall policy. It has been noted elsewhere *(8)*, that in some countries, notably those in Europe, existing school food and nutrition policies recommend the inclusion of health services as part of the school environment; typically such services provide growth and developmental monitoring, followed by referral when necessary.

The scoping review identified a number of other areas of potential interest, at least from the perspective of the planned WHO guidelines, that are currently underserved by the existing evidence base. For instance, this scoping review did not identify any reviews that assessed the effectiveness of policies to restrict the marketing and availability of unhealthy foods in or around schools. It was also noticeable that the evidence base assessed in this scoping review is dominated by questions related to obesity and overweight; there were no reviews that assessed undernutrition outcomes such as underweight, stunting or wasting. This is perhaps a reflection of the fact that most studies were conducted in high-income countries, particularly in North America, Europe and Australia, where this is the most pressing problem to address.

6. Strengths and limitations

Although this scoping review was conducted according to the PRISMA-ScR guidelines, a few minor modifications to the recommended process were necessary, some of which may have introduced bias. For instance, for pragmatic reasons and time constraints, it was not possible to carry out independent and duplicate first and second stage screening, or data abstraction. It was also necessary to limit the database searches to systematic reviews published in the last eight years (2012–2019). However, a number of measures were taken in order to minimize bias. Firstly, a random sample of the records excluded at the title-and-abstract and full-text screening stages were checked in an attempt to reduce the risk of missing relevant reviews. Secondly, a list of all the studies that were excluded at the full-text screening stage is attached to this report as Annex 3, for scrutiny by the reader. Finally, some of the data extraction was cross-checked during the data analysis stage in order to ensure accurate representation of the key characteristics of the included reviews.

The eligibility criteria included a strict definition of a systematic review, requiring evidence of searching across more than one database and appraisal of the quality included primary studies (i.e. risk of bias assessment). The application of these criteria may have increased the likelihood that higher quality systematic reviews were included. Included reviews were not subjected to a quality assessment, a step that is generally considered essential to ensure the credibility of the findings of any systematic review. Nor was an assessment of whether the included reviews assessed the level of confidence in the review findings (for example by using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach or another tool). However, given that the primary aim of this scoping review was to determine the scope of future review questions – not to inform decisions about effectiveness of policies and programmes – this omission is less of a concern. The English language restriction is likely to be another limitation of the present scoping review.

The relative paucity of systematic reviews on the topic of nutrition-related health services, including reviews on deworming or nutrient supplementation was not anticipated. As previously stated, this may be due to these types of reviews often pertaining to settings beyond the school, and thus were either not identified through the search or were excluded on the grounds of being conducted in the "wrong setting". This suggests a gap in the evidence base, at least in terms of assessing the effectiveness of these interventions in the school setting in the context of a broad school food and nutrition policy, and a need for this topic to be considered during the guideline panel scoping process.

7. Conclusions

This scoping review has identified and mapped the available evidence from published and planned systematic reviews on the effects of school food and nutrition policies on important health and educational outcomes in school-aged children. It has also identified key gaps in the existing evidence base as it relates to effectiveness and implementation of school-based food and nutrition policies.

The present review was commissioned and conducted in order to support the development of WHO guidelines on school food and nutrition policies. A set of potential policy elements and associated interventions was identified a priori (Table 1), and the existing evidence base mapped against this framework. This process has facilitated the identification of the evidence needed to shape and inform the planned WHO guidelines – in terms of understanding what policy elements and interventions are important and should be addressed by the guidelines, which research questions have already been answered in the literature and where there are still gaps. In particular, the scoping review has helped to identify gaps in the evidence base pertaining to those interventions that will form part of the policy framework but for which no systematic reviews appear to have been conducted.

Based on the findings of the scoping review a set of potential systematic review questions were proposed, which were structured in accordance with the PICO format (Table 8). These questions have since been discussed and refined by the WHO Nutrition Guidance Expert Advisory Group (NUGAG) Subgroup on Policy Actions, and a new systematic review has been commissioned to underpin the guideline's recommendations on school food and nutrition policies.

Table 8. Proposed research questions for future systematic reviews

	Research question
PICO 1	What are the effects of school nutrition education interventions or policies, including or excluding involvement of parents and teachers compared with no intervention or an alternative intervention for schoolchildren (aged 5–18 years)?
PICO 2	What are the effects of Nutrition standards or procurement policies that determine the quality of food available in schools compared to no intervention or an alternative intervention for school children (aged 5–18 years)?
PICO 3	What are the effects of interventions or policies to restrict marketing of unhealthy foods and non-alcoholic beverages (FNABS) in and around schools compared to no intervention or an alternative intervention for school children (aged 5 – 18 years)?
PICO 4	What are the effects of pricing policies or interventions in the school setting to promote healthier alternatives compared to no intervention or an alternative intervention for school children (aged 5–18 years)?
PICO 5	What are the effects of direct food provision in schools (e.g. meal programmes; vegetable and fruit distribution) compared to no intervention or an alternative intervention for school children (aged 5–18 years)?
PICO 6	What are the effects of school nutrition and health services interventions or policies compared to no intervention or an alternative intervention for school children (aged 5–18 years)?
PICO 7	What are the effects of multifaceted school-based food and nutrition interventions or policies that address two or more policy elements compared to no intervention or an alternative intervention for school children (aged 5–18 years)?

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Annexes

Annex 1. Search strategies

Database	Cochrane Library (2012–2019)	
Date	16 September 2019	
ID	**Search**	**Hits**
#1	[mh schools] OR school:ti,ab,kw or [mh child] or child:ti,ab,kw or schoolchild*:ti,ab,kw or "school-based":ti,ab,kw or [mh adolescent] or adolescen*:ti,ab,kw (Word variations have been searched)	228 303
#2	[mh "diet, food and nutrition"] or nutrition or [mh diet] or diet:ti,ab,kw or dietary:ti,ab,kw or "energy intake":ti,ab,kw or [mh food] or food:ti,ab,kw or fruit:ti,ab,kw or vegetable:ti,ab,kw or [mh beverages] or beverage:ti,ab,kw or "drinking water":ti,ab,kw or micronutrient*:ti,ab,kw (Word variations have been searched)	139 692
#3	[mh "health education"] or [mh "school health services"] or "school health":ti,ab,kw or [mh "health promotion"] or (health next promotion*):ti,ab,kw (Word variations have been searched)	22 317
#4	[mh hygiene] or hygiene:ti,ab,kw or handwash*:ti,ab,kw or (hand near/3 (wash* or clean* or disinfect* or sterility)):ti,ab,kw (Word variations have been searched)	8568
#5	[mh "water supply"] or "water supply":ti,ab,kw or (water near/3 (filt* or purif* or treat* or consum* or drink* or decontaminat* or disinfect* or improv* or clean* or quality)):ti,ab,kw (Word variations have been searched)	3501
#6	[mh sanitation] or sanit*:ti,ab,kw or toilet:ti,ab,kw or lantrine:ti,ab,kw or "septic tank":ti,ab,kw or urinal:ti,ab,kw or privy:ti,ab,kw or lavator*:ti,ab,kw or "water closet":ti,ab,kw or ablution:ti,ab,kw (Word variations have been searched)	41 715
#7	policy:ti,ab,kw or guideline:ti,ab,kw or standard:ti,ab,kw or educat*:ti,ab,kw or program:ti,ab,kw or programme:ti,ab,kw or regulation:ti,ab,kw or intervention:ti,ab,kw or teach:ti,ab,kw or teaching:ti,ab,kw (Word variations have been searched)	568 988
#8	[mh "nutrition policy"]	386
#9	#2 OR #3 OR #4 OR #5 OR #6	191 911
#10	#7 OR #8	569 014
#11	#1 AND #9 AND #10 with Cochrane Library publication date Between Jan 2012 and Sep 2019, in Cochrane Reviews	**496**

Abbreviations: mh = indexing term; ti = title field; ab = abstract field; kw = keyword field

Database	PubMed (2012–2019)	
Date	16 September 2019	
ID	**Search**	**Hits**
#1	(Schools[mh] OR school[tiab] OR schools[tiab] OR child[mh] OR child[tiab] OR children[tiab] OR schoolchild*[tiab] OR school-based[tiab] OR adolescent[mh] OR adolescen*[tiab])	3 433 822
#2	(diet,food and nutrition[mh] OR nutrition*[tiab] OR diet[mh] OR diet[tiab] OR diets[tiab] OR dietary[tiab] OR energy intake[tiab] OR food[mh] OR food[tiab] OR foods[tiab] OR fruit[tiab] OR fruits[tiab] OR vegetable*[tiab] OR beverages[mh] OR beverage[tiab] OR beverages[tiab] OR drinking water[tiab] OR micronutrient*[tiab])	1 515 274
#3	(health education[mh] OR school health services[mh] OR school health[tiab] OR health promotion[mh] OR health promotion*[tiab])	267 669
#4	(hygiene[mh] OR hygiene[tiab] OR handwash*[tiab] OR hand wash*[tiab] OR hand clean*[tiab] OR hand disinfect*[tiab] OR hand sterility[tiab])	83 858
#5	(water supply[mh] OR water supply[tiab] OR water filt*[tiab] OR water purif*[tiab] OR water treat*[tiab] OR water consum*[tiab] OR water drink*[tiab] OR water decontaminat*[tiab] OR water disinfect*[tiab] OR water improv*[tiab] OR water clean*[tiab] OR water quality[tiab])	67 598
#6	(sanitation[mh] OR sanitat*[tiab] OR toilet[tiab] OR toilets[tiab] OR latrine*[tiab] OR septic tank*[tiab] OR urinal*[tiab] OR privy[tiab] OR lavator*[tiab] OR water closet*[tiab] OR ablution*[tiab])	111 788
#7	(#2 OR #3 OR #4 OR #5 OR #6)	1 940 602
#8	(policy[tiab] OR policies[tiab] OR guideline[tiab] OR guidelines[tiab] OR standard[tiab] OR standards[tiab] OR educat*[tiab] OR program[tiab] OR programs[tiab] OR programme[tiab] OR programmes[tiab] OR regulation*[tiab] OR intervention*[tiab] OR teach [tiab] OR teaching[tiab])	3 957 683
#9	(nutrition policy [mh])	10216
#10	(#8 OR #9)	3 962 365
#11	(#1 AND #7 AND #10)	122 794
#12	(Systematic review[pt] OR review[ti] OR meta-analysis[pt] OR meta-analys*[ti])	542 894
#13	((#11 AND #12) NOT (animals[mh] NOT humans[mh]))) AND ("2012/01/01"[Date - Publication] : "2019"[Date - Publication])	**2947**

Abbreviations: mh = indexing term; tiab = title or abstract field; pt = publication type

Database	Epistemonikos (2012–2019)
Date	16 September 2019

ID	Search	Hits
#1	(advanced_title_en:(school* OR "school-based" OR child* OR adolescen*) OR advanced_abstract_en:(school* OR "school-based" OR child* OR adolescen*))	---
#2	(advanced_title_en:(nutrition* OR diet* OR "energy intake" OR food* OR fruit* OR vegetable* OR beverage* OR "drinking water" OR micronutrient*) OR advanced_abstract_en:(nutrition* OR diet* OR "energy intake" OR food* OR fruit* OR vegetable* OR beverage* OR "drinking water" OR micronutrient*)) (advanced_title_en:(policy OR policies OR guideline OR guidelines OR standard OR standards OR educat* OR program OR programs OR programme OR programmes OR regulation* OR intervention* OR teach OR teaching) OR advanced_abstract_en:(policy OR policies OR guideline OR guidelines OR standard OR standards OR educat* OR program OR programs OR programme OR programmes OR regulation* OR intervention* OR teach OR teaching))	---
#3	[Filters: protocol=no, classification=systematic-review, cochrane=missing, min_year=2012, max_year=2019]	---
#4	#1 AND #2 AND #3	**1431**

Abbreviations: en = English language; min = minimum; max = maximum

Database	Epistemonikos (2012–2019)
Date	17 September 2019

ID	Search	Hits
#1	(advanced_title_en:(school* OR "school-based" OR child* OR adolescen*) OR advanced_abstract_en:(school* OR "school-based" OR child* OR adolescen*))	---
#2	(advanced_title_en:(hygiene OR "hand washing" OR handwashing OR (hand AND (clean* OR disinfect*)) OR (water AND (filt* OR purif* OR treat* OR consum* OR improv* OR clean*)) OR "water quality" OR sanitation OR toilet* OR latrine* OR "septic tank" OR "septic tanks" OR urinal* OR privy OR lavator* OR "water closet" OR "water closets" OR ablution) OR advanced_abstract_en:(hygiene OR "hand washing" OR handwashing OR (hand AND (clean* OR disinfect*)) OR (water AND (filt* OR purif* OR treat* OR consum* OR improv* OR clean*)) OR "water quality" OR sanitation OR toilet* OR latrine* OR "septic tank" OR "septic tanks" OR urinal* OR privy OR lavator* OR "water closet" OR "water closets" OR ablution))	---
#3	(advanced_title_en:(policy OR policies OR guideline OR guidelines OR standard OR standards OR educat* OR program OR programs OR programme OR programmes OR regulation* OR intervention* OR teach OR teaching) OR advanced_abstract_en:(policy OR policies OR guideline OR guidelines OR standard OR standards OR educat* OR program OR programs OR programme OR programmes OR regulation* OR intervention* OR teach OR teaching))	---
#4	[Filters: protocol=no, classification=systematic-review, cochrane=missing, min_year=2012, max_year=2019]	---
#5	#1 AND #2 AND #3 AND #4	**226**

Abbreviations: en = English language; min = minimum; max = maximum

Annex 2. Characteristics of included studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
POLICIES							
Bramante 2019 *(20)*	Systematic review of natural experiments for childhood obesity prevention and control	To evaluate the effectiveness of population-level policies and programmes from natural experiments for childhood obesity prevention	Children and adolescents aged 10–18 years old	School and/or community-based programmes or policies aimed at combatting paediatric obesity	Control group without intervention	Primary: BMI measures (change in BMI; BMI z-score; BMI percentile; BMI classification according to age) Secondary: Physical activity; dietary behaviours (fruit and vegetable intake; intake of sugar-sweetened beverages)	Natural experiments with a comparison group
Mansfield 2017 *(21)*	Effect of school wellness policies and the Healthy, Hunger-Free Kids Act on food-consumption behaviors of students, 2006–2016: a systematic review	To assess whether policy changes impacted food-consumption behaviours of students during periods when (1) school wellness policies were implemented (2006–2007); (2) the Healthy, Hunger-Free Kids Act was passed (2010–2012); and (3) the Healthy, Hunger-Free Kids Act was implemented (2012–present)	Children and adolescents aged 5–18 years	National School Lunch Programme	Control group without intervention	Primary: Food-consumption behaviours Secondary: Not specified	RCTs; cohort studies; cross-sectional studies; case–control studies; pre- and post-intervention studies; other quasi-experimental studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
POLICIES							
Micha 2018 *(22)*	Effectiveness of school food environment policies on children's dietary behaviors: A systematic review and meta-analysis	To systematically review and quantify the impact of school food environment policies on dietary habits, adiposity and metabolic risk in children	Healthy children and adolescents aged 2–18 years	School food environment policies promoting healthful food and beverages	Control group without intervention	Primary: Change in habitual consumption of the targeted food, beverage or nutrient, evaluated by reported intakes or objective sales/purchases data as a proxy for consumption Secondary: In-school meal nutrient content; nutrient intake; total caloric intake; adiposity; prevalence of overweight, obesity and overweight/ obesity combined; metabolic measures (e.g. blood lipids, blood glucose, blood pressure)	RCTs; quasi-experimental interventional studies
Singh 2017 *(23)*	Impact of school policies on non-communicable disease risk factors – a systematic review	To identify, collate, and synthesize evidence on the effectiveness of school policies on reduction of NCD risk factors	Children and adolescents aged 6–18 years	School policies that modify the four identified risk factors (unhealthy diet, physical inactivity, alcohol and tobacco use)	Control group without intervention	Primary: BMI; waist circumference; overweight; obesity; physical activity; tobacco use; alcohol use; other relevant outcomes Secondary: Knowledge and attitudes	RCT; controlled before- and-after studies; quasi-experimental interventional studies; interrupted time series studies; cohort studies; cross-sectional studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Williams 2013 *(24)*	Systematic review and meta-analysis of the association between childhood overweight and obesity and primary school diet and physical activity policies	To evaluate the effects of policies related to diet and physical activity in schools, either alone, or as part of an intervention programme on the weight status of children aged 4 to 11 years	Children aged 4–11 years	National, regional and school specific policies related to diet or physical activity during primary education	Control group without intervention	Primary: BMI; BMI z-score or standard deviation score; percentage of body fat; waist circumference; waist-to-hip ratio; waist-to-height ratio; skin pinch/skin fold thickness Secondary: Not specified	RCTs; controlled before-and-after studies; interrupted time series studies; cohort studies; cross- sectional studies
INTERVENTIONS							
Aceves-Martins 2016 *(25)*	Effectiveness of social marketing strategies to reduce youth obesity in European school-based interventions: a systematic review and meta-analysis	To assess the effectiveness of European school-based interventions to prevent obesity relative to the inclusion of social marketing benchmark criteria domains in the intervention	Children and adolescents aged 5–17 years old in European countries	School-based dietary or physical activity interventions that used social marketing benchmark approaches	Control group with intervention not including social marketing benchmark criterion	Primary: Dietary behaviour; physical activity; BMI; prevalence of over- weight and obesity Secondary: Not specified	RCTs; non-RCTs
Adom 2017 *(26)*	Protocol for systematic review of school-based interventions to prevent and control obesity in African learners	To conduct a systematic review of the published literature to identify and characterize school-based interventions that focused on promoting healthy eating and physical activity among learners aged 6–15 years in Africa to prevent childhood obesity, as well as to identify factors that lead to successful	Children and young adolescents aged 6–15 years in African countries	Dietary/nutrition and physical activity interventions implemented in school setting but with community- and family-based components	Control group without intervention	Primary: Nutrition and physical activity knowledge, attitudes and self-efficacy; BMI; physical activity; fruit and vegetable intake; sugar-sweetened beverage consumption Secondary: Not specified	Any controlled study design of at least 12 weeks duration with or without randomization, including pre-experimental, quasi-experimental, experimental pre-and post-test, and cohort study designs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
		interventions or potential barriers to success of these programmes within the African context, as reported in studies published between January 2000 and June 2016					
Al-Khudiary 2017 *(27)*	Diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years (Review)	To assess the effects of diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years	Overweight or obese adolescents aged 12–17 years	Behaviour-changing interventions aimed at treating overweight or obesity that include any form of dietary, physical activity or behavioural therapy, or any combination of these, delivered in school, community or healthcare settings	No treatment/ wait list control; usual care; alternative concomitant therapy	Primary: BMI; body weight; adverse events Secondary: Health-related quality of life; self-esteem; all-cause mortality; morbidity; anthropometric measures other than BMI; behavioural change; participants views of the intervention; socioeconomic effects; parenting skill and relationships	RCTs
Andrade 2018 *(28)*	Systematic review: frameworks used in school-based interventions, the impact on Hispanic children's obesity-related outcomes	To examine the frameworks used within school-based intervention programmes in the United States and Mexico that showed improvements in obesity-related outcomes among Hispanic children	Hispanic children aged 6–12 years	School-based interventions aimed at reducing obesity underpinned by a framework or incorporating aspects of a framework	Control group with non-community-based intervention	Primary: Dietary behaviours; anthropometric measures Secondary: Not specified	Experimental (i.e. interventional) study designs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Antwi 2012 *(29)*	Effectiveness of web-based programmes on the reduction of childhood obesity in school-aged children: a systematic review	To identify the best available evidence on the effectiveness of web-based interventions on the reduction of childhood obesity in school-aged children	Children and adolescents aged 4–18 years	Web-based programmes using, among other platforms, the Internet, social networking media, Internet mobile applications, and email aimed at the reduction of obesity among school-age children	Control group with non-web-based intervention	Primary: Measures of overweight and obesity (including but not limited to BMI, body weight and waist circumference) Secondary: Not specified	RCTs; pseudo-RCTs
Avery 2015 *(30)*	A systematic review investigating interventions that can help reduce consumption of sugar-sweetened beverages in children leading to changes in body fatness	To describe interventions that reduce the consumption of sugar-sweetened beverages in children, and to determine whether reduction in the consumption of sugar-sweetened beverages leads to subsequent changes in child body fatness	Children and adolescents aged 2–18 years	School- and home-based educational programmes and environmental change interventions aimed at reducing the consumption of sugar-sweetened beverages	Control arm without intervention	Primary: sugar-sweetened beverage consumption Secondary: Body composition indicative of body fatness (e.g. BMI, prevalence of overweight or obesity, risk of being overweight, skinfold thickness, waist circumference)	Studies with both intervention and control data
Bagherniya 2018 *(31)*	Obesity intervention programs among adolescents using social cognitive theory: a systematic literature review	To evaluate the efficacy of intervention studies based on social cognitive theory in reducing or preventing overweight and obesity in adolescents	Adolescents aged 12–18 years	Social cognitive theory interventions aimed at improving dietary habits and/or physical activity of study participants delivered in the school setting, counselling groups and/or recreation centres	Control group without intervention or interventions without social cognitive theory	Primary: Measures of overweight and obesity Secondary: Not specified	RCTs; quasi-experimental interventional studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Bailey 2019 *(32)*	Food literacy programmes in secondary schools: A systematic literature review and narrative synthesis of quantitative and qualitative evidence	To synthesize the literature on food literacy interventions among adolescents in secondary schools, the attitudes and perceptions of food literacy interventions in secondary schools, and their effects on dietary outcomes	Adolescents aged 10–19 years old	School-based food literacy interventions aimed at improving dietary habits, healthy food choices, nutrition knowledge and cooking skills	Control group without intervention	Primary: Food literacy Secondary: Adolescents' attitudes and perceptions of food literacy programmes and the topic of home economics; home-economics teachers' perspectives on food literacy programmes and the topic of home economics	Cross-sectional studies; mixed-methods studies; quantitative studies; qualitative studies
Black 2017 *(33)*	How effective are family-based and institutional nutrition interventions in improving children's diet and health? A systematic review	To assess the impact of family-based and school/preschool nutrition interventions on the health of children aged 12 or younger, including the sustainability of these impacts and the relevance to socio-economic inequalities	Children aged 0–12 years in high-income countries	School and family-based interventions to complement institutional nutrition programmes to improve the nutrition and health of young children in high-income countries	Control group without intervention, delayed intervention or alternative intervention	Primary: Nutritional intake; health status (including mortality, morbidity, hospital and emergency department admissions, and child growth and development outcomes); longer term effects following programme completion; adverse outcomes [stigmatisation, dependency, decreased total family expenditure on food (including subsidy), increase in consumption of high fat/high sugar foods (including takeaway food), and obesity or excessive weight loss] Secondary: Not specified	RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Bleich 2013 *(34)*	Systematic review of community-based childhood obesity prevention studies	To assess the impact of community-based obesity prevention interventions	Children and adolescents aged 2–18 years in the United States of America	School-, family- and community-based interventions designed to complement institutional nutrition programmes to improve the nutrition and health of young children in a high- income country	Control group with usual care, another different intervention, or no intervention	Primary: BMI; BMI z-score; prevalence of obesity and overweight; percent body fat; waist circumference; skinfold thickness Secondary: Energy intake; fruit and vegetable intake; fatty food intake; intake of sugar-sweetened beverages; physical activity; sedentary behaviour	RCTs; quasi-experimental studies; natural experiments
Bleich 2018 *(35)*	Interventions to prevent global childhood overweight and obesity: a systematic review	To synthesize the existing global evidence on childhood overweight and obesity interventions in school, preschool, community, and home settings	Children and adolescents aged 2–19 years	School-, family- and community-based Interventions to prevent or manage weight gain in children and adolescents using components targeting diet or physical activity, or both	Control group without intervention	Primary: Not specified Secondary: Not specified	RCTs; quasi-experimental studies; natural experiments with control group
Brown 2016 *(36)*	A systematised review of primary school whole class child obesity interventions: effectiveness, characteristics, and strategies	To examine the effectiveness of school-based interventions that focus on changing dietary intake and physical activity levels to reduce childhood obesity	Primary school-aged children	School-based interventions that focus on changing dietary intake and physical activity levels to reduce childhood obesity	Control group without intervention	Primary: BMI; BMI-standard deviation score; Z-score Secondary: Physical activity; fruit intake; vegetable intake; sedentary time; screen time; intake of sugar-sweetened beverages	RCTs; non-RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Cai 2014a *(37)*	Effect of childhood obesity prevention programs on blood pressure: A systematic review and meta-analysis	To assess the effects of childhood obesity prevention interventions on blood pressure and adiposity-related outcomes	Children and adolescents aged 2–18 year in high-income countries	School-, family- and community-based Interventions targeting diet, physical activity or the combination of the two, in any one setting or combination of settings (i.e. school, home and/or community settings, including child and day care and primary health care facilities)	Control group without intervention	Primary: Systolic blood pressure; diastolic blood pressure Secondary: Adiposity measures	RCTs; quasi-experimental studies; natural experiments
Cai 2014b *(38)*	Effect of childhood obesity prevention programmes on blood lipids: A systematic review and meta-analysis	To assess the effects of childhood obesity prevention interventions on blood lipids and adiposity measures	Children and adolescents aged 2–18 years in high-income countries	School-, family- and community-based interventions targeting diet, physical activity or the combination of the two, in any one setting or combination of settings (i.e. school, home and/or community settings, including child and day care and primary health care facilities)	Control group without intervention	Primary: Total cholesterol ; low density lipoprotein-cholesterol; high density lipoprotein-cholesterol; triglycerides Secondary: Adiposity measures	RCTs; quasi-experimental studies; natural experiments
Calvert 2018 *(39)*	Delivering in-school interventions to improve dietary behaviours amongst 11- to 16-year-olds: A systematic review	To review types of interventions delivered, dietary behaviours targeted, and interventions' effectiveness in improving dietary behaviour and associated intervention components	Adolescents aged 11–16 years	School-based healthy eating interventions aimed to change dietary behaviours	Pre- and post-intervention comparisons	Primary: Dietary behaviours Secondary: Characteristics and moderators that may contribute to the effectiveness of dietary behaviour change	RCTs; quasi-experimental studies; cohort studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Champion 2017 *(40)*	A systematic review of school-based eHealth interventions targeting alcohol use, smoking, physical inactivity, diet, sedentary behaviour and sleep among adolescents: a review protocol	To systematically review the literature on school-based eHealth interventions designed to target two or more of the following lifestyle risk behaviours among adolescents: alcohol use, smoking, poor diet, physical inactivity, sedentary behaviour and sleep	Adolescents aged 11–18 years	eHealth school-based interventions to reduce six unhealthy lifestyle behaviours	Control group without intervention	Primary: Prevention, delay in the onset, or reduction of any of the six lifestyle risk behaviours targeted in the intervention: smoking, alcohol use, physical inactivity, poor diet, poor sleep patterns and sedentary behaviour Secondary: Knowledge, attitudes future intentions and self-efficacy to engage/not engage in the lifestyle risk behaviours; mental health outcomes (e.g. anxiety, depression, suicide or self-harm); physical health outcomes (e.g. obesity, type II diabetes, premature mortality); educational attainment and employment	RCTs; cluster RCTs
da Silveira 2013 *(41)*	The effect of participation in school-based nutrition education interventions on body mass index: a meta-analysis of randomized controlled community trials	To evaluate the effectiveness of school-based nutrition education interventions in reducing or preventing overweight and obesity among children and adolescents	Children and adolescents aged 5–18 years	School-based nutrition education (educational games, classroom activities, school nutrition policies, parental involvement) interventions administered by health professionals or school teachers	Control arm of RCT (classroom or school with no intervention)	Primary: BMI Secondary: Not specified	Community RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
de Medeiros 2019 *(42)*	Protocol for systematic reviews of school-based food and nutrition education intervention for adolescent health promotion	To comprehensively review the quantitative and qualitative literature on the effects of school-based food and nutrition education interventions on adolescent health promotion through healthy eating habits	Adolescents aged 10–19 years	School-based interventions to promote adolescent health through changes in food consumption, biological or biochemical parameters in an intervention group	Non-school-based comparators	Primary: Changes in adolescent food consumption Secondary: Changes in biological parameters (BMI, waist circumference, waist-to-height ratio, total body fat); biochemical parameters (glycemia, triglycerides, total cholesterol, low density lipoprotein-cholesterol; high density lipoprotein-cholesterol); qualitative evidence that supports or explains the effect of school-based food and nutrition education interventions on adolescent food consumption	RCTs; cluster RCTs; non-RCTs; controlled before-and-after studies
do Amaral E Melo 2017 *(43)*	Nutritional interventions for adolescents using information and communication technologies (ICTs): A systematic review	To identify technologies and their main characteristics used for nutritional interventions for adolescents, and to evaluate their effectiveness	Adolescents in high- income countries	Nutritional interventions that use information and communication technologies	Control group without intervention or non-ICT intervention; pre- intervention comparison group	Primary: Technologies and their characteristics used for interventions Secondary: Quality of included studies and effectiveness of included interventions	RCTs; quasi-experimental studies; observational studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Driessen 2014 *(44)*	Effect of changes to the school food environment on eating behaviours and/ or body weight in children: a systematic review	To systematically review the evidence relating to interventions that change the school food environment, with outcomes including both food-related behaviours (purchasing, consumption) and body weight	Children and adolescents	School-based interventions in which a material change was made to the school food environment, with or without a relevant school policy directing this	Control group without intervention; pre-intervention comparisons	Primary: Body weight; BMI; waist circumference Secondary: Purchasing and consumption of foods	Not pre-specified
Dudley 2015 *(45)*	Teaching approaches and strategies that promote healthy eating in primary school children: a systematic review and meta-analysis	To: 1) perform a systematic review of randomized controlled, quasi-experimental and cluster controlled trials examining the school-based teaching interventions that improve the eating habits of primary school children; and 2) perform a meta-analysis to determine the effect of those interventions	Primary school-aged children	Teaching and school-based elementary school interventions delivered by teachers or teacher substitutes that sought to bring about positive nutritional consumption, preference or knowledge change in primary school children	Pre- intervention comparison group	Primary: Food consumption and energy intake; fruit and vegetable consumption or preference; sugar consumption or preference; nutritional knowledge Secondary: Not specified	RCTs; cluster-controlled trials; quasi-experimental studies
Evans 2012 *(46)*	Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 years	To quantify the impact of school-based interventions on fruit and vegetable intake in children aged 5–12 years old	Children aged 5–12 years; school settings (primary)	School-based dietary interventions designed to increase fruit and vegetable intake	Control group without intervention or usual practice	Primary: Total weight in grams of fruit and vegetables consumed daily, separately and combined (excluding potatoes) Secondary: Not specified	RCTs; non-RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Ganann 2014 *(47)*	Enhancing nutritional environments through access to fruit and vegetables in schools and homes among children and youth: a systematic review	To examine the effects of interventions delivered in the home, school and other nutritional environments designed to increase fruit and vegetable availability among 5- to 18-year-olds	Children and adolescents aged 5–18 years, their parents and teachers, as well as other members of the local community	Interventions and policies targeting organizational nutrition environments (including the home, schools and other community settings) and aimed at modifying the fruit and vegetable environment through fruit and vegetable provision and/or education; provision of economic supplements and subsidies for the purchase of fruit and vegetables, as well as other community programmes and environmental interventions	Not specified	Primary: Fruit and vegetable supply (i.e. market inventory); change in food environment (e.g. at home, in schools); fruit and vegetable disappearance/food transition (cafeteria and grocery store sales) Secondary: Consumption of fruit and vegetables; awareness of importance/impact of fruit and vegetable consumption among targeted individuals; attitudes towards consumption of fruit and vegetable; general health measures (including changes in weight); and any reported adverse outcomes or unintended consequences	RCTs; non-RCTs (including cluster-controlled trials, controlled time series); studies with interrupted time series designs (to assess changes that occur over time); controlled before-and-after studies (including historical controls)
Gori 2017 *(48)*	Effectiveness of educational and lifestyle interventions to prevent paediatric obesity: systematic review and meta-analyses of randomized and non-randomized controlled trials	To update the results of a previous meta-analysis (published in 2011 by Waters et al.);[a] to confirm and define the effectiveness of specific interventions stratifying by patient age, and intervention setting and duration; and to conduct subgroup analyses to explore the effects of specific interventions in each age group	Obese and overweight children and adolescents	Educational, lifestyle and health promotion interventions including psychological and motivational interventions directed at children/ adolescents and/or their families, focusing on diet and/or physical activity	Not specified	Primary: Change in standardized BMI Secondary: Not specified	RCTs; non-RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Gray 2019 *(49)*	School-level factors associated with obesity: A systematic review of longitudinal studies	To determine the current evidence on effects of school-level factors on obesity outcomes in longitudinal studies	School-aged children or adolescents	School-based obesity prevention interventions	Not specified	Primary: BMI; waist circumference; obesity prevalence Secondary: Not specified	Longitudinal observational studies
Grech 2015 *(50)*	A systematic literature review of nutrition interventions in vending machines that encourage consumers to make healthier choices	To determine the efficacy of nutrition interventions in vending machine in prompting dietary behaviour change to improve diet quality or weight status of the consumers of vended snacks compared with customers of vending machines where there is no change to the products typically sold	Participants who have access to vending machines in any setting including schools, universities and work sites	All intervention strategies aimed at improving the nutritive content of snacks and beverages purchased from vending machines	Not specified	Primary: Dietary behaviour change (e.g. sales data, dietary intake or BMI) Secondary: Not specified	Experimental trials including RCTs, cluster RCTs, quasi-experimental controlled studies and pre-and-test studies
Guimarães 2015 *(51)*	Effectiveness of intervention programs in schools to reduce health risk factors in adolescents: a systematic review	To conduct a systematic review of intervention programmes with planned physical activity and/or nutrition education actions to reduce health-related risk factors in Brazilian adolescent students aged 10–19 years	Adolescents aged 10–19 years in Brazil	Programmed physical activity and/or nutrition interventions conducted in public and/or private schools aimed at reducing health risk factors (i.e overweight/ obesity and metabolic profile alterations)	Pre- intervention group	Primary: BMI Secondary: Not specified	Pre-and-post-test studies and trials

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Hamel 2012 *(52)*	Computer- and web-based interventions to promote healthy eating among children and adolescents: a systematic review	To: (1) determine the effect of computer- and web-based interventions on improving eating behaviour and/ or diet-related physical outcomes among children and adolescents; and (2) examine if particular elements of these interventions increased success	Children and adolescents aged 6–18 years	Computer- or web-based healthy eating interventions with or without a physical activity intervention for children (6– 11 years of age) or adolescents (12–18 years of age) implemented in schools, camp and home settings	Control group without intervention or usual practice	Primary: Eating behaviour (e.g. increasing fruit and vegetable consumption; decreasing fat consumption) and/or diet-related physical outcomes (e.g. BMI) Secondary: Not specified	RCTs, quasi-experimental designs, or studies which had a control/ comparison group and provided quantitative results
Hendrie 2012 *(53)*	Combined home and school obesity prevention interventions for children: what behavior change strategies and intervention characteristics are associated with effectiveness?	To: (a) examine the effectiveness of combined-setting (school or community centres and the home) obesity prevention interventions to change children's weight-related dietary, activity, and sedentary behaviours and risk of obesity; and (b) determine whether there is an association between the effectiveness of these combined-setting interventions and the food and activity behaviours targeted and the behaviour change techniques (BCTs) used	Children and adolescents aged 1– 18 years and at least one parent	Community-based (e.g. child care, community centres) or school-based interventions that included a nutrition or activity component AND a behaviour change component targeting an increase in physical activity, decrease in sedentary behaviour, change in nutrition intake or weight status in children AND involved parents or caregivers	Control group without intervention or usual practice	Primary: Child's adiposity (e.g. BMI- z score or percent overweight) or health risk factors (e.g. cholesterol); self-reported measures of child's dietary intake or activity behaviours Secondary: Determinants of children's lifestyle behaviours, focusing on parental characteristics such as knowledge; parent and child interactions such as feeding practices; environmental measures such as food availability; and predictors of behaviour change such as self-efficacy	Any study design that evaluated the effectiveness of an intervention run in parallel with a control/ comparison group with outcomes measured at baseline and post-intervention

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Hersch 2014 *(54)*	The impact of cooking classes on food-related preferences, attitudes, and behavior's of school-aged children: a systematic review of the evidence, 2003–2014	To assess the latest evidence concerning childhood cooking programmes and their association with children's food-related preferences, attitudes, and behaviours; to inform future efforts; and to identify gaps in the literature	Children aged 5–12 years	Cooking education programme or intervention delivered in a school or community setting that involved food preparation lessons	Control group without intervention or usual practice	Primary: Food preparation skills; dietary intake; cooking confidence; fruit and vegetable preferences; attitudes toward food and cooking; and food-related knowledge Secondary: Not specified	RCTs and quasi-experimental studies which included pre- and post-assessment
Holub 2014 *(55)*	School-wide programs aimed at obesity among Latino youth in the United States: a review of the evidence	To examine the effects of evidence-based research of obesity-related interventions on Latino children in schools in the United States	Children of any age attending schools in the USA with a high proportion of Latino pupils (at least 50%)	School-, home- and community-based obesity interventions (interventions had to include at least one school-based component)	Not specified	Primary: Obesity-related outcomes (e.g. BMI z-score, weight, waist circumference, percent body fat, prevalence of overweight and obesity) Secondary: Not specified	RCTs, group randomized trials, non-randomized trials and pre- and post assessment studies
Kong 2016 *(56)*	Limitations of studies on school-based nutrition education interventions for obesity in China: a systematic review and meta-analysis	To review the existing literature with regard to school-based nutrition education aimed at preventing obesity in primary school students in China	Primary-school aged children in the People's Republic of China	Nutrition education interventions aimed at reducing obesity delivered via school-based programmes	Not specified	Primary: BMI; prevalence of obesity Secondary: Not specified	Not pre-specified

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Langford 2014 *(10)*	The WHO Health Promoting School framework for improving the health and well-being of students and their academic achievement (Cochrane review)	To re-assess the effectiveness of the Health Promoting Schools (HPS) framework in improving the health and well-being of students and their academic achievement	Children and adolescents aged 4– 18 years attending schools or colleges	Interventions which involved active engagement in three domains: the school curriculum; changes to school's ethos and/ or environment; and engagement with families and/or communities	Schools not offered intervention, standard practice, or an alternative intervention including only one or two of the three domains	Primary: Health outcomes including overweight/obesity, physical activity and sedentary behaviours, nutrition, tobacco use, alcohol use, substance use, sexual health, mental health, violence, bullying, infectious disease (e.g. diarrhoea, respiratory infections), safety and accident prevention, body image/ eating disorders, sun safety, and oral health; educational outcomes such as academic achievement (e.g. standardized test scores or school-level academic achievement) Secondary: School attendance; other school-related outcomes (e.g. school climate or attachment to school)	Cluster RCTs, where randomization took place at the level of school, district or other geographical area
Lima-Serrano 2014 *(57)*	Impact of school-based health promotion interventions aimed at different behavioural domains: a systematic review	To summarize characteristics and effects of school-based interventions leading to behaviours such as nutrition, physical activity, mental and holistic health, and risk prevention (eating disorders, substance use, sexuality, violence and road safety)	Healthy adolescents aged 11–17 years	School-based physical activity and nutrition interventions designed to improve the school environment and make it more conducive to physical activity and healthy nutrition	Control group without intervention or usual practice, or pre-intervention comparison group	Primary: Health nutrition and physical activity (e.g. hours of physical activity, fruit and vegetable provision); mental and holistic health; risk prevention Secondary: Not specified	Quantitative experimental or observational studies in which an intervention group was compared at least twice (i.e. pre-test and post-test)

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Lobelo 2013 *(58)*	School-based programs aimed at the prevention and treatment of obesity: evidence-based interventions for youth in Latin America	To examine the effectiveness of school-based interventions aimed at preventing or treating obesity among youth in Latin America	Children aged 6–14.5 years in Latin American countries	Programmes that had at least one school-based intervention focused on obesity-related topics (as opposed to general health promotion)	Control group without intervention or pre-intervention comparison group	Primary: BMI; weight; waist circumference; percent body fat; overweight; obese Secondary: Not specified	RCTs (including crossover designs); non-RCTs; pre- and post-study designs
Martin 2018 *(59)*	Physical activity, diet and other behavioural interventions for improving cognition and school achievement in children and adolescents with obesity or overweight (Cochrane review)	To assess whether lifestyle interventions (in the areas of diet, physical activity, sedentary behaviour and behavioural therapy) improve school achievement, cognitive function (e.g. executive functions) and/or future success in children and adolescents with obesity or overweight	Obese or overweight children and adolescents aged 3–18 years	School-based behavioural and lifestyle interventions aimed at reducing obesity	Standard care; waiting-list control; no treatment; attention placebo control group	Primary: School achievement; cognitive function; adverse outcomes Secondary: Future success; obesity indices	RCTs and quasi-RCTs
Mbakaya 2017 *(60)*	Hand hygiene intervention strategies to reduce diarrhoea and respiratory infections among schoolchildren in developing countries: A systematic review	To identify hand hygiene intervention strategies to reduce infectious diseases such as diarrhoea and respiratory tract infections among schoolchildren in developing countries	Children aged 6–12 years in developing countries	Multi-level school- and community- based interventions and strategies aimed at improving hand-washing practices	Control group without intervention or usual practice	Primary: incidence of diarrhoea; incidence of respiratory illnesses; school absenteeism; cleanliness of hands due to the impacts of hand hygiene; reduction in the number of microorganisms on the hands Secondary: Not specified	RCTs; cluster RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Muzaffar 2018 *(61)*	Narrative review of culinary interventions with children in schools to promote healthy eating: Directions for future research and practice	To critically evaluate culinary skill interventions in schools to identify specific programmes and programmatic factors associated with improvement in outcomes	Children aged 5–12 years 9and their parents)	School-based programmes designed to teach "hands-on" culinary skills either as a stand-alone intervention or as part of a comprehensive package of interventions	Control group without intervention or pre-intervention comparison group	Primary: Diet-related behaviours (e.g. fruit and vegetable consumption, frequency of cooking); weight status; attitudes toward healthy eating Secondary: Not specified	RCTs; quasi-experimental interventional studies including pre- and post-test designs
Nathan 2019 *(62)*	The effectiveness of lunchbox interventions on improving the foods and beverages packed and consumed by children at centre-based care or school: a systematic review and meta-analysis	Primary aim: to assess the effectiveness of lunchbox interventions aiming to improve the foods and beverages packed and consumed by children attending centre-based care or school Secondary aim: to assess the effectiveness of these interventions on child adiposity or waist circumference	Children and adolescents aged 2–18 years	Any educational, experiential, health promotion and/or family or structural or policy or legislative intervention that targeted food provided from home for consumption by children during attendance at school or centre-based care	Any parallel comparison group	Primary: Number or proportion of serves, portions or grams of food provided or consumed, as measured by direct observation, surveys or weighed food in lunchboxes Secondary: Anthropometric measures including BMI, BMI percentile, waist measurements or body composition (e.g. per cent body fat, per cent lean body mass or skin folds)	RCTs; non-RCTs; controlled clinical trials
Nørnberg 2015 *(63)*	Choice architecture interventions for increased vegetable intake and behaviour change in a school setting: A systematic review	To assess the prevalence and quality of existing studies on the effect of choice architectural nudge interventions promoting the intake of vegetables among adolescents in a school context and to identify studies estimating adolescents' attitudes towards architectural nudge interventions	Healthy adolescents aged 11–19 years	School-based Interventions aimed at influencing vegetable intake which applied choice architecture nudging (e.g. distribution of free vegetables, modifications to serving style, changes to the physical environment)	Not specified	Primary: Vegetable intake; measures of attitudes or level of public approval towards nudge interventions or food consumption Secondary: Not specified	Intervention or experimental studies, including cluster RCTs, quasi experimental designs and pre- and post-test experiments

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Ohly 2016 *(64)*	A systematic review of the health and well-being impacts of school gardening: synthesis of quantitative and qualitative evidence	To understand the health and well-being impacts of school gardens and the factors that help or hinder their successful development	Entire school community, including pupils, staff, family and community members of all ages OECD countries	School-based gardening activities, including preparing the soil, planting, weeding, watering, harvesting and garden-related cooking and tasting activities, integrated into the curriculum or conducted outside of lesson time (e.g. after school clubs, school-organized trips to community allotments)	Control group with no intervention or groups participating in alternative activities (e.g. nutrition education without gardening activities) (quantitative studies)	Primary: Dietary intake; food-related knowledge, attitudes and preferences; physical, mental or emotional health; and quality of life indicators (quantitative studies); themes, concepts and metaphors relating to the experience and meaning of school gardens, and any perceived factors that help or hinder their success (qualitative studies) Secondary: Additional outcomes including adverse or unintended outcomes (only when reported alongside health and well-being outcomes)	Suitable quantitative studies, including RCTs, non-RCTs and other controlled before-and- after studies, and qualitative studies
Oosterhoff 2016 *(65)*	The effects of school-based lifestyle interventions on body mass index and blood pressure: a multivariate multilevel meta-analysis of randomized controlled trials	To revise, systematically, the current evidence on the impact of school-based lifestyle interventions on children's BMI and blood pressure with the use of multilevel meta-analysis techniques	Children aged 4–12 years	School-based lifestyle interventions promoting a change towards healthier eating (e.g. by changes in foods provided by school canteens/ cafeterias), or a change in physical (in)activity levels (e.g increasing physical education load) and/or education for healthier behaviours (e.g. pamphlets, lectures)	Control group with no intervention beyond the usual curricular activities	Primary: BMI; cardiovascular risk factors (e.g. systolic blood pressure, diastolic blood pressure) Secondary: Not specified	RCTs reporting at least one follow-up moment post intervention start

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Panter 2018 *(66)*	Obesity prevention: A systematic review of setting-based interventions from Nordic countries and the Netherlands	To identify, synthesize, and evaluate the quality of interventions including environmental components based in the in settings from Nordic countries and the Netherlands, aimed at preventing obesity	All age groups Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) and the Netherlands	School-, community- and workplace-based Interventions targeting the weight status of the population which include at least one environmental component (e.g. school curriculum changes, infrastructure and built environment, policies)	Not specified	Primary: BMI and obesity or chronic disease prevention measures (e.g. changes in physical activity, smoking, blood pressure, lipids) Secondary: Not specified	Any interventional study designs other than purely qualitative studies
Rahman 2018 *(67)*	Effectiveness of behavioural interventions to reduce the intake of sugar-sweetened beverages in children and adolescents: a systematic review and meta-analysis	To explore the effectiveness of educational and behavioural interventions to reduce sugar-sweetened beverage intake and to influence health outcomes among children aged 4 to 16 years	Children and adolescents aged 4–16 years	School-, home and community-based educational or behavioural interventions targeting the reduction of sugar-sweetened beverage consumption	Control group without intervention	Primary: Sugar-sweetened beverage consumption Secondary: obesity prevalence (status); age and gender specific BMI z-scores; dental caries measured by the difference in decayed, missing, and filled teeth; cardiovascular disease risk factors; risk of any chronic disease, including type II diabetes mellitus, hypertension, dyslipidaemia, and orthopaedic ailments	RCTs only
Sacco 2016 *(68)*	The influence of menu labelling on food choices among children and adolescents: a systematic review of the literature	To assess whether menu labelling influences the amount of calories ordered by children and adolescents (or parents on behalf of youth) in food outlets including restaurants and cafeterias	Children and adolescents aged under 18 years	Menu-labelling interventions with disclosure of calories and other nutrients on menus or menu boards in food outlets, including restaurants and school cafeterias	Control group without intervention or pre- intervention comparison group	Primary: Mean calories selected per participant Secondary: Total fat content of food; purchased or consumed; awareness of nutrition information on menus and menu boards; self-reported use of labels when purchasing food; menu-labelling format preferences	RCTs; before-and-after studies (described in results)

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
Saraf 2012 *(69)*	A systematic review of school-based interventions to prevent risk factors associated with noncommunicable diseases	To assess the effectiveness of school-based interventions in bringing about a change in the knowledge, attitude and practices of schoolchildren at school, family and community levels for the prevention of NCD risk factors (physical inactivity, diet and tobacco consumption) and to identify processes that affect the main outcome	School-aged children	School-based interventions with or without a family or community component focused on modifying physical activity, nutrition, obesity-related risk factors, sedentary habits and/or tobacco consumption	A parallel comparison control group or a pre-intervention comparison group	Primary: Change in knowledge, attitude, practices; anthropometric measures (e.g. BMI, weight, skin fold thickness) Secondary: Not specified	Not pre-specified
Savoie-Roskos 2017 *(70)*	Increasing fruit and vegetable intake among children and youth through gardening-based interventions: a systematic review	To identify the effectiveness of gardening interventions that have been implemented to improve fruit and vegetable consumption among children aged 2 to 15 years in school, community and afterschool settings	Children and adolescents aged 2–18 years in developed countries	Any school-based, gardening-based interventions and programmes delivered as part of the school curricula or as part of out-of-school clubs or community projects which allowed children to receive hands-on experience with planting, growing, and harvesting fruit and vegetables	Not specified	Primary: Fruit and vegetable consumption Secondary: Not specified	Any study design
Schroeder 2016 *(71)*	Are school nurses an overlooked resource in reducing childhood obesity? A systematic review and meta-analysis	To examine the efficacy of school-based obesity interventions that involve nurses	School-aged children	School-based interventions to prevent or treat childhood obesity that involve nurses in a role beyond anthropometric measurement	Not specified	Primary: body weight or BMI (e.g. BMI, BMI z-score, BMI percentile) Secondary: Not specified	Quasi-experimental or experimental designs (e.g RCTs)

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Sobol-Goldberg 2013 *(72)*	School-based obesity prevention programmes: a meta-analysis of randomized controlled trials	To assess the efficacy of school-based obesity prevention programmes (using the methodology employed by a previous review by Kamath et al., 2008[b] and based on studies published between 2006 and 2012)	Children and adolescents aged 5–18 years	School-based intervention programmes aimed at preventing childhood obesity	Control group with no intervention	Primary: BMI Secondary: Not specified	RCTs
Turbutt 2019 *(73)*	The impact of hot food takeaways near schools in the UK on childhood obesity: A systematic review of the evidence	To identify all papers published since the identification of the obesogenic environment in 1998 focused on the impact of hot food takeaways in the food environment surrounding schools in the UK on childhood obesity	School-aged children and their parents in the UK	Policies and programmes (including food environment design) which influence the food environment surrounding schools	Not specified	Primary: Measures of childhood obesity measures (e.g. BMI, weight, obesity prevalence) Secondary: Food-related behaviours among pupils or adults in the environment surrounding schools	Not pre-specified
Turner 2020 *(74)*	Food environment research in low- and middle-income countries: a systematic scoping review	To address the following five questions : 1) Where has food environment research been undertaken? 2) How have food environments been conceptualized? 3) Which key domains and dimensions of food environments have been studied? 4) Which study designs, methods and measures have been implemented?	Low- and middle-income countries	Interventions aimed at improving the school food environment by reducing the availability of energy-dense foods and sugar-sweetened beverages; increasing the availability of healthier food options; providing nutrition education; adopting school policies; and limiting access to vendors selling unhealthy foods in and around schools	Not specified	Primary: Dietary, nutritional status or health measures Secondary: Not specified	Any original peer-reviewed published articles (quantitative and qualitative studies)

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
		5) What are the key findings regarding associations between food environment exposure and dietary, nutrition, and health outcomes?					
Van Lippevelde 2012 *(75)*	Does parental involvement make a difference in school-based nutrition and physical activity interventions? A systematic review of randomized controlled trials	To determine the impact of parental involvement in school-based obesity prevention interventions, to identify the characteristics of parents who do participate in school-based interventions, and to explore the kind of parental involvement in school-based interventions that may contribute to effectiveness	Healthy children and adolescents aged 6–18 years, and their parents	School-based interventions focused on obesity-, nutrition- and physical activity-related behaviours (e.g. health education, increased opportunities for physical activity, school food service modifications, active travel promotion)	School-only intervention group	Primary: anthropometric outcomes (e.g. BMI, overweight); nutrition behaviours, knowledge and attitudes (fruit consumption, snacking); physical activity-related behaviours (e.g. exercise, screen time) Secondary: Not specified	Controlled trials in which a school-only intervention group was compared with a school-plus-family-intervention-group
Vargas-Garcia 2017 *(76)*	Interventions to reduce consumption of sugar-sweetened beverages or increase water intake: evidence from a systematic review and meta-analysis	To evaluate the effectiveness of public health interventions to reduce sugar-sweetened beverage intake or increase water intake in children, adolescents and adults	Children and adults no younger than 3 years	Community-based interventions which include a specific school component that are aimed at reducing sugar-sweetened beverage consumption (school–specific interventions include educational materials (e.g. student booklets, posters and fact sheets for parents) as well as educational activities (e.g. theatre sketches, movies, puppet shows, writing and drawing contests)	Any control group	Primary: Intakes of sugar-sweetened beverage or water (daily change, in millilitres) Secondary: Not specified	RCTs; cluster RCTs; non-RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Verjans-Janssen 2018 *(77)*	Effectiveness of school-based physical activity and nutrition interventions with direct parental involvement on children's BMI and energy balance-related behaviors – A systematic review	To study the effectiveness of primary school-based physical activity and nutrition interventions with direct parental involvement regarding children's weight status and energy balance-related behaviours	Children aged 4–12 years	Primary school-based interventions with direct parental involvement targeting physical activity behaviour, sedentary behaviour and/or nutrition behaviour	Not specified	Primary: BMI; BMI z-score (adjusted for age and gender) ; physical activity; sedentary behaviour and/or nutritional behaviour Secondary: Not specified	Any matching search terms: Evaluation(s) (study), effect(s), effective(ness), effectivity, pre-post-test(s)
Verstraeten 2012 *(78)*	Effectiveness of preventive school-based obesity interventions in low- and middle-income countries: A systematic review	To identify effective pathways that alter behaviour and/or BMI in schoolchildren in low- and middle-income countries	Children and adolescents aged 6–18 years in low- and middle-income countries	School-based programmes focused on primary prevention of overweight or obesity in children through interventions which target dietary and/ or physical activity behaviours	Any control group	Primary: Dietary and physical activity behaviour outcomes and/or anthropometric outcomes Secondary: Not specified	Any controlled trial study design (with or without randomization)
Vézina-Im 2017 *(79)*	Efficacy of school-based interventions aimed at decreasing sugar-sweetened beverage consumption among adolescents: a systematic review	To perform a systematic review of school-based interventions aimed at reducing sugar-sweetened beverage consumption among adolescents aged 12–17 years	Adolescents aged 12–17 years	Secondary school-based interventions and nutrition policies aimed at reducing sugar-sweetened beverage consumption	Not specified	Primary: Sugar-sweetened beverage consumption Secondary: Not specified	RCTs; quasi-experimental studies; one group pre–and-post studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
von Philipsborn 2019 *(80)*	Environmental interventions to reduce the consumption of sugar-sweetened beverages and their effects on health	To assess the effects of environmental interventions (excluding taxation) on the consumption of sugar-sweetened beverages and sugar-sweetened milk, diet-related anthropometric measures and health outcomes, and on any reported unintended consequences or adverse outcomes'	Children and adults	School-, home- and consumer-based interventions (i.e. including interventions in supermarkets and restaurants/cafes) intending to reduce, or have potential effects on, the consumption of sugar-sweetened beverages and sugar-sweetened milk, or mitigate their adverse effects on health	Control group with no intervention or minimal or alternative interventions (e.g. behavioural intervention)	Primary: Direct and indirect measures of sugar-sweetened beverage intake; diet-related anthropometric measures and health outcomes; any reported adverse outcomes or unintended consequences Secondary: Measures of financial and economic viability; diet-related psychosocial variables; target group perceptions of the intervention; consumption of beverages other than sugar-sweetened beverages	RCTs (including cluster RCTs); non-RCTs (including cluster non-RCTs); controlled before-and-after studies; interrupted time-series studies; repeated measures studies
Wang 2013 *(81)*	The implementation and effectiveness of school-based nutrition promotion programmes using a health-promoting schools approach: a systematic review	To evaluate the implementation and effectiveness of school-based nutrition promotion programmes using the health promoting schools (HPS) approach, to indicate areas where further research is needed and to make recommendations for practice in this field	Schoolchildren, their parents and teachers	School-based interventions on nutrition which involve health-promoting activities in one or more of the following three areas: (a) the school ethos and/or environment (e.g. school policy); (b) the curriculum, specifically the nutrition curriculum; (c) the family and/or community School setting	No restrictions applied on grounds of comparator groups	Primary: Participants' knowledge; participants' attitudes and skills; participants' behaviours relating to diet and nutrition Secondary: Not specified	Controlled studies; before-and-after studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
INTERVENTIONS							
Wang 2015 *(82)*	What childhood obesity prevention programmes work? A systematic review and meta-analysis	To systematically evaluate the effectiveness of all childhood obesity prevention programmes implemented in various settings	Children and adolescents aged 2–18 years in high-income countries	Interventions conducted in multiple settings (i.e. school, home, primary care, childcare and other community settings) to prevent obesity (or "excessive weight gain") in children aged 2–18 years	Not specified	Primary: Adiposity-related outcomes (e.g. BMI, BMI z-score, BMI percentile, waist circumference , percent body fat, skin-fold thickness, prevalence of overweight or obesity) Secondary: Behavioural outcomes (e.g. dietary intakes, physical activity and sedentary behaviours); obesity-related clinical outcomes (e.g. blood pressure and blood lipid levels)	RCTs; quasi-experimental studies; natural experiments that reported intervention effects on adiposity-related outcomes
Whittemore 2013 *(83)*	School-based Internet obesity prevention programmes for adolescents: A systematic literature review	To describe, synthesize and evaluate the research on school-based Internet obesity prevention programmes for adolescents	Adolescents	School-based obesity prevention programmes targeting adolescents	Any control group	Primary: BMI; nutrition behaviours; physical activity behaviour Secondary: Not specified	Empirical studies
Willmott 2015 *(84)*	Effectiveness of hand hygiene interventions in reducing illness absence among children in educational settings: a systematic review and meta-analysis	To establish the effectiveness of handwashing in reducing absence and/or the spread of respiratory tract and/or gastrointestinal infection among school-aged children and/or staff in educational settings	Children aged 3–11 years, and their carers/teachers	School- based (primary or elementary) hand hygiene interventions	Placebo or active comparator groups	Primary: Incidence of respiratory tract and gastrointestinal infections or symptoms; absenteeism rate; laboratory-confirmed respiratory tract and gastrointestinal infections	RCTs

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
						Secondary: Hospital admissions due respiratory tract and/ or gastrointestinal infections; knowledge, attitudes, beliefs or behaviours about hand hygiene among children and/or staff working with them	
IMPLEMENTATION REVIEWS							
Frerichs 2016 *(85)*	Child and youth participatory interventions for addressing lifestyle-related childhood obesity: a systematic review	To identify to identify child and youth participatory interventions in the peer-reviewed literature in order to characterize the approaches and examine their impact on obesity and obesity-related lifestyle behaviours	Children and adolescents aged 5–18 or above (up to college-age)	School- and community-based healthy-lifestyle interventions which involved children and youth in participatory roles in their implementation	Pre-intervention control group	Primary: Weight; physical activity; dietary change Secondary: Not specified	Individual RCTs; cluster RCTs; controlled before-and-after studies
Schaap 2018 *(86)*	Measuring implementation fidelity of school-based obesity prevention programmes: a systematic review	To: 1) identify which fidelity components have been measured in school-based obesity prevention programmes; 2) identify how fidelity components have been measured; and 3) score the quality of these methods	Children and adolescents aged 4–18 years	School-based programmes that target obesity (through nutrition and/or physical activity interventions) for which at least one component of fidelity implementation was measured	Not specified	Primary: Implementation fidelity measures (e.g. dose, responsiveness, adherence, quality of delivery)[c] Secondary: Not specified	Studies evaluating implementation fidelity using quantitative methods (i.e. questionnaires, observations, structured interviews or logbooks)

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
IMPLEMENTATION REVIEWS							
Wolfenden 2017 *(87)*	Strategies for enhancing the implementation of school-based policies or practices targeting risk factors for chronic disease (Review)	To examine the effectiveness of strategies aiming to improve the implementation of school-based policies, programmes or practices to address child diet, physical activity, obesity, tobacco or alcohol use	Childrena and adolescents aged 5–18 years	School-based interventions aimed at improving the implementation of policies, programmes or practices in a school setting which target healthy eating, physical activity, obesity prevention, tobacco or alcohol prevention (or combination of)	Parallel group without intervention	Primary: Objectively or subjectively (self-reported) assessed measure of school policy, programme or practice implementation (e.g. partial/complete uptake consistent with protocol/design) Secondary: Measures of health behaviours or risk factors relevant to policies, programmes, or practices being implemented; any measure of school staff knowledge, skills or attitudes related to the implementation of policies, programmes or practices supportive of diet, physical activity, or healthy weight, or tobacco or alcohol use prevention; estimates of absolute costs or any assessment of the cost- effectiveness of strategies to improve implementation of policies, programmes or practices in schools; any reported unintended adverse consequences	RCTs; cluster RCTs; quasi-RCTs; cluster quasi-RCTs; controlled before-and-after studies; cluster controlled before-and-after studies

Study ID	Title	Aim	Population	Interventions	Comparator groups	Outcomes (primary & secondary)	Eligible study designs
						of a strategy to improve implementation of policies, programmes or practices in schools	

BMI, body mass index; HPS, health promoting schools; ICT, information and communication technologies; NCD, noncommunicable disease; non-RCTs,non-randomised controlled trials; RCTs, randomized controlled trials;

[a] Waters E, de Silva-Sanigorski A, Burford BJ, Brown T, Campbell KJ, Gao Y et al. Interventions for preventing obesity in children. Cochrane Database of Syst Rev. 2011: CD001871.

[b] Kamath CC, Vickers KS, Ehrlich A, McGovern L, Johnson J, Singhal V et al. Clinical review: behavioral interventions to prevent childhood obesity: a systematic review and metaanalyses of randomized trials. J Clin Endocrinol Metab. 2008;93(12):4606–15. doi: 10.1210/jc.2006-2411.

[c] Used fidelity measures previously defined by Dusenbury L, Brannigan R, Falco M, Hansen WB. A review of research on fidelity of implementation: implications for drug abuse prevention in school settings. Health Educ Res. 2003;18(2):237–56.

Annex 3. Characteristics of excluded studies

Study ID (author & year)	Title	Reason for exclusion
Aaron 2015	Multiple-micronutrient fortified non-dairy beverage interventions reduce the risk of anemia and iron deficiency in school-aged children in low-middle income countries: a systematic review and meta-analysis	Review did not include any school-based interventions (wrong intervention)
Adolphus 2013	The effects of breakfast on behaviour and academic performance in children and adolescents	Review did not complete risk of bias/quality assessment (wrong study design)
Adolphus 2016	The effects of breakfast and breakfast composition on cognition in children and adolescents: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Alan 2013	Elementary school personnel's perceptions of and recommendations for managing child obesity: a naturalistic study	Review did not include school-based interventions (wrong intervention)
Aliyar 2015	A review of nutritional guidelines and menu compositions for school feeding programmes in 12 countries	Review did not complete risk of bias/quality assessment (wrong study design)
Aloia 2016	Pertinence of the recent school-based nutrition interventions targeting fruit and vegetable consumption in the United States: a systematic review	Review only used one database for search (wrong study design)
An 2012	Effectiveness of subsidies in promoting healthy food purchases and consumption: a review of field experiments	Review did not complete risk of bias/quality assessment (wrong study design)
Ashton 2019	Effectiveness of interventions and behaviour change techniques for improving dietary intake in young adults: a systematic review and meta-analysis of RCTs	Review included participants 17 to 35 years old (wrong participants)
Barco Leme 2019	Brazilian children's dietary intake in relation to Brazil's new nutrition guidelines: a systematic review	Review did not include any school-based studies (wrong intervention)
Berezowitz 2015	School gardens enhance academic performance and dietary outcomes in children	Review did not complete risk of bias/quality assessment (wrong study design)
Bhatnagar 2014	Food marketing to children in India: comparative review of regulatory strategies across the world	Study is an editorial/literature review article (wrong study design)
Bonell 2013	The effects on student health of interventions modifying the school environment: systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Bonell 2013	Systematic review of the effects of schools and school environment interventions on health: evidence mapping and synthesis	Study is a mapping review (wrong study design)
Bonell 2013	The effects of the school environment on student health: A systematic review of multi-level studies	Review included studies with only psycho-social outcomes (wrong intervention)
Bourke 2014	Are dietary interventions effective at increasing fruit and vegetable consumption among overweight children? A systematic review	Review did not include any school-based interventions (wrong intervention)
Boyl 2016	Advertising as a cue to consume: a systematic review and meta-analysis of the effects of acute exposure to unhealthy food and non-alcoholic beverage advertising on intake in children and adults	Review did not include school-based interventions (wrong intervention)

Study ID (author & year)	Title	Reason for exclusion
Brackney 2014	Prevention of type 2 diabetes among youth: a systematic review, implications for the school nurse	Review only used one database for search (wrong study design)
Brand 2014	What works in community-based interventions promoting physical activity and healthy eating? A review of reviews	Review assessed the effectiveness of community-based interventions and it was not possible to separate out data on school-based interventions (wrong intervention)
Brannon 2014	A systematic review: Is there an app for that? Translational science of paediatric behaviour change for physical activity and dietary interventions	Review did not include school-based interventions (wrong intervention)
Branscum 2012	After-school based obesity prevention interventions: A comprehensive review of the literature	Review did not complete risk of bias/quality assessment (wrong study design)
Brennan 2014	Childhood obesity policy research and practice evidence for policy and environmental strategies	Review did not complete risk of bias/quality assessment and includes systematic reviews as well as primary studies (wrong study design)
Brooks 2014	Adolescent food literacy programmes: A review of the literature	Review did not complete risk of bias/quality assessment (wrong study design)
Busch 2013	Changing multiple adolescent health behaviour's through school-based interventions: a review of the literature	Study is an editorial/literature review article (wrong study design)
Casemiro 2014	Promoting health in school: reflections based on a review of school health in Latin America	Study is an editorial/literature review article (wrong study design)
Cesar 2016	School Food in Brazil and the United States: an integrative review	Non-English publication
Chae 2017	TEACH Kitchen: A chronological review of accomplishments	Study is not a systematic review (wrong study design)
Chambers 2015	Reducing the volume, exposure and negative impacts of advertising for foods high in fat, sugar and salt to children: A systematic review of the evidence from statutory and self-regulatory actions and educational measures	Review did not include any school-based interventions (wrong intervention)
Chau 2018	The use of social media in nutrition interventions for adolescents and young adults — A systematic review	Review did not include any school-based interventions (wrong intervention)
Chriqui 2013	Obesity prevention policies in U.S. states and localities: Lessons from the field	Study is an editorial/literature review article (wrong study design)
Chriqui 2014	Influence of school competitive food and beverage policies on obesity, consumption, and availability: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Chung 2017	The influence of peers on diet and exercise among adolescents: a systematic review	Review assessed the association of peer behaviour with adolescent diet and exercise interventions (wrong intervention)
Clarke 2013	The views of stakeholders on the role of the primary school in preventing childhood obesity: a qualitative systematic review	Study is a qualitative systematic review (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Clasen 2015	Interventions to improve water quality for preventing diarrhoea (Review)	Review did not include any school-based interventions (wrong intervention)
Collins 2013	Effectiveness of parent-centred interventions for the prevention and treatment of childhood overweight and obesity in community settings: a systematic review	Review did not include any school-based interventions (wrong intervention)
Colquitt 2016	Diet, physical activity, and behavioural interventions for the treatment of overweight or obesity in preschool children up to the age of 6 years	Review included participants ≥ 6 years old (wrong participants)
Coufopoulous 2013	Interventions to improve nutrition and nutrition related health amongst homeless mothers and their children: a systematic review	Review included mothers as participants (wrong participants)
Coughlin 2017	Community-based participatory research to promote healthy diet and nutrition and prevent and control obesity among African Americans: A literature review	Study is an editorial/literature review article (wrong study design)
Curran 2016	School-based positive youth development: a systematic review of the literature	Review included positive youth development interventions with psychosocial-social outcomes (wrong intervention)
Dangour 2013	Can nutrition be promoted through agriculture-led food price policies? A systematic review	Review did not include school-based policies (wrong intervention)
Darfour-Oduro 2018	Review of policies to increase fruit and vegetable consumption and physical activity in 49 low- and middle-income countries	Review did not complete risk of bias/quality assessment (wrong study design)
de Alcântara 2019	Digital technologies for promotion of healthy eating habits in teenagers	Review did not include school-based interventions (wrong intervention)
De Buck 2017	Approaches to promote handwashing and sanitation behaviour change in low- and middle-income countries: a mixed method systematic review	Review did not include school-based interventions (wrong intervention)
de Melo Boff 2016	Weight loss interventions for overweight and obese adolescents: a systematic review	Review did not include school-based interventions (wrong intervention)
DeCosta 2017	Changing children's eating behaviour– a review of experimental research	Review did not complete risk of bias/quality assessment (wrong study design)
Dixon 2012	Elementary school personnel's perceptions of and recommendations for managing child obesity: A naturalistic study	Study is editorial/literature review article (wrong study design)
Dunn 2019	A systematic review and content analysis of classroom teacher professional development in nutrition education programmes	Review included teachers as participants (wrong participants)
Dwyer 2015	Promoting family meals: a review of existing interventions and opportunities for future research	Review did not include school-based interventions (wrong intervention)
Eid 2018	Child nutrition programmes in kindergarten schools implemented by the governmental sector and global nutrition consulting companies: A systematic review	Study is not a systematic review (wrong study design)
Everson-Hock 2013	Community-based dietary and physical activity interventions in low socioeconomic groups in the UK: A mixed methods systematic review	Review did not include school-based interventions (wrong intervention)

Study ID (author & year)	Title	Reason for exclusion
Ewart-Pierce 2016	Using mobile apps to promote a healthy lifestyle among adolescents and students: a review of the theoretical basis and lessons learned	Review did not complete risk of bias/quality assessment (wrong study design)
Friedrich 2012	Effect of interventions on the body mass index of school-age students	Review did not complete risk of bias/quality assessment (wrong study design)
Ganann 2012	Community-based interventions for enhancing access to or consumption of fruit and vegetables among five to 18-year olds: a scoping review	Study is a scoping review (wrong study design)
Garcia 2016	Urban gardens and build of environments promoters of healthy eating	Study is an editorial/literature review article (wrong study design)
Girum 2018	The effect of deworming school children on anemia prevalence: a systematic review and meta-analysis	Review did not complete risk of bias/quality assessment (wrong study design)
Godin	Examining guidelines for school-based breakfast programmes in canada: a systematic review of the grey literature	Review did not complete risk of bias/quality assessment (wrong study design)
Gordon 2018	Healthier choices in school cafeterias: a systematic review of cafeteria interventions	Review did not complete risk of bias/quality assessment (wrong study design)
Gorga 2016	School and family-based interventions for promoting a healthy lifestyle among children and adolescents in Italy: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Graziose 2018	Factors related to fruit and vegetable consumption at lunch among elementary students: a scoping review	Study is a scoping review (wrong study design)
Griebler 2017	Effects of student participation in school health promotion: a systematic review	Review assessed the effects of student participation in designing, planning, implementing and/or evaluating school health promotion measures (wrong intervention)
Guerra 2013	The effect of school-based physical activity interven- tions on body mass index: a meta-analysis of randomized trials	Review assessed school-based physical activity interventions that did not contain nutrition components (wrong intervention)
Guerra 2014	School-based physical activity and nutritional education interventions on body mass index: A meta-analysis of randomised community trials — Project PANE	Review did not complete risk of bias/quality assessment (wrong study design)
Hackman 2014	Theory of reasoned action and theory of planned behaviour-based dietary interventions in adolescents and young adults: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Haddad 2018	Food consumption pattern and physical activity level among adolescents from families in diverse social strata: Systematic literature review and analysis of data of the National School Health Survey	Review did not include school-based interventions (wrong intervention)

Study ID (author & year)	Title	Reason for exclusion
Hale 2014	A systematic review of effective interventions for reducing multiple health risk behaviour's in adolescence	Review included interventions that prevented health risk behaviours (i.e. tobacco use, alcohol use, illicit drug use, risky sexual behaviour, aggressive acts) (wrong intervention)
Harriger 2014	Assessment of school wellness policies implementation by benchmarking against diffusion of innovation framework	Review did not complete risk of bias/quality assessment (wrong study design)
Hernandez-Garbanzo 2013	Psychosocial measures used to assess the effectiveness of school-based nutrition education programmes: review and analysis of self-report instruments for children 8 to 12 years old	Review assessed psychometric properties of evaluation instruments that measure mediators of dietary behaviours in school-aged children (wrong intervention)
Hillier-Brown 2014	A systematic review of the effectiveness of individual, community and societal level interventions at reducing socioeconomic inequalities in obesity amongst children	Review did not complete risk of bias/quality assessment (wrong study design)
Hollands 2019	Altering the availability or proximity of food, alcohol, and tobacco products to change their selection and consumption (Review)	Review included participants ≥ 18 years old (wrong participants)
Hopkins 2015	A historical review of changes in nutrition standards of usda child meal programmes relative to research findings on the nutritional adequacy of programme meals and the diet and nutritional health of participants: implications for future research and the Summer Food Service Programme	Study is an editorial/literature review article (wrong study design)
Huelskamp 2018	Enhancing the health of school garden programmes and youth: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Hung 2014	Understanding of factors that enable health promoters in implementing health-promoting schools: A systematic review and narrative synthesis of qualitative evidence	Review assessed the efficacy of strategies used by health promoters to implement school-based interventions (wrong intervention)
Hung 2015	A meta-analysis of school-based obesity prevention programmes demonstrates limited efficacy of decreasing childhood obesity	Review did not complete risk of bias/quality assessment (wrong study design)
Hyseni 2017	Systematic review of dietary salt reduction policies: Evidence for an effectiveness hierarchy?	Review assessed the evidence on the effectiveness of possible salt reduction interventions (wrong study design)
Jamal 2013	The school environment and student health: a systematic review and meta-ethnography of qualitative research	Review included only qualitative studies (wrong study design)
Jamal 2014	Consulting with young people to inform systematic reviews: an example from a review on the effects of schools on health	Study is an editorial/literature review article (wrong study design)
Jasper 2012	Water and sanitation in schools: a systematic review of the health and educational outcomes	Review did not complete risk of bias/quality assessment (wrong study design)
Joshi 2013	Impact of water, sanitation, and hygiene interventions on improving health outcomes among school children	Review did not complete risk of bias/quality assessment (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Jourdan 2016	The involvement of young people in school- and community-based noncommunicable disease prevention interventions: a scoping review of designs and outcomes	Study is a scoping review (wrong study design)
Kagie 2019	A pragmatic review to assist planning and practice in delivering nutrition education to indigenous youth	Review did not complete risk of bias/quality assessment (wrong study design)
Kase 2017	Educational outcomes associated with school behavioural health interventions: a review of the literature	Study is an editorial/literature review article (wrong study design)
Ke 2015	Food insecurity and hunger: A review of the effects on children's health and behaviour	Study is an editorial/literature review article (wrong study design)
Kelishadi 2014	Controlling childhood obesity: A systematic review on strategies and challenges	Review did not complete risk of bias/quality assessment (wrong study design)
Kessler 2016	Simple interventions to improve healthy eating behaviours in the school cafeteria	Review did not complete risk of bias/quality assessment (wrong study design)
Khambalia 2011	A synthesis of existing systematic reviews and meta-analyses of school-based behavioural interventions for controlling and preventing obesity	Review did not complete risk of bias/quality assessment (wrong study design)
Kirkland 2018	School-based nutrition and garden programmes and parental dietary changes in low-income settings: a review	Review did not complete risk of bias/quality assessment (wrong study design)
Kirkpatrick 2018	Gaps in the evidence on population interventions to reduce consumption of sugars: A review of reviews	Review did not complete risk of bias/quality assessment and included systematic reviews as well as primary studies (wrong study design)
Knowlden 2013	Systematic review of school-based obesity interventions targeting African american and Hispanic children	Review did not complete risk of bias/quality assessment (wrong study design)
Kraak 2012	Government and school progress to promote a healthful diet to American children and adolescents: a comprehensive review of the available evidence	Review did not complete risk of bias/quality assessment (wrong study design)
Kraak 2013	Addressing barriers to improve children's fruit and vegetable intake	Study is an editorial/literature review article (wrong study design)
Krishnaswami 2012	Community-engaged interventions on diet, activity, and weight outcomes in US schools: A systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Kula 2016	Effectiveness of combined interventions for the prevention of overweight for children and youths : A systematic review	Non-English publication
Lane 2016	A systematic review to assess sugar-sweetened beverage interventions for children and adolescents across the socioecological model	Review did not complete risk of bias/quality assessment (wrong study design)
Langellotto 2012	Gardening increases vegetable consumption in school-aged children: a meta-analytical synthesis	Review did not complete risk of bias/quality assessment (wrong study design)
Langford 2015	Obesity prevention and the Health Promoting Schools framework: Essential components and barriers to success	Review did not complete risk of bias/quality assessment (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Larson	Policies with the potential to impact disparities in US child-care settings? A narrative review and call for surveillance and evaluation efforts	Review included participants ≥ 6 years old (wrong participants)
Lavelle 2012	Systematic review and meta-analysis of school-based interventions to reduce body mass index	Review did not complete risk of bias/quality assessment (wrong study design)
Lawson 2012	Impact of school feeding programmes on educational, nutritional, and agricultural development goals: a systematic review of literature	Review did not complete risk of bias/quality assessment (wrong study design)
Lee 2016	A systematic review and meta-analysis of intervention for paediatric obesity using mobile technology	Review did not include school-based interventions (wrong intervention)
Leroy 2012	The impact of daycare programmes on child health, nutrition and development in developing countries: a systematic review	Review included participants ≥ 6 years old (wrong participants)
Levine 2019	Prevention of eating disorders: 2018 in review	Study is an editorial/literature review article (wrong study design)
Lineberry 2014	The role and impact of nurses in American elementary schools: a systematic review of the research	Review assessed the efficacy of school nursing activities in elementary schools (wrong intervention)
Luecking 2017	Social marketing approaches to nutrition and physical activity interventions in early care and education centres: a systematic review	Review included participants 2 to 5 years old (wrong participants)
Mancipe Navarrete 2015	Effectiveness of educational interventions conducted in Latin America for the prevention of overweight and obesity in scholar children from 6–17 years old: a systematic review	Non-English publication
Martin 2014	Lifestyle intervention for improving school achievement in overweight or obese children and adolescents	Review did not include school-based interventions (wrong intervention)
Mazarello Paes 2015	Determinants of sugar-sweetened beverage consumption in young children: a systematic review	Review included participants ≥ 6 years old (wrong participants)
McGinnis 2017	A systematic review: Costing and financing of Water, Sanitation, and Hygiene (WASH) in Schools	Review described the current knowledge around the costs of WASH components as well as financing models for schools (wrong intervention)
McIsaac 2016	Interventions to support system-level implementation of health promoting schools: a scoping review	Study is a scoping review (wrong study design)
McIsaac 2019	Factors influencing the implementation of nutrition policies in schools: a scoping review	Study is a scoping review (wrong study design)
McKinnon 2016	Obesity-related policy/environmental interventions: a systematic review of economic analyses	Review did not complete risk of bias/quality assessment (wrong study design)
McMichael 2019	Water, Sanitation and Hygiene (WASH) in schools in low-income countries: a review of evidence of impact	Review did not complete risk of bias/quality assessment (wrong study design)
Medeiros 2018	Studies evaluating of health interventions at schools: an integrative literature review	Review did not complete risk of bias/quality assessment (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Mukamana 2016	What is known about school-based interventions for health promotion and their impact in developing countries? A scoping review of the literature	Study is a scoping review (wrong study design)
Murimi 2018	Factors that contribute to effective nutrition education interventions in children: a systematic review	Review did carry out risk of bias assessment (wrong study design)
Mutschler 2018	Realist-informed review of motivational interviewing for adolescent health behaviours	Review sought to understand how, for whom, and under what circumstances motivational interviewing works for adolescent health behaviour change (wrong intervention)
Newton 2019	A systematic review of tools measuring nutrition knowledge of pre-adolescents and adolescents in a school-based setting	Review did not include school-based interventions (wrong intervention)
Niebylski 2014	Healthy food procurement policies and their impact	Review did not complete risk of bias/quality assessment (wrong study design)
Nigg 2016	A review of promising multicomponent environmental child obesity prevention intervention strategies by the Children's Healthy Living Programme	Review did not include school-based interventions (wrong intervention)
Oddo 2018	Potential interventions targeting adolescent nutrition in Indonesia: a literature review	Review did not complete risk of bias/quality assessment (wrong study design)
Oeralta 2015	Teaching healthy eating to elementary school students: a scoping review of nutrition education resources	Review did not complete risk of bias/quality assessment (wrong study design)
Oosterhoff 2018	A systematic review on economic evaluations of school-based lifestyle T interventions targeting weight-related behaviours among 4–12 year olds: Issues and ways forward	Review examined and discussed the key aspects in the design of economic evaluations on school-based interventions (wrong intervention)
Peralta 2016	Teaching healthy eating to elementary school students: a scoping review of nutrition education resources	Study did not perform risk of bias assessment (wrong study design)
Pedraza 2018	Evaluation of the National School Food Programme: review of the literature	Review did not complete risk of bias/quality assessment (wrong study design)
Perez Cueto 2011	Assessment of evaluations made to healthy eating policies in Europe: A review within the EATWELL Project	Published before 2012
Pérez-López 2015	Effects of school-based physical activity and nutrition programmes in spanish adolescents: systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Pollick 2013	Salt fluoridation: a review	Study is an editorial/literature review article (wrong study design)
Pratt 2017	A Systematic Review of Obesity Disparities Research	Review did not complete risk of bias/quality assessment (wrong study design)
Price 2017	Nutrition education and body mass index in grades k-12: a systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Prowse 2017	Food marketing to children in Canada: a settings-based scoping review on exposure, power and impact	Study is a scoping review (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Pucher 2012	School health promotion interventions targeting physical activity and nutrition can improve academic performance in primary- and middle school children	Review did not complete risk of bias/quality assessment (wrong study design)
Qutteina 2019	Media food marketing and eating outcomes among pre-adolescents and adolescents: a systematic review and meta-analysis	Review did not include school-based interventions (wrong intervention)
Racey 2016	Systematic review of school-based interventions to modify dietary behaviour: does intervention intensity impact effectiveness?	Review did not complete risk of bias/quality assessment (wrong study design)
Ran 2016	Economic evaluation of school-based health centres: a community guide systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Ramos 2013	Food and nutrition education in school: a literature review	Non-English publication
Randev 2018	Vitamin D supplementation in childhood – A review of guidelines	Review did not include school-based interventions (wrong intervention)
Reeves 2012	School toilets: facilitating hand hygiene? A review of primary school hygiene facilities in a developed country	Study is an editorial/literature review article (wrong study design)
Ribeiro de Vasconcelos 2018	Educational interventions in the promotion of health eating in schools	Study is an editorial/literature review article (wrong study design)
Robinson 2014	Effectiveness of pre-school- and school-based interventions to impact weight-related behaviours in African American children and youth: a literature review	Review did not complete risk of bias/quality assessment (wrong study design)
Ruggieri 2014	A comprehensive review of school-based body mass index screening programmes and their implications for school health: do the controversies accurately reflect the research?	Review did not complete risk of bias/quality assessment (wrong study design)
Santillana Marín 2013	Programmes aimed to increase the nutritional content of lunch packs; systematic review	Non-English publication
Schober 2013	The reporting of fidelity measures in primary prevention programmes for eating disorders in schools	Review assessed the effectiveness of interventions for primary prevention for eating disorders (wrong intervention)
Seward 2017	Factors that influence the implementation of dietary guidelines regarding food provision in centre based childcare services: a systematic review	Review included participants ≥ 18 years old (wrong participants)
Shirley 2015	Combinations of obesity prevention strategies in US elementary schools: a critical review	Study is an editorial/literature review article (wrong study design)
Silden 2018	Impact of competitive foods in public schools on child nutrition: effects on adolescent obesity in the United States an integrative systematic literature review	Review did not complete risk of bias/quality assessment (wrong study design)
Sisson 2016	Obesity prevention and obesogenic behaviour interventions in child care: a systematic review	Review included participants 3 to 5 years old (wrong participants)
Stephens 2015	K-12 school food service staff training interventions: a review of the literature	Review did not complete risk of bias/quality assessment (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Tanskey 2018	The State of the Summer: a review of child summer weight gain and efforts to prevent it	Review did not include school-based interventions (wrong intervention)
Tremblay 2012	Major initiatives related to childhood obesity and physical inactivity in canada: the year in review	Study is an editorial/literature review article (wrong study design)
Tugault-Lafleur 2017	A systematic review of methods to assess children's diets in the school context	Review assessed the accuracy and reliability of dietary assessment methods used in the school context (wrong intervention)
Ty 2012	Impact of school feeding programmes on educational, nutritional, and agricultural development goals: a systematic review of literature	Study is an editorial/literature review article (wrong study design)
Valentine 2019	Families and Schools Together (FAST) for improving outcomes for children and their families (Review)	Review assessed the effectiveness of the Families and Schools Together (FAST) programme in improving outcomes among children and their families (wrong intervention)
Vasques 2014	Effects of intervention programmes on child and adolescent BMI: a meta-analysis study	Review did not complete risk of bias/quality assessment (wrong study design)
Velazquez 2017	Food and beverage marketing in schools: a review of the evidence	Review examined current approaches for measuring school food and beverage marketing practices (wrong intervention)
Verloigne 2012	Family- and school-based correlates of energy balance-related behaviours in 10–12-year-old children: a systematic review within the ENERGY (EuropeaN Energy balance Research to prevent excessive weight Gain among Youth) project	Review did not complete risk of bias/quality assessment (wrong study design)
Verrotti 2014	Childhood obesity: prevention and strategies of intervention. A systematic review of school-based interventions in primary schools	Review did not complete risk of bias/quality assessment (wrong study design)
Ward 2016	Strength of obesity prevention interventions in early care and education settings: a systematic review	Review included studies conducted in preschool or childcare settings with all participants ≥ 6 years old (wrong participants)
Watson 2017	Does targeting children with hygiene promotion messages work? The effect of handwashing promotion targeted at children, on diarrhoea, soil-transmitted helminth infections and behaviour change, in low- and middle-income countries	Review did not include school-based interventions (wrong intervention)
Weaver 2011	A conceptual model for training after-school programme staffers to promote physical activity and nutrition	Review included after-school personnel as participants (wrong participants)
Weihrauch-Blüher 2018	Current guidelines for obesity prevention in childhood and adolescence	Review did not complete risk of bias/quality assessment (wrong study design)

Study ID (author & year)	Title	Reason for exclusion
Welch 2017	Mass deworming to improve developmental health and wellbeing of children in low-income and middle-income countries: a systematic review and network meta-analysis	Review assessed the effects of mass deworming for soil-transmitted helminths on growth, educational achievement, cognition, school attendance, quality of life, and adverse effects in children in endemic helminth areas (wrong intervention)
Wheaton 2016	School start times, sleep, behavioural, health, and academic outcomes: a review of the literature	Review assessed the association between school start times, sleep, and other outcomes among adolescent students (wrong intervention)
Wolf 2018	Effectiveness of obesity intervention programmes based on guidelines for adolescent students: systematic review	Review did not complete risk of bias/quality assessment (wrong study design)
Wolfenden 2016	Strategies to improve the implementation of healthy eating, physical activity and obesity prevention policies, practices or programmes within childcare services	Review included participants ≥ 6 years old (wrong participants)
Wu 2013	Future research needs for childhood obesity prevention programmes	Study is an editorial/literature review article (wrong study design)
Wu 2015	Is the balanced school day truly balanced? A review of the impacts on children, families, and school food environments	Study is an editorial/literature review article (wrong study design)
Wu 2019	The influence of diet quality and dietary behaviour on health-related quality of life in the general population of children and adolescents: a systematic review and meta-analysis	Review did not include school-based interventions (wrong intervention)
Yager 2013	What works in secondary schools? A systematic review of classroom-based body image programmes	Review did not complete risk of bias/quality assessment (wrong study design)
Yakoob 2017	Nutrition (micronutrients) in child growth and development: a systematic review on current evidence, recommendations and opportunities for further research	Review did not complete risk of bias/quality assessment (wrong study design)
Yip 2016	Peer-led nutrition education programmes for school-aged youth: a systematic review of the literature	Review did not complete risk of bias/quality assessment (wrong study design)
Zheng 2015	Substitution of sugar-sweetened beverages with other beverage alternatives: a review of long-term health outcomes	Review did not include school-based interventions (wrong intervention)
Zhou 2014	Childhood obesity prevention interventions in childcare settings: systematic review of randomized and nonrandomized controlled trials	Review included participants ≤ 6 years old (wrong participants)

Annex 4. Systematic reviews awaiting assessment

Systematic reviews deemed potentially eligible for inclusion, but for which the full-texts could not be accessed at the time of writing are listed below.

No.	Citation
1	Ajie WN, Chapman-Novakofki KM. Impact of computer-mediated nutrition education interventions in adolescents: A systematic review. J Adolesc Health. 2014;54(6):631–45. doi: 10.1016/j.jadohealth.2013.12.019.
2	Canella D, Q., J.; oni, D. Scientific production of the national school food programme in Brazil: a systematic review. Ann Nutr Metabol. 2017;315.
3	Cardoso C, F., Matheus Pintanel; Rombaldi, Airton J. School-based interventions to promote a healthy life style among elementary school students: a systematic review. Rev. Bras. Ciênc. Saúde. 2016; 20(3):247–252.
4	Colley P, Myer B, Seabrook J, Gilliland J. The Impact of Canadian school food programmes on children's nutrition and health: a systematic review. Can J Diet Pract Res. 2019; 80(2):79–86. doi: 10.3148/cjdpr-2018-037.
5	Dute DJ, Bemelmans WJE, Breda J. Using mobile apps to promote a healthy lifestyle among adolescents and students: a review of the theoretical basis and lessons learned. JMIR Mhealth Uhealth. 2016;4(2):e39. doi: 10.2196/mhealth.3559.
6	Godin K, Leatherdale ST, Elton-Marshall T. A systematic review of the effectiveness of school-based obesity prevention programmes for First Nations, Inuit and Metis youth in Canada. Clin Obes. 2015;5(3):103–115. doi.org/10.1111/cob.12099.
7	Markova AI. [Health promoting schools and health of schoolchildren (analytical review)]. Gig Sanit. 2013;May-Jun(3):60–66. In Russian.
8	Micha R, Bakogianni I, Karageorgou D, Trichia E, Shulkin ML, Shangguan S et al. Effectiveness of school procurement policies for improving dietary behaviours: A systematic review and meta-analysis. Circulation. 2016;133(Suppl. 1): Abstract MP89.
9	Park JJ, Bakhet R, Karl D, Yuan F, Lonn E. Effects of school-based interventions on body mass index in children and adolescents: A systematic overview and meta-analysis. Circulation. 2014;130(Suppl. 2):Abstract 17944.
10	Rausch Herscovici C, Kovalskys I. Childhood obesity. A review of school-based preventive interventions. Rev Mex Trastor Aliment {Mex J Eating Dosorders]. 2015;6(2):143–151. DOI: 10.1016/j.rmta.2015.10.006
11	Thury C, Melo de Matos CV. Prevention of childhood obesity: a review of the current guidelines and supporting evidence. S D Med. 2015;Spec No.:18–23.
12	Welch VA, Ghogomu E, Hossain A, Awasthi S, Bhutta Z, Cumberbatch C et al. Deworming and adjuvant interventions for improving the developmental health and well-being of children in low- and middle-income countries. Campbell Systematic Reviews. 2016;12(1):1–376. doi.org/10.4073/csr.2016.7
13	Wang Y, Wu Y, Wilson RF, Bleich S, Cheskin L, Weston C et al. Childhood obesity prevention programs: comparative effectiveness review and meta-analysis [Internet]. Rockville, MD: Agency for Healthcare Research and Quality (US); 2013 (Report No.: 13-EHC081-EF. PMID: 23865092).
14	Williams J, Scarborough P, Matthews A, Cowburn G, Foster C, Roberts N et al. A systematic review of the influence of the retail food environment around schools on obesity-related outcomes. Obes Rev, 2014;15(5): 359–74. doi: 10.1111/obr.12142.

No.	Citation
15	Wu Y, Brandyn LD, Bleich S, Cheskin L, Boult C, Segal JB et al. Future research needs for childhood obesity prevention programs. Future Research Needs Papers, Number 31. Rockville, MD: Agency for Healthcare Research and Quality (US); 2013 (AHRQ Publication No. 13-EHC036-EF; https://effectivehealthcare.ahrq.gov/sites/default/files/pdf/child-obesity-future_research.pdf, accessed 26 February 2021).
16	Community-based programs to improve early childhood health outcomes. Guidelines and Recommendations Ottawa, ON: Canadian Agency for Drugs and Technologies in Health; 2013 (CADTH Rapid Response Reports; https://www.cadth.ca/community-based-programs-improve-early-childhood-health-outcomes-guidelines-and-recommendations, accessed 24 February 2021).

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