



Research Article

Investigating differential effects of interventions to prevent obesity in children and young people: a novel analytic framework

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Published October 2025

DOI: 10.3310/QLPD8523

Abstract

Background: Recent systematic reviews and meta-analyses on the effects of interventions to prevent obesity in children aged 5–18 years identified over 200 randomised trials. Interventions targeting diet, activity (including physical activity and sedentary behaviours) and both diet and activity appear to have small but beneficial effects on average. However, these effects varied between studies and might be explained by variation in characteristics of the interventions, for example, by the extent to which the children enjoyed the intervention or whether they aim to modify behaviour through education or physical changes to the environment. Here we develop a novel analytic framework to identify key intervention characteristics considered likely to explain differential effects.

Objectives: To describe the development of the analytic framework, including the involvement of school-aged children, parents, teachers and other stakeholders, and to present the content of the finalised analytic framework and the results of the coding of the interventions.

Design and methods: We first conducted a literature review to find out from the existing literature what different types of characteristics of interventions we should be thinking about and why. This information helped us to develop a comprehensive map (called a logic model) of these characteristics. We then used this logic model to develop a list of possible intervention characteristics. We held a series of workshops with children, parents, teachers and public health professionals to refine the list into a coding scheme. We then used this to code the characteristics of each intervention in all the trials which aimed to prevent obesity in children aged 5–18 years.

Findings: Our finalised analytic framework included 25 questions across 12 characteristics. These addressed aspects such as the setting of the intervention (e.g. at school, at home or in the community), mode of delivery (e.g. to individuals or to groups of children), whether the intervention targeted diet and/or activity, complexity (e.g. focused on a single swap of juice for water or aimed to change all aspects of the diet), intensity, flexibility, choice, mechanism of action (e.g. through participation, education, change in the social environment, change in the physical environment), resonance (e.g. credibility of the person delivering the intervention), commercial involvement and the ‘fun factor’ (as perceived by children). We coded 255 interventions from 210 randomised trials.

Conclusions: Our evidence-based analytic framework, refined by consulting with stakeholders, allowed us to code 255 interventions aiming to prevent obesity in children aged 5–18 years. Our confidence in the validity of the

framework and coding results is increased by our rigorous methods and, especially, the involvement of children at multiple stages.

Future work: Future work will include the development of statistical methods for the synthesis and its application to the data coded according to the analytic framework.

Limitations: The coding results depend on the level of detail provided to describe the interventions, and the applicability of the analytic framework may be limited by demographic profile of the children and young people involved in the project.

Funding: This article presents independent research funded by the National Institute for Health and Care Research (NIHR) Public Health Research programme as award number NIHR131572.

A plain language summary of this research article is available on the NIHR Journals Library Website <https://doi.org/10.3310/QLPD8523>.

Background

Population levels of overweight and obesity in childhood are a significant global challenge.¹ From 1990 to 2022, age-standardised prevalence of obesity increased in girls in 186 countries (93%) and in boys in 195 countries (98%); in most countries, obesity more than doubled.² Children and adolescents living with obesity are more likely to experience reduced health-related quality of life and, for adolescents, a number of comorbidities, including type 2 diabetes mellitus, fatty liver disease and depression.³

We recently conducted two systematic reviews and meta-analyses of over 200 randomised trials of interventions aimed at preventing obesity in children and young people (CYP) aged 5–11 and 12–18 years, respectively.^{4,5} Within each age group, we performed meta-analyses of body mass index (BMI), age and sex standardised BMI and BMI percentile results, comparing interventions targeting diet, activity (including physical activity and sedentary behaviour) or a combination of both. Our findings suggest that activity interventions, alone or in combination with dietary interventions, can have a modest beneficial effect on obesity. However, there was evidence of substantial statistical heterogeneity (i.e. effects that varied substantially from study to study) in 26 of 54 primary analyses. Pre-specified subgroup analyses by the main setting of the intervention (school, home, school and home, other), country income status (high vs. non-high), participants' socioeconomic status (SES) (low vs. mixed) and duration of the intervention (short vs. long; age group 5–11 studies only) did not sufficiently explain the heterogeneity among the studies.

This heterogeneity is likely to be due in part to variation among the interventions within each category (dietary, activity and combined), since the interventions examined varied notably in nature, setting, complexity, delivery, intensity and duration. Variation in results will also arise from differences in the participants, and potentially because of different biases in the studies. These sources of heterogeneity not only present a statistical problem but

also pose challenges for decision-making and for planning future studies. The work described in this paper arose from our desire to investigate the heterogeneity across the substantial body of evidence containing over 200 randomised trials. A protocol for the project was posted in advance on the funder's website (<https://fundingawards.nihr.ac.uk/award/NIHR131572>).

We sought to develop a strategy for examining features of the interventions that might be associated with greater or lesser effectiveness. We reviewed public health guidance for developing a whole-system approach to obesity prevention to help inform our list of key characteristics.⁶ We also drew on the general principles of a taxonomy development method using a component approach to inform meta-analysis⁷ to develop a bespoke list of components, which we term 'key characteristics' in this paper.

Here we describe the development and coding of the analytic framework. Specific steps in the development of the framework included review of existing logic models and analytic frameworks; refinement of our existing logic model; identification of key features of the interventions; involvement of CYP, schoolteachers and public health professionals; development and piloting of the final framework; and preparation of a coding manual.

Here we describe how we coded the interventions in collaboration with CYP and how we analysed the data, and we report the results of the coding. In subsequent work described elsewhere, we reported the statistical methods developed specifically for the synthesis and the results of the application of these methods to the data coded according to the analytic framework.⁸ The analytic framework comprises a logic model to refer to the general characteristics that are relevant to the problem (which we illustrate graphically) and a coding scheme that pulls out components of the logic model to inform the synthesis.

A preprint of this article is available at medrxiv.org/cgi/content/short/2024.03.07.24303614v1.

Methods

Development of the analytic framework

Development of the analytic framework consisted of four phases (Figure 1): (1) drafting of a preliminary logic model; (2) refinement of the logic model; (3) consultation with CYP and their parents, our research advisory group (including academics expert in the field and two young people), teachers and public health professionals; and (4) development of a coding scheme. We describe each phase below.

Preliminary logic model (see Figure 1, Stage 1)

Following advice from Cochrane,⁹ and other sources of information,^{6,7,10} we drafted a preliminary logic model while drafting the review protocol (<https://fundingawards.nihr.ac.uk/award/NIHR131572>) to organise our initial thoughts on potentially important intervention and population features. Elements of the logic model included the type of intervention,^{11,12} the setting¹³ and the mode of delivery.¹⁴ Since our interventions of interest seek to change dietary and/or activity behaviour, the preliminary model also drew on elements from the Capability, Opportunity, Motivation and Behaviour change framework¹⁵ and a complex adaptive systems perspective.¹⁰ We additionally drew on previous work in which we employed a 'wider determinants of health' (WDoH) perspective to characterise obesity interventions studied in obesity prevention trials in children, using a de novo 'mapping tool' developed to cover 226 potential causes of obesity.¹⁰ This analysis revealed that many of the studied interventions were aligned with the individual lifestyle factors domain of WDoH, many with the living and working

conditions domain and some with social and community factors. In the light of this, we considered contextual factors that may influence BMI. We also drew on our realist review addressing the contextual and mechanistic factors associated with successful interventions in schools.¹⁶

The preliminary logic model (see Appendix 1) included the concepts of setting (e.g. school, home, region, country); participant characteristics (e.g. age, sex, SES); intervention characteristics, including function (e.g. education, training, enablement); the targeted behaviour (e.g. diet, activity); intensity, sources of behaviour change (motivation, capability, opportunity); how it is experienced by the child (e.g. one-to-one, group based); who is targeted by the intervention (e.g. child, parent, community); and who delivers the intervention (e.g. self-delivered, parents, teachers). The logic model also included short-term outcomes (e.g. changes in social and physical environment, empowerment of providers and/or children/families), medium-term outcomes (e.g. improved diet and physical activity) and our target long-term outcome of reduced incidence of obesity.

Refinement of the logic model (see Figure 1, Stage 2)

To formalise and refine our preliminary logic model after the project was funded, we undertook an informal literature review of existing logic models and analytic frameworks in the fields of (1) obesity prevention, (2) behavioural change and (3) assessment of complex interventions in the context of systematic reviews. We searched PubMed using phrases such as 'analytic framework and obesity', 'logic model and obesity', 'analytic framework and

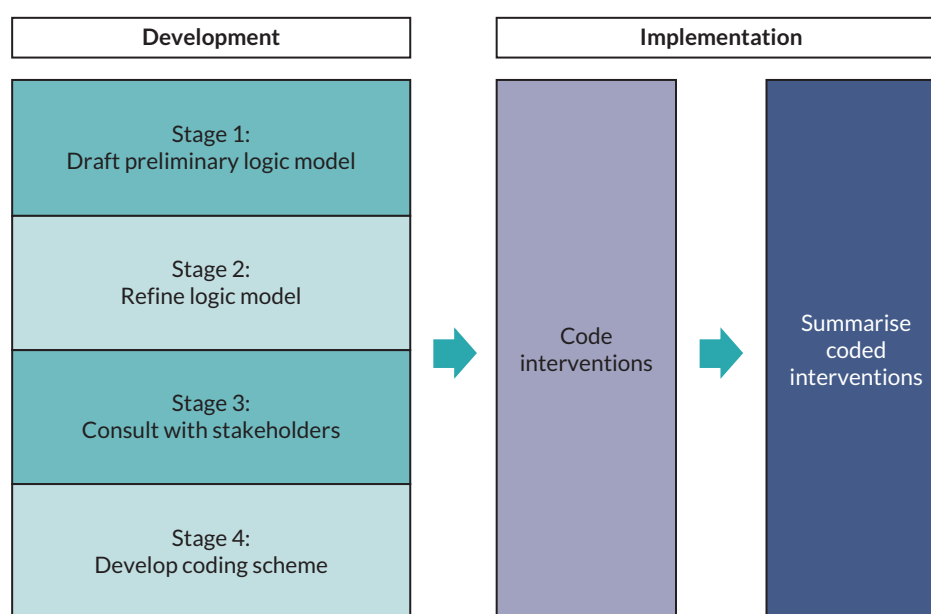


FIGURE 1 An overview of the stages of the development and implementation of the analytic framework.

behavioural change', 'logic model and behavioural change', 'complex interventions', examined reference lists and consulted with collaborators. The full text of each identified record was evaluated for relevance by one reviewer. Our search was not intended to be systematic, since we aimed to identify a wide, rather than a comprehensive, selection of ideas to refine our logic model.

Stakeholder consultation (see [Figure 1](#), Stage 3)

The third stage of development of the analytic framework was to share the list of intervention features from the logic model with stakeholders. We sought input on what intervention features or components could be used to characterise the available studies and lead to building blocks of future interventions or their implementation. As per the Health Research Authority/NiHR INVOLVE statement,¹⁷ ethical approval was not required for the contribution of the public as part of the patient and public involvement (PPI) and engagement.

Children, young people, parents and teachers

We took the view that CYP have much to contribute to the design and delivery of interventions targeted at them, particularly when processes that respond to their preferences for engagement support them to share their views.¹⁸ Furthermore, consultation with both CYP and schoolteachers during the development of the research programme highlighted that for sustaining an intervention, they considered it important that families and parents were optimally engaged. We, therefore, started with two workshops to engage this audience, the first with a group of five CYP aged 12–18 years on their own, and the second with a group of six CYP aged 12–16, each accompanied by a parent (January 2022).

We identified participants through Bristol's Generation R Young People's Advisory Group (YPAG; <https://generationr.org.uk/bristol/>), a group funded by the National Institute for Health and Care Research (NIHR) Applied Research Collaborations West and the Bristol Biomedical Research Centre. YPAG comprises CYP aged 10–22 years who are interested in health care and research, offering an opportunity for them to evaluate critically the way research about them takes place. Both workshops were also attended by one of the YPAG co-ordinators, who chaired the meeting, and by four members of the project team.

We later held two online meetings with teachers and headteachers (January 2023) which were attended by three and five teachers, respectively. One of the authors (Julian PT Higgins) facilitated both meetings.

The approach we used to elicit input was similar in all four of these workshops. We started the meeting by asking the group 'What should we do to prevent childhood obesity?' We then provided some examples of interventions we have included in our reviews and asked some more specific questions ([Box 1](#)).

BOX 1 Questions asked at workshops with children, young people, parents and teachers

1. What should we do to prevent childhood obesity?
2. What sorts of approaches do you think might work?
3. From the ideas generated, what sorts of approaches might work best?
4. Are there approaches that might work well across all age groups? Or that might differ importantly?
5. Are there approaches that might work particularly well for those most likely to gain weight?
6. Are there combinations that might be particularly good or particularly bad?

Public health professionals

We held an online meeting with public health professionals from local authorities in our region (January 2023), which was attended by five public health experts, one young person a member of our advisory group (see below), one schoolteacher from our workshop with teachers and six project staff. After a brief introduction to the project and presentation of the latest list of important intervention features (including a summary of the ideas generated through the workshops with CYP, parents and schoolteachers), we discussed each item and specifically asked for feedback on the relevance of features included, whether there were important features missing and whether any should be dropped. We also discussed whether any of the features may work better in tandem (i.e. have interaction or synergistic effects). In addition to this meeting, we held three one-to-one meetings and two two-to-one meetings with various public health professionals who could not attend the group meeting.

Advisory group

Alongside these, we consulted with our project advisory group. Our advisory group comprised international academics with expertise in the field and two young people aged 15 and 16 years. We presented a preliminary version of list of intervention features at our annual advisory group meeting in February 2022 (online), attended by six advisory group members, one YPAG co-ordinator and four project staff. We started the meeting by outlining the themes emerging from the workshops with the children and discussed these themes with the aim of reducing these ideas to a smaller number of generic codable features. The specific discussion points were (1) to consider whether it

was feasible to code the items currently included, (2) to consider how to code the items and (3) to identify any additional concepts.

To facilitate notetaking and subsequent analysis, each consultation, meeting and workshop was audio-recorded (with consent obtained from all participants). Following each consultation, one reviewer summarised the data using the recorded audio to complement the meeting notes. The outcomes from each consultation were then discussed and evaluated among the review team, and any agreed item or suggestion was incorporated into the development of the analytic framework.

Development of interventions coding scheme (see Figure 1, Stage 4)

We created a coding scheme out of the final list of intervention features. Since the coding scheme would feed directly into the statistical analysis, we established the following informal criteria for the scheme so as to maximise our prospect of obtaining informative results: (1) each item in the coding scheme should be applicable to every intervention examined in the studies, (2) each item should ideally be a dichotomous variable that approximately divides the studies into halves (since this would maximise precision in the estimation of the regression coefficients), (3) the coding scheme should include as many intervention features that potentially impact on effectiveness as possible and (4) the number of items should be kept to a minimum. There is clearly a tension between the last two criteria. To try and meet (3), we considered all the features identified by stakeholders. To try and meet (4), we bore in mind that rules of thumb generally advocate at least 10 data points per predictor in regression analyses, suggesting that at most 25 items should be included.

The questions in the coding scheme were formulated to elicit binary responses ('Yes'/'No') or using a very small number of categories for the purpose of inclusion in our statistical model. There were two exceptions, both relating to intervention duration for which responses were collected in number of weeks.

In addition to features of the interventions, we added to the coding scheme some features of the trial participants that might impact on intervention effectiveness: age group, income category of the country in which the trial was performed and whether the trial specifically targeted individuals of low SES.

We wrote a guidance document to explain each of the items in the coding scheme.

Implementation of the coding scheme

Data set

The set of trials to which we applied the coding was derived from two Cochrane reviews of interventions to prevent obesity in children aged 5–11 and in CYP aged 12–18^{4,5} published between 1997 and 2022 (the last searches for the two Cochrane reviews were conducted in February 2023). We coded only studies that were included in meta-analyses in these reviews and therefore had valid data for inclusion in the planned complex synthesis (to be reported elsewhere). Because intervention coding was conducted at intervention level and not at study level, for each study we had to consider (1) whether the reference arm was a control group such as no intervention or 'usual care', or an eligible active intervention (i.e. the trial made a 'head-to-head' comparison); and (2) whether more than one intervention was implemented in each study (i.e. the trial was a multiarm study). We coded only active interventions in controlled trials and coded all active interventions in multiarm studies.

Piloting

We piloted the coding in several waves. One reviewer (Francesca Spiga) first tested the framework on five studies. Two reviewers (Francesca Spiga and Annabel L Davies) then independently piloted the framework on 10 studies that were purposefully selected to provide a diverse collection. In the third wave, a further 20 studies were coded by 2 different pairs of reviewers (Francesca Spiga and Annabel L Davies; Francesca Spiga and Jennifer C Palmer). After each wave of the piloting, we recorded and discussed issues identified among the project team and implemented appropriate modifications to the coding scheme and/or coding manual as necessary to achieve consistent and comprehensive capture of study features, following previous methods.¹⁹

Coding

Following the piloting phase, we used the finalised coding scheme for application to the interventions described in the remaining studies. Two reviewers (from Francesca Spiga, Annabel L Davies, Jennifer C Palmer, Eve Tomlinson, Theresa HM Moore, Deborah M Caldwell and Julian PT Higgins) independently coded each study using the data extracted during the Cochrane reviews, with recourse to the full study reports as necessary. All coding discrepancies were resolved by discussion, and in case of disagreement, a third reviewer was involved.

Involvement of children and young people

One of the intervention features that emerged from talking with the CYP was the importance of the intervention being enjoyable (to use their words, having the 'fun factor'). Inspired by a discussion with the children, we decided that the most appropriate people to code an item about this would be CYP themselves. We recruited a panel of young people from the Bristol YPAG by e-mailing the group with an explanation of the aim of the project and the task involved. We supplemented volunteers from the group with younger children known to the members of the research team.

From each study, we extracted a brief description of the intervention(s). We compiled these into batches of 10 intervention strategies. For each intervention, the documentation included a strategy identity document (ID) (study name and year), the intended age group (i.e. the mean age or age range of the target children as reported in the study) and the setting of the interventions (see [Appendix 2, Table 4](#)). We asked the CYP to read the description of each intervention and then answer the following two questions using an online survey via *Online surveys* (www.online-surveys.ac.uk/), with possible answers being 'really boring'/'a bit boring'/'neutral'/'a bit fun'/'really fun':

- Question 1: How enticing would you find this strategy?
- Question 2: How enticing do you think *children in the intended age group* would find this strategy?

Our primary interest was in Question 2. Question 1 was included for us to learn about the interests of our volunteers and in the hope that it would reduce the impact of personal preferences on their answer to Questions 2. We also gave the CYP the opportunity to comment on the specific interventions by providing an optional free-text box (see [Appendix 3](#)).

The volunteering CYP decided how many batches of the interventions they wanted to assess. We ensured that each intervention was coded by at least four CYP. In case of multiple participating CYP from the same household, we assigned a different batch of interventions to each. We compensated the volunteers £25 for the completion of each batch of 10 interventions. We did not develop a strategy for resolving discrepancies; instead, we developed an algorithm to determine a judgement based on the individual responses, described in the following section.

Analysis of the coded data

We analysed the coded data for all the active intervention arms separately for the two age groups, 5–11 years and 12–18 years. For each item with categorical responses (e.g. 'Yes'/'No'), we calculated the number of interventions

falling into each possible category and expressed these as percentages. We converted total and peak duration into binary variables (short or long) by dichotomising at the medians of the reported values. For these, we also present the means and standard deviations (SDs) of the quantitative data.

For the fun factor, we had four distinct responses from four volunteer CYP. We first combined the 'really fun' and 'a bit fun' categories and combined the 'really boring' and 'a bit boring' categories. We then classified an intervention as 'fun' if, across the four (or more) coders, either the majority of coders regarded it as fun or an equal number of coders regarded it as fun and neutral. We classified an intervention as neutral if equal numbers of coders regarded it as fun and boring. We classified an intervention as boring otherwise (i.e. if either the majority of coders regarded it as boring, or an equal number of coders regarded it as boring and neutral). We refer to this approach as category-based analysis for consensus fun factor (CACFF). We performed a sensitivity analysis in which we calculated the numerical average response by assigning the following values to each possible answer given by each coder for each intervention: really boring = 1, a bit boring = 2; neutral = 3; a bit fun = 4; really fun = 5. We then classified each intervention as fun (mean > 3), neutral (mean = 3) or boring (mean < 3). We refer to this method as number-based analysis for consensus fun factor (NACFF).

Results

Refined logic model

Our informal review of other models and frameworks identified, in addition to those already identified when drafting the preliminary logic model, 10 relevant academic papers in the field of obesity prevention,^{20–26} and related fields in which interventions aimed at behaviour change were described.^{27–29} We also identified three guidelines to assess complex interventions in systematic reviews^{30–32} and one framework that address equity in the context of evidence synthesis, including the Place, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social capital (PROGRESS-PLUS) framework.³³ In order to translate key aspects of the interventions (e.g. complexity) into questions, we referred to three published guidelines, including those from Gale *et al.* (2014), Higgins *et al.* (2019) and Petticrew *et al.* (2019).^{34–36} These additional frameworks gave us insights into further characteristics of the intervention that are likely to be important for their effectiveness, such as the target, the complexity of the interventions and the role of the community. Guided by

the PROGRESS-PLUS framework, we also implemented a more comprehensive description of the participants' characteristics.

The refined version of our logic model is available in [Appendix 2, Table 4](#). The preliminary logic model was modified to expand participant characteristics (including the PROGRESS-PLUS framework);³³ we also made substantial modifications to the intervention characteristics to include duration, complexity (e.g. simple or multiple components), fidelity (i.e. whether the intervention was implemented as intended), whose behaviour the intervention aims to change (e.g. child, parent, community) and other characteristics (e.g. participation, flexibility). We did not implement any changes in the setting and outcomes.

Feedback from consultation

Children, young people and their parents emphasised the importance of (1) thinking differently about different age groups (primary vs. secondary school age), (2) infrastructural changes (e.g. improved dining facilities in schools), (3) engaging families in achieving behavioural change and (4) if those delivering the intervention had credibility with or were role models for the CYP. Additional important features of the intervention that emerged from talking with the young people were (5) the adaptability and flexibility of the intervention (e.g. children should be able to choose their favourite sporting activity) and (6) the importance of the intervention being fun. A full list of themes that we addressed is reported in [Appendix 5, Box 3](#). Consultation with children, young people and their parents led to a list that comprised 17 categories, including realm targeted, multifactor-ness, intensity and duration, theory, mechanism of action (i.e. change children's dietary or activity behaviour by making them do something, educating them or changing their social and/or physical environment), commercial interests, integration, choice, fun factor, messaging (i.e. how the intervention is 'sold' to the children/young people), resonance, peer support, community engagement, setting, recipient, targeting and fidelity.

Teachers commented on the setting for different types of interventions: for example, physical activity interventions are readily delivered at school, whereas it is more difficult to control children's diets if they bring lunch boxes from home. They also discussed the importance of role models and whether teachers are the most appropriate to provide guidance. They mentioned resource and time constraints, and that embedding the programme within the curriculum may be more efficient than changing the existing curriculum. They thought that it was important for the intervention to be sustainable in the long term. Furthermore,

they highlighted the importance of involving the parents to ensure continuity of school-based interventions (e.g. school-based cooking classes followed by meal boxes delivered at home for children and parents to prepare the meals together). Our discussions with the teachers also highlighted the importance of empowering the children (e.g. involving them in preparing home meals) and considerations for the different age groups (e.g. educational interventions may be more effective in younger children, because older children are more independent). The teachers also suggested that it may be effective to link interventions to mental health outcomes as these are of paramount interest to young people these days.

Discussions with our project advisory group resulted in some features being dropped from our list of intervention features. Some items were judged to be less informative than others (e.g. whether the intervention was theory-based), others as overlapping with other components (e.g. who was targeted by the intervention, whether there was community engagement) and others as unfeasible to code due to lack of information (e.g. fidelity in implementation of the intervention). Items recommended to be retained as important included consideration of who is delivering the intervention (and, in particular, the resonance it would have with the children), seeking to influence the child's social environment as part of the mechanism of action and the complexity of the interventions (e.g. in terms of how many dimensions or factors it comprises). Crucially, it was advised that it is 'important to code the things that are important to the young people and their parents'.

Our final discussions with public health professionals reinforced many of the points mentioned above and helped us refine the list of items substantially. Although no additional components were included at this stage, some questions and answers were reworded for the sake of precision, clarity and unambiguity; for example, in the item about children's choice in how they modified their diet or activity, the question 'Is there choice of activity/diet within the intervention?' was amended to 'Is choice of activity/diet designed into the intervention?', and in the realm-targeted item, the answer 'Yes'/'No' was amended to 'Yes exclusively or substantially'/'Yes minimally'/'No'.

The finalised coding scheme and coding manual

The finalised version of the coding scheme comprises 25 individual questions spread across 12 categories ([Table 1](#)).

We largely achieved our aim of formulating a series of questions that can be answered for each intervention with

TABLE 1 Finalised analytic framework

Item	Question (possible answers)
1. Setting	Is the intervention delivered in a school (in full or in part)? (Yes/No)
	Is the intervention delivered in the home (in full or in part)? (Yes/No)
	Is the intervention delivered in the community or other non-school and non-home setting (in full or in part)? (Yes/No)
	Does the intervention include a home activity? (Yes/No)
2. Mode of delivery to the child	How is the intervention delivered? (<i>Exclusively or mainly individually/Both individually and as a group/Exclusively or mainly as a group</i>)
	Is the intervention delivered electronically? (Yes, exclusively/Yes, significantly/Yes, as a minor component/No)
3. Realm targeted	Does the intervention aim to change diet? (Yes, exclusively or substantially/Yes, minimally/No)
	Does the intervention aim to change activity levels? (Yes, exclusively or substantially/Yes, minimally/No)
4. Multifactor-ness and dimensionality	Does the intervention use multiple strategies (three or more)? (Yes/No)
	Is the intervention applied in a single phase? (Yes/No)
	Is the intervention applied for a continued period? (Yes/No)
5. Peak intensity and duration	During how many weeks does the whole intervention last? (Numerical; to be dichotomised at the median)
	For how many weeks does the peak engagement period of intervention last? (Numerical; to be dichotomised at the median)
	What is the level of engagement with the children? (High/Low)
6. Integration	Is the intervention integrated into the normal curriculum/habits? (Yes/Partially/No)
7. Flexibility	Is the intervention designed to be implemented in a flexible manner/tailored to specific participants? (Yes/No)
8. Choice	Is choice of activity/diet designed into the intervention? (Yes/No)
9. Fun factor	How enticing would you find this strategy? (Boring/Neutral/Fun)
	How enticing do you think children in the intended age group would find this strategy? (Boring/Neutral/Fun)
10. Resonance	Is the intervention experienced by children via someone external or unusual? (Yes/No)
11. Mechanism of action and recipient	Does the intervention have an explicit component that requires the child to participate? (Yes/No)
	Does the intervention have an explicit component of education/information provision for the child? (Yes/No)
	Does the intervention have an explicit component aiming to change the social environment of the child? (Yes/No)
	Does the intervention have an explicit component aiming to change the physical environment of the child? (Yes/No)
12. Commercial interests	Are commercial interests involved in the trial and/or intervention? (Yes/No)

a small number of possible answers. The coding manual contains, for each item, a detailed explanation of the question and a selection of examples illustrating how the interventions should be coded. A copy of the manual is available in [Appendix 6, Table 5](#). Below we provide a brief explanation of each of the 12 categories with examples.

Coding categories

Setting

This is a measure of the setting where the intervention is delivered. Possible answers were 'school', 'home' or 'community or other non-school/home' (e.g. club, gym, shop, library, healthcare centres). Within *setting*, we also coded

each intervention according to whether the intervention protocol included home-based activities for the children (e.g. cooking or games activities with parents, additional homework).

Mode of delivery to the child

This is a measure of how the child experiences the intervention, that is, as an individualised intervention (e.g. a leaflet about healthy meals given to each student at school; a visit to an healthcare centre, homework with parents, a website to view at home), through a group of children (e.g. school classes or scout troop meeting) or both (e.g. school classes and homework activities). Within *mode of delivery*, we also coded the intervention according to whether it was delivered electronically (i.e. via digital media, online website or app) and in what capacity (i.e. exclusively, significantly, as a minor component or not at all).

Realm targeted

This is a measure of whether the intervention seeks to change 'diet' (e.g. introduction or replacement of food beverages with healthier options; reorganisation of food display in the school canteen or in shops; education on healthy diet; cooking classes; healthy meal box for the family), 'activity', including increase in physical activity (e.g. modified or additional physical activity classes at school) and/or reduce sedentary time at home (e.g. active video games), or 'both diet and activity', and in what capacity (i.e. exclusively or substantially to indicate the main component, minimally to indicate a minor component, or not at all).

Multifactor-ness/dimensionality

This is a measure of how complex the intervention is, including how many ways the children are targeted, for example, at multiple levels or in multiple phases. Questions within this category include whether the intervention has multiple components, that is, uses at least three different strategies (e.g. classroom activities, changes in the canteen food and homework activities); is delivered in multiple phases, that is, uses different strategies or settings at different times (e.g. a more active phase followed by a less active 'maintenance' phase or a 'top-up' phase); and is delivered in a continuous manner, that is, without breaks between the beginning and the end of the intervention (during the whole school-year) or for a discontinuous period (e.g. lectures delivered for 12 weeks/year for 2 years).

Peak intensity and duration

This is a measure of how intensely the intervention is experienced by the child, and it covers the duration and

frequency of the intervention. Questions within this category cover the duration in weeks of the whole intervention and of the peak engagement (if different from the whole intervention). The category also measures the level of engagement with the children during the peak period, using the number of sessions of engagement per week as guidance so that the interventions are coded as 'high' engagement if there was at least one session of engagement with the children per week and 'low' if there was < 1 session of engagement with the children per week.

Integration

This is a measure of the extent to which the intervention is 'normalised' within the school curriculum or normal habits of the child (e.g. as part of regular homework). This measure provides an indication of how much 'extra effort' (by the provider and/or the recipient) would be required for the intervention to be successful. Examples of interventions that are completely integrated include modification of physical activity classes or the addition or replacement of regular school meals with healthier options. Examples of interventions that are partially integrated are those with a combination of integrated activities and something extra (e.g. after-school programme or homework). Examples of interventions that are not integrated at all are those in which the school needs to add something to an existing programme (e.g. an extra physical activity class extending school hours or home activities with the parents) or when the child needs to sign up for/agree to after-school classes.

Flexibility

This is a measure of the extent to which the intervention can be implemented flexibly within the intervention protocol. That is, whether an intervention is adapted to the particular classroom/household at teachers/parents' discretion (e.g. an intervention consisting of the replacement of regular meals with healthy meals, where the healthy meals are decided by each participating school kitchen staff).

Choice

This is a measure of the extent to which children are free to make the intervention work for them (e.g. an intervention in which the child is able to choose which sport they do, or which food to eat).

Fun factor

This is a measure of the extent to which the intervention is expected to be enjoyable for the age group to whom it is delivered. We anticipated that some interventions that involve games, songs, plays may look fun to everyone, whereas interventions that includes sport activities or cooking with the parents may not look fun to everyone,

and interventions that included classroom lectures or replacement of sugar-sweetened drinks with water may not look fun to anyone. We also considered that some interventions may be appropriate for children aged 5–11 years but not for older children (e.g. a song about healthy eating), and *vice versa*, a video game intervention designed for older children (12–18 years old) may not be fun for a 5-year-old child. We designed the questions and answers for this category to be suitable and appropriate for CYP as they were invited to help us with coding the interventions for this item (see [Methods](#) on fun factor).

Resonance

This is a measure of the extent to which the intervention is likely to attract the respect of the young people, particularly through the credibility of the person delivering the intervention. For example, an intervention may be experienced by children via someone external or unusual (e.g. a sport coach, a professional athlete, an influencer, a dietitian or a nurse) or someone familiar to them (form teacher or a parent/carer).

Mechanism of action and recipient

This is a measure of who is the direct recipient of the intervention [e.g. child, the teacher(s), parent(s), the child's environment or others] and how the intervention aims to achieve a change in the child's dietary and/or activity behaviour. Options for the latter are 'participation', 'education', 'social environment' and 'physical environment'. An intervention that has an explicit component of modifying the child's behaviour through participation is an intervention in which the child learns by doing something (e.g. a session of physical activity or a workshop on healthy nutrition in which the children are involved

in cooking a meal). An example of an intervention that has an explicit component of education or information is the provision of literature or lessons in which there is no activity involving the child doing something. An example of an intervention that has an explicit component aiming to change the social environment of the child at school or home is an intervention in which teachers are instructed to encourage children to change their dietary or activity behaviours or parents are educated on healthy food. Examples of interventions that have an explicit component aiming to change the physical environment of the child at school or home are interventions that include placement of healthy foods in the school canteen, provision of exercise equipment at school or in the community, drawing running tracks in the playground or changing the school meal menu. For interventions using multiple mechanisms, we answered 'Yes' to all relevant options.

Commercial interests

This is a measure of whether commercial interests are involved in the trial or in the delivery of the intervention, such as an intervention within a study that was funded by industry (e.g. food or pharmaceutical industry) or an intervention that include use of equipment supplied by a manufacturer of sport equipment, or provision of food/drinks by a food supplier.

Results of the coding

We coded 255 interventions from 210 randomised trials. Descriptive statistics summarising the coding of these intervention arms are reported in [Table 2](#). Results by age group are reported in [Appendix 7, Table 6](#), and the full data set is available in [Report Supplementary Material 1](#).

TABLE 2 Coding results of all active intervention arms (n = 255)

Characteristic	Answer	Number (%) ^a
Setting		
Delivered in school	Yes	180 (70.6)
	No	75 (29.4)
Delivered in the home	Yes	47 (18.4)
	No	208 (81.6)
Delivered in the community or other setting	Yes	72 (28.2)
	No	183 (71.8)
Includes a home activity	Yes	91 (35.7)
	No	164 (64.3)

TABLE 2 Coding results of all active intervention arms (n = 255) (continued)

Characteristic	Answer	Number (%) ^a
Mode of delivery		
Delivered to the child	Individually	44 (16.9)
	Individually and as a group	78 (30.7)
	As a group	133 (52.4)
Web component		
Delivered electronically	Exclusively	16 (6.3)
	Significantly	17 (6.7)
	As a minor component	21 (8.3)
	No	201 (78.8)
Realm targeted		
Aims to change diet	Exclusively or substantially	186 (72.9)
	Minimally	13 (5.1)
	No	56 (22)
Aims to change activity	Exclusively or substantially	207 (81.2)
	Minimally	7 (2.7)
	No	41 (16.1)
Multifactor-ness and dimensionality		
Uses multiple strategies	Yes	161 (63.1)
	No	94 (36.9)
Applied in a single phase	Yes	207 (81.2)
	No	48 (18.8)
Applied for a continued period	Yes	246 (96.5)
	No	9 (3.5)
Peak intensity and duration		
Total duration	Mean weeks (SD)	45.9 (42.20)
Peak duration	Mean weeks (SD)	39.6 (41.1)
Level of engagement with the child	High	152 (59.6)
	Low	103 (40.4)
Integration		
Integrated into the normal curriculum/habits	Completely	121 (47.6)
	Partially	55 (21.6)
	No	79 (31)
Flexibility		
Implemented in a flexible/tailored manner	Yes	86 (33.7)
	No	169 (66.3)
		continued

TABLE 2 Coding results of all active intervention arms (n = 255) (continued)

Characteristic	Answer	Number (%) ^a
Choice		
Designed to have choice of activity and/or diet	Yes	66 (25.9)
	No	189 (74.1)
Fun factor		
How enticing for children in the intended age group	Fun	154 (60.4)
	Boring	71 (27.8)
	Neutral	30 (11.8)
Resonance		
Experienced via someone external or unusual	Yes	134 (52.8)
	No	121 (47.2)
Mechanism of action and recipient		
Child participation	Yes	170 (66.7)
	No	85 (33.3)
Provision of education/information	Yes	190 (74.5)
	No	65 (25.5)
Change in child's social environment	Yes	175 (68.6)
	No	80 (31.4)
Change in child's physical environment	Yes	79 (31)
	No	176 (69)
Commercial interests		
Commercial interests in the trial and/or intervention	Yes	27 (10.6)
	No	228 (89.4)

a Except for duration which is reported as mean and SD.

Of the 255 active intervention arms coded, 180 (70.6%) were delivered at school, 47 (18.4%) were delivered in the home and 72 (28.2%) were delivered in the community or other settings (e.g. primary care setting); 91 interventions (35.7%) included a home activity. Forty-four of the interventions were delivered individually (16.9%) and 133 as a group (52.4%), and 78 (30.7%) were delivered both individually and as a group. Sixteen interventions (6.3%) were delivered exclusively electronically, 17 interventions (6.7%) included a significant electronic component and 21 (8.3%) included a minor electronic component. One hundred and eighty-six interventions (72.9%) were aimed at changing diet exclusively or substantially, and in 13 (5.1%), the component aimed at changing diet was minimal. There were 207 (81.2%) interventions aimed at changing activity (including increasing physical activity and reducing sedentary behaviour) exclusively or substantially, and

in 7 (2.7%) of these, the component aimed at changing activity was minimal.

At least 3 different intervention components (or different strategies) were implemented in 161 interventions (63.1%), 207 interventions (81.2%) were applied in a single phase and 246 (96.5%) were applied for a continued period. The total mean duration of the intervention was 45.9 weeks (SD 42.2) with a mean peak period duration of 39.6 weeks (SD 41.1). The level of engagement with the children was high in 152 interventions (59.6%) and low in 103 (40.4%). The interventions were completely integrated in the normal curriculum or habits in 121 interventions (47.6%) and partially integrated in 55 interventions (21.6%). Eighty-six interventions (33.7%) were implemented in a flexible or tailored way, and in 66 (25.9), there was an element of

choice of diet and/or activity for the children. One hundred and thirty-four interventions (52.8%) were delivered (partially or exclusively) by someone external or unusual. With regard to the mechanisms by which the interventions aimed at preventing obesity, 170 interventions (66.7%) required the child participation, 190 (74.5%) provided education or information, 175 (68.6%) changed the social environment of the child and 79 (31%) changed the physical environment of the child. Commercial interests in the trial and/or intervention were found in 27 interventions (10.6%).

We received an overwhelming response from YPAG members to code the 'fun factor', with 31/89 CYP aged 12–18 years volunteering to participate in the project. Additionally, we recruited four children aged 6–13 years through colleagues at the University of Bristol. The 35 participants contributing to coding this item therefore ranged from 6 to 18 years of age. Among the 31 CYP who declared their ethnicity, 1 was Asian/Black/White, 1 Black African, 1 Indian, 6 Somali, 1 South Asian and 20 White British; 51% were female. According to our CACFF approach, 154 interventions (60.6%) were regarded as fun, 71 (27.8%) were regarded as boring and 30 (11.8%) elicited neutral views (Table 3).

In our sensitivity analysis using the NACFF approach, we found discrepancy with the CACFF approach in just 9% of the interventions. When asked about their own

views of the interventions (rather than the views of age-appropriate children in general), views were slightly more neutral, with slightly fewer being categorised as fun and slightly fewer as boring. We present examples of feedback received from the CYP on their experience of undertaking coding in Box 2.

BOX 2 Feedback from CYP on their coding of the 'fun factor'

Alongside the 'fun factor' questions, we also provided the coder with the opportunity to comment on the specific interventions. Some examples of feedback on interventions that they coded as fun were:

*This strategy sounds very fun, integrating video games into it is a very good idea and will work extremely well.
I think this strategy is very good as it will involve education and skills as well as physical exercise.
Cooking classes for families and taster foods, games and tasting and cooking sessions with family members.*

On interventions that the children coded as boring:

*A bit too academic, could be taught in a more fun way.
I think incorporating normal school curriculum lessons with physical activity could take the fun out of it for some students.
I don't think students this age would find lectures and doing group presentations to a class at all enjoyable.*

Finally, on interventions that the children coded as neutral:

*Kids may be reluctant to take advice from parents.
I think this strategy would be very effective but may be less interesting than others.
I think 10-year-olds will work well with their family and I like the idea of trying new recipes, but I think 10 sessions a month could feel like a lot.*

TABLE 3 Coding results for fun factor (n = 255)

The CACFF approach		Q2: How enticing do you think children in the intended age group would find this strategy?			
		Fun	Neutral	Boring	Total
Q1: How enticing would you find this strategy?	Fun	124	9	13	146
	Neutral	19	13	17	49
	Boring	11	8	41	59
	Total	154	30	71	255
Sensitivity analysis: the NACFF approach		Q2: How enticing do you think children in the intended age group would find this strategy?			
		Fun	Neutral	Boring	Total
Q1: How enticing would you find this strategy?	Fun	130	11	13	154
	Neutral	14	4	12	30
	Boring	14	4	53	70
	Total	158	19	78	255

We gave participants the opportunity at the end of their coding assignment to provide feedback on their experience. We received feedback from 14 participants (or their parents). Most of the feedback highlighted positive aspects of the project/task:

Thank you for this awesome opportunity it was great fun!
Bristol YPAG member

The process was amazing thanks for asking.
Bristol YPAG member

I think the process for this YPAG was very good and enjoyable to give feedback on.
Bristol YPAG member

I think as an activity it worked really well, no issues at all with the forms as I guess sometimes it's difficult to fill out the same one twice with the same device/account so credits to that platform for allowing that for a task like this, maybe one to remember for next time. From my end it all seems well organised, documents were clear and not too complicated, forms were straightforward, and appreciated the extra box for additional comments if it was sometimes relevant.
Bristol YPAG member

We also received some valuable advice on how the coding process could be improved:

On the surface, I think the boys assumed the last piece of work would be easier than a meeting, but it proved more difficult as they found it a bit repetitive ... the strategies were so similar that it was hard for them to come up with original comments ... Also, our youngest needed input from (older sibling) so he could understand the strategies.
Parent of child aged 12 years

Overall, I think the form is quite straightforward to fill in. From the information I was given before doing the batches it sounded a bit complicated (in terms of different batches), however actually filling it in was relatively easy. I would say that having the feedback form and information on the same page would make the process easier because it got a bit confusing going back and forth through different tabs.
Bristol YPAG member

And some comment on the reporting of the interventions:

I think that what sounds interesting or boring when reading the research proposals could be very different if actually taking part in the studies.
Bristol YPAG member

Discussion

Our extensive engagement with CYP, teachers and public health professionals led to the development of a novel coding scheme that we used to code 255 interventions in 210 randomised trials. Our consultations highlighted themes such as the recipient of the intervention (e.g. child, family, school, community), aspects of setting (e.g. home vs. school vs. community), duration and intensity of the intervention (e.g. low-level intensity and long duration vs. high-level intensity and short duration), integration of the intervention (e.g. fully integrated in the curriculum vs. intermediate vs. not at all), choice and flexibility (e.g. children can choose the type of physical activity, whether the intervention can be implemented in a flexible manner), the 'fun factor' of the intervention (e.g. if the intervention

is expected to be fun for everyone), resonance (e.g. the importance of role models or external professionals) and mode of delivery of the intervention (e.g. by changing behaviour of the child vs. educating the child vs. changing the social and/or physical environment of the child).

A key strength was its iterative development through consultation with both recipients and implementers of obesity prevention interventions as well as with experts in the fields of obesity prevention and public health. Involvement of the project advisory group and its guidance in the design and implementation of the analytic framework was also highly beneficial. A particularly notable feature of our work was the involvement of CYP in both the development and the application of the analytic framework. They helped us determine the intervention characteristics included, and a group of 35 CYP performed the coding of all interventions in relation to the 'fun factor'. Working with the CYP was mutually beneficial; both we and the CYP found the experience highly stimulating, and we believe the research was considerably improved by this partnership.

Challenges we encountered during the analytic framework development included overlap between some of the characteristics, finding appropriate wording of the questions and answers, and identification of characteristics that were unfeasible to code. Nonetheless, by iteratively applying changes to our various list of items to consider, we were able to refine the set of core features of interventions that we believe might have an impact on their effectiveness in preventing obesity in children. A limitation of the coding results is their dependency on the level of detail provided to describe the interventions. For most of the studies, the interventions were well described and so we are confident that coding is accurate and reliable. However, some of the interventions were poorly described with limited information provided, an issue that likely affected the quality of the coding. Our feedback from the CYP involved in the coding also highlighted that some of the descriptions were not clear to them.

A limitation of this work relates to the demographic profile, particularly the SES and age, of the CYP who took part in the workshops and 'fun factor' coding. Although we did not collect data on the SES of these children, our perception was that these children were most likely to come from middle-class families. Furthermore, the age of the CYP contributing to the 'fun factor' coding ranged from 6 to 18 years of age, with only 3 being younger than 12 years. Although children were asked to answer the questions on behalf of children within the target age group, we cannot guarantee that older children could reliably speak for younger children.

The development approach described here should be suitable for application to other types of diverse and complex interventions and could be reproduced by other researchers (e.g. for evidence synthesis or intervention development). From the children involved in the coding, we learnt the importance of ensuring that tasks offered to them are appropriately tailored to the age group. If conducting a similar exercise in the future, we would reserve additional resources for ensuring that intervention descriptions are edited to make them more understandable to the younger children.

We have used the finalised analytic framework to re-analyse the results of the randomised trials, feeding the results of the coding into a complex synthesis model.³⁷ Through this analysis, using meta-regression-based methods within a Bayesian statistical framework, we have been able to evaluate the effect of each intervention component in producing a beneficial outcome in terms of prevention of obesity in children. In brief, we found that the most effective approaches were physical activity interventions delivered in the school setting, delivered at individual level, using multiple strategies of short duration and high intensity and involving modification of behaviour through participation in activities. The results of such analysis have the potential to have an impact on the future development of interventions to prevent childhood obesity. Ultimately, the evidence produced by our main analysis may contribute to the reduction in childhood obesity.

Additional information

CRediT contribution statement

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Other contributions

Maddie Coleman: PPI contribution.

Elizabeth Sheldrick: PPI contribution.

Lucy Condon: PPI contribution.

Acknowledgements

We particularly thank the children, young people and parents participating in our workshops: Ameilia Holford, Amelie Low, Daniel Seretny, Elaine S Seretny, Francesca Quick, George Thomas, Havi Carel, Karen Low, Lucy Naser, Lucy Thomas, Nino Faber Gray, Riya Baghirathan Nicholls. We are also indebted to the CYP who participated in coding: Abdi Ali, Alice Matthews, Amaani Isse, Amelie Low, Amiira Isse, Archie Cazalet, Arwen Sofia Sequeira White Wandschneider, Ayaan Isse, Elizabeth Sheldrick, George Thomas, Harry Allbless Roberts, Hudda Mahamed, Isaac Hodge, Isaac Tregidgo, Jake Andrews, Joe Freer, Joseph Thomas,

Katie Bond, Lottie Freer, Lowenna Negus, Matilda Hodge, Matilda Tregidgo, Max Andrews, Millie Freer, Oliver Leary, Oscar Lopez-Cottrell, Rahma Farah, Riya Baghirathan Nicholls, Shafia Mahamed, Sol Okasha, Sophie Phillips, Stanley Thomas, Tejas Ramanan, Theo Donnelly. We thank the following teachers for participating in workshops: Stephen Breeze, Joanne Davies, Robert Davies, Gill Hampton, Martin Holmes, Emily Proffit, Gill Richards. We thank the following public health professionals participating in workshops and informal discussions: Justine Womack (Office for Health Improvement and Disparities South West, OHID SW), Penny Marno (Swindon Borough Council), Lewis Bird (Swindon Borough Council), Sarah Amos (South Gloucestershire Council), Georgie MacArthur (North Somerset Council), Caoimhe Gowran (Bristol City Council). Finally, we acknowledge the invaluable input from our project advisory group members: Jeremy Grimshaw (University of Ottawa), Tom Trikalinos (Brown University), Miranda Pallan (University of Birmingham), Graham Moore (Cardiff University), Lesley Stewart (University of York).

Data-sharing statement

As this is an evidence synthesis project, data are mainly contained within the referenced literature, tables and appendices of our reports. For more information, please contact the corresponding author.

Ethics statement

This review did not involve the collection or analysis of any data that was not included in previously published research in the public domain. Therefore, it was exempt from formal ethical review by the University of Bristol Ethics Committee.

Information governance statement

There were no personal data involved in the production of this report.

Disclosure of interests

Full disclosure of interests: Completed ICMJE forms for all authors, including all related interests, are available in the toolkit on the NIHR Journals Library report publication page at <https://doi.org/10.3310/QLPD8523>.

Primary conflicts of interest: Francesca Spiga, Julian PT Higgins, Deborah M Caldwell and Jelena Savović were supported in part by the NIHR Bristol Evidence Synthesis Group. Julian PT Higgins, Theresa HM Moore, Sharea Ijaz and Jelena Savović were supported in part by the NIHR Applied Research Collaboration West (ARC West) at University Hospitals Bristol and Weston NHS Foundation Trust. Julian PT Higgins is a NIHR Senior Investigator (grant number NIHR203807). Julian PT Higgins had expenses paid by the organisers to give an invited talk at the 30th European Congress on Obesity in 2023.

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This article was published based on current knowledge at the time and date of publication. NIHR is committed to being inclusive and will continually monitor best practice and guidance in relation to terminology and language to ensure that we remain relevant to our stakeholders.

Study registration

This study is registered as PROSPERO CRD42021259859.

Funding

This article presents independent research funded by the National Institute for Health and Care Research (NIHR) Public Health Research programme as award number NIHR131572.

This article reports on one component of the research award *Towards optimal public health interventions for preventing obesity in children: a novel evidence synthesis*. For other articles from this thread and for more information about this research, please view the award page (www.fundingawards.nihr.ac.uk/award/NIHR131572).

About this article

The contractual start date for this research was in July 2021. This article began editorial review in March 2024 and was accepted for publication in May 2025. The authors have been wholly responsible for all data collection, analysis and interpretation, and for writing up their work. The Public Health Research editors and publisher have tried to ensure the accuracy of the authors' article and would like to thank the reviewers for their constructive comments on the draft document. However, they do not accept liability for damages or losses arising from material published in this article.

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List of supplementary material

Report Supplementary Material 1

Interventions coding full data set.

Supplementary material can be found on the NIHR Journals Library report page (<https://doi.org/10.3310/QLPD8523>).

Supplementary material has been provided by the authors to support the report and any files provided at submission will have been seen by peer reviewers, but not extensively reviewed. Any supplementary material provided at a later stage in the process may not have been peer reviewed.

The supplementary materials (which include but are not limited to related publications, patient information leaflets and questionnaires) are provided to support and contextualise the publication. Every effort has been made to obtain the necessary permissions for reproduction, to credit original sources appropriately, and to respect copyright requirements. However, despite our diligence, we acknowledge the possibility of unintentional omissions or errors and we welcome notifications of any concerns regarding copyright or permissions.

List of abbreviations

BMI	body mass index
CACFF	category-based analysis for consensus fun factor
CYP	children and young people
ID	identity document
NACFF	number-based analysis for consensus fun factor

NIHR	National Institute for Health and Care Research
PPI	patient and public involvement
PROGRESS	Place, Race, Occupation, Gender, Religion, Education, Socioeconomic status, Social capital
SES	socioeconomic status
YPAG	Young People's Advisory Group
WDOH	wider determinants of health

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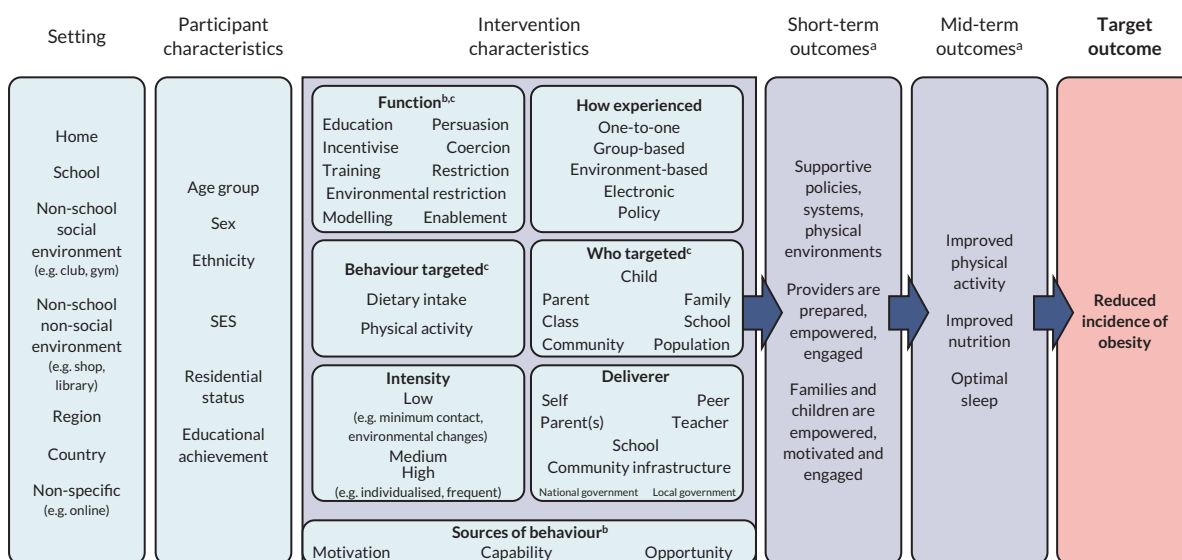
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Appendix 1

Preliminary logic model.



^aBased on O’Connor *et al.* (2015).¹³ ^bBased on Michie *et al.* (2011).¹⁵ ^cMore than one may apply.

Appendix 2

Example of description of the interventions that we send to the CYP for the coding of the 'fun factor'. See [Table 4](#).

TABLE 4 Example of description of the interventions sent to CYP for the coding of the 'fun factor'

Batch 1	
Please read the summary of the 10 strategies aiming to prevent CYP from gaining excess weight and answer the questions in the survey for the strategies in the same order they appear below	
The survey can be found at https://sscm.onlinesurveys.ac.uk/strategies_fun_factor	
Strategy 1	
Strategy ID	Adab 2018
Intended age group	6
Setting	School + home
Strategy summary	Several behaviour change strategies were employed to encourage increased physical activity and improved diet quality. School staff were provided with training and resources for intervention delivery. A termly family newsletter reinforced messages delivered through the various intervention components. The 12-month intervention encouraged healthy eating and physical activity, including a daily additional 30-minute school-time physical activity opportunity, a 6-week interactive skill-based programme in conjunction with Aston Villa football club, signposting of local family physical activity opportunities through mailouts every 6 months and termly school-led family workshops on healthy cooking skills
Strategy 2	
Strategy ID	Annesi 2016
Intended age group	7
Setting	School (after-school programme)
Strategy summary	<p>Youth Fit 4 Life use theory-based behavioural skills to support increased physical activity and healthy eating behaviours occurring both within and beyond after-school care time. It included highly structured daily session of 30-minute/day of moderate to vigorous physical activity and used cognitive-behavioural methods to encourage children to consume healthy foods and beverages</p> <p>The components of the daily sessions were similar and are indicated below:</p> <ul style="list-style-type: none"> • 5 minutes: active warm-up and focus upon a specific movement for the week (e.g. skipping) – 10 minutes: the day's assigned high-intensity activity (e.g. galloping tag); • 10 minutes: alternate days of either a behavioural topic (e.g. positive self-talk[^]) or health topic (e.g. what is a grain?); • 10 minutes: content reinforcement activity where the day's behavioural or health topic was bolstered by a structured physical activity (e.g. complete an assigned physical movement when a whole- vs. refined-grain food is named by a counsellor); • 10 minutes: go-to game consisting of a moderate- to high-intensity game selected by the counsellor from an approved list. Posters supported the health topics, simple apparatus (e.g. cones, foam balls, hoops) supported the physical activities, and an activity sheet supported a participant-specific goal-setting process. <p>In an effort to obtain further support for the physical activity and nutrition behaviours, brief letters explaining what was recently emphasised within the programme, and how it might be supported outside of school, were sent to parents/guardians weekly. In the fifth day of the week, the time allocated to physical activity was left to the discretion of the after-school care counsellor</p>

TABLE 4 Example of description of the interventions sent to CYP for the coding of the 'fun factor' (continued)

Batch 1	
Strategy 3	
Strategy ID	Baranowski 2003
Intended age group	8
Setting	Community + Telehealth + Web
Strategy summary	The intervention was a 4-week summer day camp, followed by an 8-week internet-based programme, plus one Saturday meeting for the girls. The intervention camp blended usual camp activities with activities specially designed for intervention. The specially designed interactive multimedia activities included buddy groups; camp cheers used as mnemonics for decision making, problem solving, and asking behaviours; training in dance; educational games targeted at increasing fruit juice and vegetable (FJV) intake and physical activity (PA); snack recipe preparation; and goal (called 'challenges') setting and review. The weekly website for the intervention girls included: a comic book with characters who attended the summer camp and faced and overcame hurdles in making lifestyle changes consistent with the dietary and PA goals; problem solving for challenges identified in the comic strips; review of attainment of previous week's goal; opportunities to set goals of 5 FJV servings/day, 5 glasses water/day, and 12,000 pedometer counts per day; a photo album of girls from the camp (both individual and group pictures); an 'ask the expert' feature; and links to various Websites of interest to girls. Girls received weekly email and telephone reminders to log-on. The weekly Website for treatment parents included: a comic book in which a parent character commented on each frame of the child's comic.
Strategy 4	
Strategy ID	Barnes 2015
Intended age group	9
Setting	School (after-school programme)
Strategy summary	The MADE4Life programme involved mothers and daughters attending weekly after-school 90-minute sessions over 8 weeks. The major focus of the mother–daughter PA sessions were fun active games, health-related fitness zumba, aerobics, pilates, yoga, rough and tumble play, and fundamental movement skills. Daughters' education sessions focused on developing an active lifestyle, benefits of PA and ways to reduce screen time. The 'daughter's booklet' contained weekly worksheets for daughters to complete with activities (e.g. the importance of PA, fun ways to be active, reducing screen time). Daughters completed weekly 'pink slip' homework tasks that encouraged home PA with their mothers (e.g. creating home-based fitness circuits). Pink slips were reviewed weekly by facilitators and daughters were rewarded with a 'scratch n smell' sticker to attach to a sticker chart. Mothers' education sessions consisted of evidence-based information on PA, behaviour change, role modelling and parenting strategies to support their daughter(s) PA. Sessions focused on the importance of mothers being a positive and active female role model. Mothers were given a 'mother's handbook' to file weekly session outlines and various resources that supported mother–daughter PA (e.g. pedometers, skipping ropes). Mothers were encouraged to set SMART goals and self-monitor their daily PA using pedometers.
Strategy 5	
Strategy ID	Beech 2003
Intended age group	9
Setting	School (after-school programme)
Strategy summary	The active interventions involved highly interactive weekly group sessions with either girls (child-targeted programme) or parents/caregivers (parent-targeted programme). Content focused on knowledge and behaviour change skills to promote healthy eating and increased physical activity. <ol style="list-style-type: none"> 1. Child-targeted intervention "GEMS Jamboree": girls participated in weekly, 90-minute intervention sessions for 12 weeks including "Movin' It" (physical activity component) and "Munchin' It" (nutrition component). Each weekly session concluded with a 'Taking It Home' segment in which the concepts of the day were reviewed, incentives (small gifts) were given, and motivation for healthy eating and the maintenance of physical activity was provided. 2. Eating and Activity Skills for Youth (EASY) was conducted in a 12-week, 90-minute session format that included: a physical activity component of dancing (EASY Moves); a didactic nutrition segment (EASY Tips); and a segment alternating food preparation and nutrition-related games (EASY Fun).

continued

TABLE 4 Example of description of the interventions sent to CYP for the coding of the 'fun factor' (continued)

Batch 1	
Strategy 6	
Strategy ID	Bohnert 2013
Intended age group	9
Setting	School (after-school programme)
Strategy summary	30-week curriculum that includes 10 3-week modules. Each module covered a different sport, health, and leadership topic and was age-appropriate for early adolescents. Each session is led by trained coaches, is approximately 90 minutes in length, and is divided into two areas of focus: 50% covers physical instruction and energetic activity through traditional and non-traditional sports and fitness activities (e.g. rhythm and movement, soccer, flag football, volleyball, tennis, basketball, lacrosse, softball, golf, track and field) and 50% addresses age-appropriate health education, nutrition education, and leadership and life skills topics. The intervention focuses on enhancing girls' health literacy, empowering the girls to believe that they can make healthy choices as well as promoting self-control around health and life choices. A 'girl of the day award' is given to the girl who worked the hardest at each session, along with a small prize. A healthy snack or meal is also provided at every session, along with take-home materials for families to reinforce programme messages.'
Strategy 7	
Strategy ID	Brandstetter 2012
Intended age group	8
Setting	School (after-school programme)
Strategy summary	URMEL-ICE focused on health-promoting behaviour change in three areas: drinking sugar-sweetened beverages, spending time with screen media and being physically active. Main issues were the following: drinking water instead of soft drinks, discovering 'hidden' sugar in drinks, encouraging everyday physical activities, engaging in leisure activities without TV, learning about local sport and leisure facilities. The URMEL-ICE-intervention consists of material for 1 school year including 29 teaching units (each 30–60 minutes), 2 short blocks of physical activity exercise a day (each 5–7 minutes), 6 family homework lessons (tasks that cannot be accomplished by the child himself without the help of a parent) and materials for the training and information of the parents.
Strategy 8	
Strategy ID	Branscum 2013a
Intended age group	9
Setting	School (after-school programme)
Strategy summary	During the 'Introduction & Purpose of lesson' the instructor introduced and reviewed the lesson's key objectives and covered necessary knowledge and skills in order to perform the behaviour the lesson targeted. In the 'Benefits' module, children learnt positive benefits associated with the health behaviour being promoted and sketched a comic-panel showing such a benefit. Next, children participated in 'Role-Playing' with the instructor to practice skills learnt in the lesson in two separate real-world examples: one with a parent or guardian, and one with a peer. Finally, during 'Goal Setting', the instructor reviewed the key objectives of the lesson, children have the opportunity to ask questions about the lesson, and children sketched comic-book panels of themselves setting goals, monitoring and self-rewarding themselves for engaging the behaviour the lesson targeted. The behavioural objectives for each lesson of the experimental intervention were to enable children to: engage in no more than 2 hours of screen time per day (lesson 1), consume water and sugar-free drinks instead of sugar-sweetened beverages (lesson 2), participate in at least 60 minutes of physical activity per day (lesson 3), and consume 5 servings of fruits and vegetables per day.

TABLE 4 Example of description of the interventions sent to CYP for the coding of the 'fun factor' (continued)

Batch 1	
Strategy 9	
Strategy ID	Branscum 2013b
Intended age group	9
Setting	School (after-school programme)
Strategy summary	Each lesson consists of four modules: Introduction and Purpose of lesson, Comic-Book activity #1, Comic-Book activity #2 and Wrap-up. During the 'Introduction and Purpose of lesson' the instructor introduced and covered the lesson's key objectives and taught necessary knowledge and skills in order to perform the behaviour the lesson targeted. In the 'Comic-Book activity #1' and 'Comic-Book activity #2' modules, children learnt an aspect of comic-book creation and sequential art. Finally, during 'Wrap-up', the instructor reviewed the key objectives of the lesson, and children had the opportunity to ask questions about the lesson. The behavioural objectives for each lesson of the comparison intervention were to enable children to: engage in no more than 2 hours of screen time per day (lesson 1), consume water and sugar-free drinks instead of sugar-sweetened beverages (lesson 2), participate in at least 60 minutes of physical activity per day (lesson 3), and consume 5 servings of fruits and vegetables per day.
Strategy 10	
Strategy ID	Breheeny 2020
Intended age group	9
Setting	School
Strategy summary	The Daily Mile involves children doing an extra 15 minutes of activity by running or walking around a track within the school grounds. Schools map out a route or track in their school grounds. The intervention was carried out in lesson time at a time to suit each class during the school day, children left the classroom to run or walk around a predefined route within the school grounds for 15 minutes (on average equivalent to a distance of around 1 mile). The intervention was carried out in all but severe adverse weather conditions and required no change of clothing or footwear and was not a substitute for physical education or break times. While advised as a daily activity, the frequency and duration were at the class teacher's discretion. Class teachers delivered the intervention and were permitted to adapt it for implementation, using motivational material such as certificates, or using it to facilitate learning within another subject area such as Maths.

Appendix 3

The 'fun factor' coding survey.

Strategies fun factor

0% complete

Page 1: Batch number

What is your age?

Please enter the batch number you are about to assess * *Required*

Page 2: Please read strategy 1 summary, write the strategy ID and answer the following two questions

Write here the strategy ID (e.g., Adab 2018) * *Required*

This part of the survey uses a table of questions, [view as separate questions instead?](#)

Answer the following questions

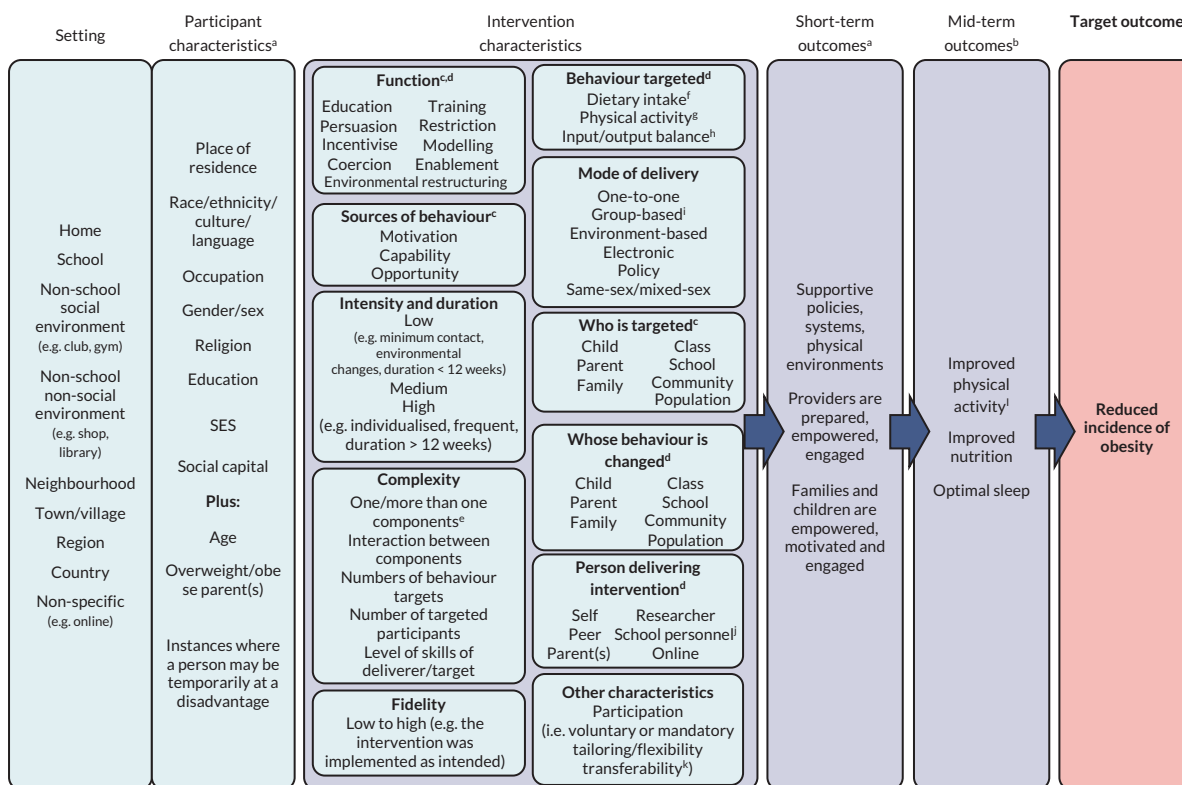
Please don't select more than 1 answer(s) per row.

	Really boring	A bit boring	Neutral	A bit fun	Really fun
How enticing would you find this strategy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
How enticing do you think children in the intended age group would find this strategy?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Do you have any comments you would like to share about this strategy?

Appendix 4

Refined logic model.



^aBased on PROGRESS-Plus.³³ ^bBased on O'Connor et al. (2015).¹³ ^cBased on Michie et al. (2011).¹⁵ ^dMore than one may apply. ^eIntegrated into a package and delivered as single or multiple intervention or delivered as bundle (Lewin et al. 2017). ^fIncluding increase of healthy food and reduction of unhealthy food.¹³ ^gIncluding increase of physical activity and reduction of sedentary behaviour.¹³ ^hMetabolic processes modulators (e.g. sleep; stress). ⁱIf family-based, are parents and/or siblings participants? ^lIncluding teacher, nurse. ^kThe effect of intervention depends on context or setting in which it is implemented.³⁰ ^jIncluding reduction of sedentary behaviour.

Appendix 5

Summary of themes addressed with children, young people and their parents.

BOX 3

Intervention characteristics

- Fun.
- Casual.
- Enjoyable.
- Interesting.
- Interactive.
- Equitable – not excluding poorer families for example implementing local initiatives to get affordable family meals.
- Practical.
- Educational.
- Allowing for choice of activity.
- Integrated into existing 'systems'.

Complexity

- Simple (e.g. rap song as format that make it easy to remember the take-home message).
- Easy to use (e.g. food boxes with instructions and weighed ingredients).

Mode of delivery

- Group-based with class at school, friends, or as a family.

Who targeted

- Target parents/family as well as the student.
- Targeting young children to instil habits from a young age – younger children more likely to do what they are told and have fewer stresses for example exams.

Contents of intervention

Food-related

- Teach children how to cook healthy food.

- Reduce the cost of healthy food in school and increase the cost of unhealthy food.
- Improve the quality of healthy food in school for example chopped fruit in pots, rather than gone off whole fruit.
- Raise awareness about nutrition and side effects of eating unhealthily.
- Limit how much unhealthy food can be bought in school.
- Reduce the amount of unhealthy food on offer in school.
- Increase availability of healthy snacks in the home.
- Involve children in preparing meals.

Movement-related

- Allow for choice of activity to let people do something they enjoy.
- Encourage people to do clubs outside of school.
- Increase physical activity after school.
- General practitioner referral for exercise.
- Make exercise part of routine rather than something extra.
- Change uniform rules to reduce time wasted getting changed for physical education (PE) and this as a barrier to enjoying PE in school.

Setting

- Impact the wider environment for example reducing canteen queues, improving healthy food offering in shops/pharmacies, government initiatives, responsibility of food producers, places for children to socialise that aren't fast food chains.

Person delivering intervention

- Led by a credible teacher for example PE teacher for exercise.
- Role models – parents and famous people can influence what children do by the way they act.
- Peer mentor/'champion'.

Functions from logic model/behaviour change wheel that came up in conversation

- Restriction (e.g. reducing unhealthy food in school or limiting amount people can buy).
- Education.
- Incentivisation.
- Coercion (briefly mentioned – e.g. to ensure people know the side effects of eating unhealthily e.g. on the NHS).
- Training.
- Enablement.
- Modelling (e.g. parents and famous people as role models).
- Environmental restructuring (e.g. changing types of food on offer in school, pharmacies, and increasing after-school clubs).
- Role models – parents, other children (more popular) and famous people can influence what children do by the way they act.

General/other

- Integrate into existing systems.
- Incentives/reward scheme.
- Peer influence/mentoring system.
- Clearly demonstrate what the young person will get in return.
- Use of apps.
- Use a differentiated approach for young children versus older children.
- Focus on mental health, meditation, self-awareness.
- Improve school curriculum – more opportunities to explore more activities and do more cooking.

Consider the language used and the impact this has in different cultures – for example, for an older generation in South Asian culture, being 'plump' is positive. Saying that what is put in lunch boxes helps a child focus or do better at school may be more impactful than saying preventing obesity.

Appendix 6

TABLE 5 Analytic framework and coding manual

Item	Explanation	Question	Answer
Setting	<p>This characteristic is a measure of the setting where the intervention is delivered in the sense of school vs. home vs. community</p> <p>School setting included after-school programmes based at school.</p> <p>Examples of community setting: club, gym, shop, library, healthcare centres</p> <p>Note that if the intervention is conducted within school facilities but set in the community, we will answer No to school and Yes to community [e.g. an intervention in which families attend lessons and cooking classes, that uses the local school facilities (i.e. not necessarily the school that the participating children attend to)]</p> <p>It is possible to answer Yes to more than one of these questions. For example: an intervention that includes a school class on how to prepare healthy meals at home will be coded as Yes for school. If the intervention also includes delivery of a food box at home, we will also answer Yes to home</p> <p>General information for parents (e.g. flyer or newsletter) received at home as part of a wider strategy set in school or community is No to home</p> <p>An intervention that involves a significant component where the parent receives instructions at home to engage the child in behavioural changes (e.g. changes to meals or physical activities) is Yes to home. NB: If the instructions are delivered from the school (e.g. via the child), then this is Yes to school, No to home but Yes to 'home activity'.</p> <p>Examples of child home activity: homework (assigned according to the intervention protocol); cooking or games activities with parents</p> <p>If an intervention is entirely electronic and the study does not specify where the children should engage with the electronic activity (e.g. 'children must log in to a website at school'), then answer No to all. Otherwise answer Yes to the specified location</p>	Is the intervention delivered in a school (in full or in part)?	Yes/No
		Is the intervention delivered in the home (in full or in part)?	Yes/No
		Is the intervention delivered in the community or other non-school and non-home setting (in full or in part)?	Yes/No
		Does the intervention include a home activity for the child?	Yes/No

TABLE 5 Analytic framework and coding manual (continued)

Item	Explanation	Question	Answer
Mode of delivery to the child	<p>This characteristic is a measure of how the child experiences the intervention. Although interventions may be delivered at various levels, the child will experience them in different ways, for example, as an individualised intervention (e.g. a leaflet about healthy meals given to each student at school, a visit to an healthcare centre, homework with parents), through a group of children (e.g. school class or scout troop meeting) or otherwise.</p> <p>Note: if the child experiences the intervention with the parents, we will code it as individual. An electronic intervention is coded as Exclusively or mainly individually.</p> <p>If the intervention is delivered exclusively through electronic media (e.g. an app for exercising to use in the free time; a website to view at home), we will answer Yes exclusively to the second question</p>	How is the intervention delivered to the child?	Exclusively or mainly individually/ Both individually and as a group/ Exclusively or mainly as a group
		Is the intervention delivered to the child electronically?	Yes exclusively/ Yes significantly/ Yes as a minor component/No
Realm targeted	<p>This characteristic is a measure of whether intervention seeks to change diet, activity (including increase in physical activity or decrease in sedentariness) or both</p> <p>Examples of changes in diet include introduction or replacement of food beverages with healthier options; reorganisation of food display in the school canteen or in shops; education on healthy diet; cooking classes; healthy meal box for the family</p> <p>Examples of changes in activity includes intervention that increase physical activity (e.g. modified or additional physical activity classes at school) and interventions that reduce sedentary time at home (e.g. active video games)</p> <p>We will answer Yes exclusively/substantially if the dietary or activity is the only realm targeted or if it is substantial in case of both dietary and activity interventions</p> <p>We will answer Yes minimally if the intervention is mainly one realm and there is a small component of the other realm (e.g. extension of the number of physical activity (PA) classes per week + a poster or leaflet about diet)</p>	Does the intervention aim to change diet?	Yes, exclusively or substantially/Yes minimally/No
		Does the intervention aim to change activity levels?	Yes, exclusively or substantially/Yes, minimally/No
Multifactor-ness/ dimensionality	<p>This characteristic is a measure of how non-simple/complex the intervention is. This includes how many ways the children are targeted, for example, at multiple levels or in multiple phases</p> <p>Interventions targeting the children at multiple levels are those that use different strategies at the same time. Examples of multiple strategies interventions are intervention that include school lectures, school workshops, leaflets and homework</p> <p>Interventions targeting the children in multiple phases are interventions that use different strategies or settings at different time. A multiphase intervention can also be an intervention with a more active phase followed by a less active 'maintenance' phase or a 'top-up' phase</p> <p>Interventions applied for a continuous period are interventions without breaks between the beginning and the end of the intervention (although school holidays don't count as a break in continuity of school-based interventions). Interventions applied for a discontinuous period are these with a break during the intervention (e.g. lectures delivered for 12 weeks/year for 2 years)</p> <p>Examples of multiple strategy interventions delivered in multiple phases are interventions that include an initial series of school lectures at the end of which participants receive leaflets (phase 1) followed by a series of school workshops and homework (phase 2)</p>	Does the intervention use multiple strategies (three or more)?	Yes/No
		Does the intervention applied have a single phase?	Yes/No
		Is the intervention applied continuously?	Yes/No

continued

TABLE 5 Analytic framework and coding manual (continued)

Item	Explanation	Question	Answer
Peak intensity and duration	This characteristic is a measure of how intensely the intervention is experienced by the child. Ideally this would cover the duration and frequency of the intervention In the case of a multiphase intervention, we will add the duration of similarly intense periods. The answer to the question ' How many weeks does the intervention last? ' will be the number of weeks of active intervention. For example, an intervention delivered for 12 weeks/year over 2 school years will be coded as 24 weeks The answer to the question ' During how many weeks does the period of peak engagement with the intervention last? ' we will consider the duration of the period of high engagement, if there is a clear distinction between a period of high engagement and a period of low engagement (e.g. an active period and a maintenance period). Often the total duration and peak engagement period will be the same (unless phases of intensity are explicitly stated) To answer the question ' What is the level of engagement with the children during the peak period? ' we will use the number of sessions of engagement per week as guidance:	How many weeks does the intervention last (the period from baseline to end of intervention)?	Strictly numeric <i>We are calculating the duration in weeks based on 4.33 weeks/month. In case of range duration (e.g. 16–20 weeks, we will take the mean = 18)</i>
	<ul style="list-style-type: none"> • High engagement is typically one or more sessions of engagement with the children per week • Low engagement is typically less than one session of engagement with the children per week 	During how many weeks does the period of peak engagement with the intervention last?	Strictly numeric <i>See above</i>
	NB: These cut-offs are for guidance only. Sometimes the number of sessions per week will not be specified. Coders should use their judgement as to whether the intervention seems high or low intensity For permanent and transient environmental changes (e.g. changes in the display of food at the school canteen) this will be coded as Low	What is the level of engagement with the children during the peak period?	High/Low
Integration	This characteristic is a measure of the extent to which the intervention is 'normalised' within the curriculum or normal habits. This measure provides an indication of how much 'extra effort' (by the provider and/or the recipient) would be required for the intervention to be successful Examples of Yes to intervention that is integrated: modification of physical activity classes; addition of, or replacement of regular school meals with, healthier options Examples of Partially answer is an intervention with a combination of integrated activities and something extra (e.g. after-school programme or homework) Examples of No for an intervention that is not integrated at all: when the school needs to add something to an existing programme (e.g. an extra physical activity class extending school hours) or when the child needs to sign up for/agree to after-school classes After-school programmes (ASP): in case of ASP, the intervention is integrated if it seeks to change the content of an existing ASP and we will answer Yes ; otherwise, it is not integrated, and we will answer No . Electronic intervention: logging on to website is not integrated, receiving (and replying) to texts/messages/links is integrated	Is the intervention integrated into the normal curriculum/habits?	Yes/Partially (p)/ No
Flexibility	This characteristic is a measure of the extent to which the intervention can be implemented flexibly, within the intervention protocol, for example an intervention is adapted to the particular classroom/household at teachers/parents' discretion Example of Yes : an intervention consisting in the replacement of regular meals with healthy meals where the healthy meals are decided by each participating school kitchen staff. Also, an intervention that is tailored to the specific characteristics of the participant (e.g. a dietary intervention that take into consideration what food the child likes or not)	Is the intervention designed to be implemented in a flexible manner/tailored to specific participants?	Yes/No
Choice	This characteristic is a measure of the extent to which participants (children) are free to make the intervention work for them Example of Yes is an intervention in which the child can choose which sport they do or which food to eat within the intervention	Is choice for the child of activity/diet designed into the intervention?	Yes/Partially (p)/No

TABLE 5 Analytic framework and coding manual (continued)

Item	Explanation	Question	Answer
Fun factor	<p>This characteristic is a measure of the extent to which the intervention is designed with the intention to be fun and whether children in the intended age group would find this strategy fun</p> <p>Examples of intervention that may look fun: game, song, play.</p> <p>Example of intervention that may not look fun to all children: sport activity, cooking with the parents.</p> <p>Example of intervention that may not look fun at all: a classroom lectures, replacement of sugar sweetened drinks with water</p> <p>Examples of intervention that children aged 5–11 years (but not an adolescent) will find fun: a song about healthy eating. Similarly, a video game intervention designed for older children (12–18 years old) may not be fun for a 5-year-old child</p>	How enticing would you find this strategy?	Boring/Worse than neutral/ Neutral/Better than neutral/Fun
		How enticing do you think children in the intended age group would find this strategy?	Boring/Worse than neutral/ Neutral/Better than neutral/Fun
Resonance	<p>This characteristic is a measure of the extent to which the effectiveness of the intervention may depend on the degree of respect that young people have for the programme/deliverer, or on the credibility of the person delivering the intervention.</p> <p>An example of Yes answer is an intervention in which the children are encouraged to do physical education (PE) with an external PE teacher or coach. Also, an intervention in which workshops on healthy nutrition are delivered by a dietitian or a nurse.</p> <p>Other examples of role model are professional athletes (e.g. footballer), influencers, peers or older student.</p> <p>An example of No answer is an intervention in which the children are encouraged to do PA by a form teacher or a parent/career.</p> <p>It will be a Yes answer if the intervention is delivered primarily by schoolteachers and one session is delivered for example by a dietitian or a professional PA coach.</p>	Is the intervention experienced by children via someone external or unusual?	Yes/No
Mechanism of action and recipient	<p>This characteristic is a measure of who is the direct recipient of the intervention [e.g. child, the teacher(s), parent(s), the child's environment or others] and how does the intervention aim to achieve a change in the child's behaviour.</p> <p>Note that for complex interventions we may answer Yes to more than one question.</p> <p>An example of an intervention that has a component that requires the child to participate is a session of PA or a workshop on healthy nutrition in which the children are involved in cooking a meal.</p> <p>An example of an intervention that has a component of education or information is a provision of literature or lessons to <i>educate children</i> about the benefits of healthy eating/PA.</p> <p>An example of an intervention that has a component aiming to change the social environment of the child at school or home is an intervention in which teachers are instructed to encourage children to change their dietary or activity behaviours or parents are educated on healthy food. Training the teachers to deliver the intervention will normally be answered as No.</p> <p>Examples of interventions that have a component aiming to change the physical environment of the child (at school or home) include the placement of healthy foods in the school canteen, provision of exercise equipment at school or in the community; drawing running tracks in the playground; changing the school meal menu.</p>	Does the intervention have an explicit component that requires the child to participate?	Yes/No
		Does the intervention have an explicit component of education/information provision for the child?	Yes/No
		Does the intervention have an explicit component aiming to change the social environment of the child (e.g. at school or home)?	Yes/No
		Does the intervention have an explicit component aiming to change the physical environment of the child (e.g. at school or home)?	Yes/No
Commercial interests	<p>This characteristic is a measure of whether commercial interests are involved in the intervention (e.g. industry involvement).</p> <p>An example of Yes answer is an intervention within a study that was funded by industry (e.g. food industry, manufacturer of sport equipment), even if the authors stated there were no conflict of interests.</p>	Are commercial interests involved in the intervention?	Yes/No

Appendix 7

TABLE 6 Results of coding active interventions arms in the age 5–11 years and 12–18 years groups

Characteristic	Answer	Age 5–11 years (n = 188) ^a n (%) ^b	Age 12–18 years (n = 67) ^a n (%) ^b
Setting			
Delivered in school	Yes	136 (72.3)	44 (65.7)
	No	52 (27.7)	23 (34.3)
Delivered in the home	Yes	38 (20.2)	9 (13.4)
	No	150 (79.8)	58 (86.6)
Delivered in the community or other setting	Yes	50 (26.6)	22 (32.8)
	No	138 (73.4)	45 (67.2)
Includes a home activity	Yes	71 (37.8)	20 (29.9)
	No	117 (62.2)	47 (70.1)
Mode of delivery			
Delivered to the child	Individually	26 (13.8)	18 (26.9)
	Individually and as a group	57 (30.3)	21 (31.3)
	As a group	105 (55.9)	28 (41.8)
Web component			
Delivered electronically	Exclusively	8 (4.3)	8 (11.9)
	Significantly	9 (4.8)	8 (11.9)
	As a minor component	15 (7.9)	6 (9.0)
	No	156 (83)	45 (67.2)
Realm targeted			
Aims to change diet	Exclusively or substantially	136 (72.3)	50 (74.6)
	Minimally	11 (5.9)	2 (3.0)
	No	41 (21.8)	15 (22.4)
Aims to change activity	Exclusively or substantially	161 (85.6)	46 (68.7)
	Minimally	4 (2.2)	3 (4.4)
	No	23 (12.2)	18 (26.9)
Multifactor-ness and dimensionality			
Uses multiple strategies	Yes	124 (66)	37 (55.2)
	No	64 (34)	40 (44.8)
Applied in a single phase	Yes	156 (83)	51 (76.1)
	No	32 (17)	16 (23.9)
Applied for a continued period	Yes	181 (96.3)	65 (97.0)
	No	7 (3.7)	2 (3.0)

TABLE 6 Results of coding active interventions arms in the age 5–11 years and 12–18 years groups (continued)

Characteristic	Answer	Age 5–11 years (n = 188) ^a n (%) ^b	Age 12–18 years (n = 67) ^a n (%) ^b
Peak intensity and duration			
Total duration	Mean weeks (SD)	50.8 (45)	32.4 (29.5)
Peak period duration	Mean weeks (SD)	44.1 (44.1)	26.8 (27.7)
Level of engagement with the child	High	112 (59.6)	40 (59.7)
	Low	76 (40.4)	27 (40.3)
Integration			
Integrated into the normal curriculum/habits	Completely	85 (45.2)	36 (53.7)
	Partially	45 (23.9)	10 (15.0)
	No	58 (30.9)	21 (31.3)
Flexibility			
Implemented in a flexible/tailored manner	Yes	64 (34)	22 (32.8)
	No	124 (66)	45 (67.2)
Choice			
Designed to have choice of activity and/or diet	Yes	44 (23.4)	22 (32.8)
	No	144 (76.6)	45 (67.2)
Fun factor			
How enticing for children in the intended age group	Fun	120 (63.8)	34 (50.7)
	Boring	45 (23.9)	26 (38.8)
	Neutral	23 (12.2)	7 (10.5)
Resonance			
Experienced via someone external or unusual	Yes	96 (51.1)	38 (56.7)
	No	92 (48.9)	29 (43.3)
Mechanism of action and recipient			
Participation	Yes	131 (69.7)	39 (58.2)
	No	57 (30.30)	28 (41.8)
Provision of education/information	Yes	135 (71.8)	55 (82.1)
	No	53 (28.2)	12 (17.9)
Change in child social environment	Yes	137 (72.9)	38 (56.7)
	No	51 (27.1)	29 (43.3)
Change in child physical environment	Yes	63 (33.5)	16 (23.9)
	No	125 (66.5)	51 (76.1)
Commercial interests			
Commercial interests in the trial and/or intervention	Yes	21 (11.2)	6 (9.0)
	No	167 (88.8)	61 (91.0)

a One intervention conducted in both age groups.

b Except for duration which is reported as mean and SD.