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NIHR | Policy Research Unit in Behavioural Science

Changing behaviour in families

Behaviour change techniques for healthy weight services to support families with children aged 4-11 years

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Executive summary

Public Health England is responsible for supporting local areas with the provision of advice to enable delivery of tier 2 healthy weight programmes for families. This guide summarises work to explore the behaviour change techniques (BCTs), which should feature in approaches to support families with primary school-aged children (4-11 years) on a healthy weight journey. Such approaches fit within a local place based whole systems approach to promoting a healthy weight. The behaviour change techniques referred to in the guide are from the Behaviour Change Centre Techniques Taxonomy Version 1 (BCTT.v1). Practical examples of how each behaviour change technique might be applied are provided, tailored to their flexible use for the whole family, including caregivers, children and other family members. The use of behaviour change to support healthy weight approaches for families and children remains an emerging field and the use of BCTs have not yet been formally identified, an exploratory approach was used to identifying suitable BCTs for approaches that target these groups.

This evidence-informed consensus guide is based on a literature scoping review of behavioural interventions and a 2-staged Delphi survey with input from subject matter experts, service providers and commissioners. It provides a pragmatic approach for translating frameworks into practical examples to guide the application of behaviour change support for specific populations, that is families and children.

This guide is for commissioners and providers of services to promote the integration of behaviour change support for whole families and children, and to prompt further research in this area.

Identifying relevant behaviour change techniques

Introduction

Guidance on weight management approaches for children who are above a healthy weight recommends strategies for changing the behaviour of the child or young person and all close family members as one of the core elements, including BCTs (1). A comprehensive list of the evidence-based 93 BCTs targeting health behaviour change is currently available (2). PHE have previously published a guide with BCTs to support the provision of tier 2 adult weight management services (3). Overall, published resources formally documenting the provision of behaviour change support predominantly target adults (2). Comparable tools for children are scarcely available (4-6), and despite BCTs being present in all behaviour change interventions, researchers have only recently begun formally identifying BCTs in the context of pediatric health behaviour change. Although literature has documented the effectiveness of behavioural interventions for children on their BMI (Body Mass Index) z-score (4), there is a need for a practice-oriented guide on how behaviour change support can be actively embedded within healthy weight approaches for families, and which behaviour change techniques may be suitable for this particular target group.

This work was undertaken to explore the relevance and applicability of evidence-based BCTs for inclusion in effective weight management interventions aimed at families with at least one child above a healthy weight (that is exceeding a relevant cut-off point on a growth reference, for example ≥91st centile of the UK 1990 charts). The resulting evidence-informed consensus guide is intended to support commissioners when developing specifications for procurement, to enable commissioners and providers to utilise appropriate BCTs to support families, and to provide input for researchers to develop appropriate methods to evaluate and understand impact of behaviour change tools in interventions. It can also provide value for practice to complement and support existing healthy weight programmes (5).

BCTs are seen as the observable, replicable, and active ingredients in an intervention that directly bring about behaviour change (6). Although BCTs were originally developed for adults, they are now being increasingly used to support behaviour change in children. This is reflected in findings from recent interventions and programmes to support families with children above a healthy weight, where the use of BCTs was associated with positive health outcomes, including a decrease in

BMI (7, 8). In addition, the CALO-RE Framework has been developed specifically for interventions that target healthy eating and physical activity with adjusted definitions, descriptions and novel techniques (9). There is some evidence suggesting that interventions and programmes that utilise BCTs to provide healthy weight support for families and children may lead to positive health outcomes, including a decrease in BMI z-score (7, 8).

BCTs should be tailored to the population need, including individuals' preferences and contextual factors (10). As children have specific developmental needs and are at a different level of cognitive development to adults, they are more dependent on their environment and caregiver, thus the use of certain BCTs to specifically target children has been rarely documented, for example in relation to stress management (11), which might be perceived as more appropriate for their use with adults. Evidence suggests that a number of BCTs, including goal setting (11-13), self-monitoring of behaviour (14-16), instructions on how to perform the behaviour (17), and restructuring of the physical environment may be effective for childhood weight management (17, 18).

Methods

A mixed-methods approach was used to develop the present guide and consisted of multiple steps which were:

- BCTs from interventions targeting children aged 4-11 years scoped and coded from the literature, based on the BCTTv.1 with the primary outcome including child weight
- a Delphi study conducted with expert consensus regarding suitability of BCTs in the context of this guide
- in a second Delphi phase, practical examples identified providing guidance on usability of use and application within real-world settings

More details about the method can be found in Annex 1. This exploratory approach was chosen as most behaviour change intervention trials tend to be complex and the evidence and terminology is not consistently described (19). These 2 issues contribute to difficulties in ascribing effectiveness to mechanisms in different ways, including isolating effects of individual BCTs and understanding exactly what was done and therefore mapping consistency across studies. Due to lack in consistency and poor reporting of BCTs in documented intervention studies, the review aimed to use the BCTTv.1 taxonomy in an effort of identifying BCTs from effective interventions as a first step towards establishing consensus about which techniques should be applied to support families in managing their child's weight. The Delphi method aimed to overcome some of these pitfalls by triangulating the findings, taking into account expert participants' personal view on available evidence and

experience of applying BCTs in this context. This means that the current work forms an evidence-informed consensus guide, and not an evidence-based guide. Although the intention was initially to code BCTs from both the BCTTv.1 and the CALO-RE framework, the final tables with BCTs (Tables 1,2 & 3) are exclusively based on the BCTTv.1 as the CALO-RE framework did not offer any additional BCTs in addition to the BCTTv.1, and therefore did not provide additional value in the context of this exercise.

Findings

The scoping review identified a total of 105 eligible papers, including 29 BCTs from at least one intervention arm, were subsequently included in the Delphi survey to seek consensus regarding their suitability for inclusion in the guide. The Delphi survey concluded that 19 BCTs should be included in the guide, including 16 BCTs for the whole family, 7 BCTs for the parent/primary caregiver and 2 BCTs for the child alone. Three techniques, which emerged towards the upper end of the suitability scale and which characterise the essence of key behavioural support in these approaches, include:

- self-monitoring of behaviour, which supports families to track and monitor goals and changes, making use of non-digital and digital approaches
- restructuring the physical environment, which encourages families to modify their living environment to maximise behaviour change, for example increase access to healthier food and drink items and if present, moving less healthier items out of sight
- relapse and coping strategies, which supports families on managing challenging situations that can trigger less healthy behaviours

Tables 1, 2 and 3 provide examples of how each BCT might be applied in practice in the context of these groups, including the whole-family, parents/caregivers[1] and children alone. More details on the findings from the scoping review and the Delphi process are available in Annex 1. There is research which indicates that targeting the entire family in weight management interventions for children can be more effective than involving children or parents/ caregivers alone (20). Therefore, it is suggested to begin with Table 1, although the additional list of BCTs suggested for the parent/primary caregiver and the child alone are relevant for specific components of an intervention that are designed to engage the child or parent/primary caregiver alone. This format would align with the typical structure of tier 2 family weight management services, where separate sessions are offered to target the whole family, parents/caregiver and children separately (21).

[1] Caregivers is a term used throughout the document to denote primary and other caregivers who look after and take responsibility for the direct care of a child/children.

Considerations

This Delphi exercise enabled a breadth of view and a holistic perspective regarding the suitability of BCTs, taking into account available evidence (with its gaps), including the practical experience of applying BCTs in the context of families. The small sample size of the Delphi respondents (n=7) limits the generalisability of the consensus exercise. Due to limited time resources, it was not possible to revalidate examples for additional BCTs identified through the second Delphi round with the same panel. However, this gap was addressed by asking relevant subject matter experts to validate these examples in a final peer review of the document. Feedback on the utilisation of this guide is therefore encouraged.

A further consideration is that there may be inconsistencies in defining families as the target group due to a lack of detail reported in studies about which family members participated in the interventions. Due to the ill-defined and variable concept of 'family' across studies, BCTs addressing multiple family members (rather than solely parents/caregivers or children) should be identified in a way that enables adjustment to the unique family context, including parent/caregiver, child and additional family members who may be relevant, such as siblings, grandparents or extended family.

Concluding remarks

There are a number of considerations about the methodology and findings which the reader should be aware of. As the nature of this scoping review was pragmatic, it lacks the rigour of gold standard systematic reviews and meta analyses. However, this pragmatic approach aims to align practice and policy needs with the vagaries of scientific pursuit. It was identified as an appropriate way and initial step in developing an evidence-informed consensus guide. Furthermore, the heterogeneity of combinations and varying numbers of BCTs across different interventions limited the validity of the current findings due to BCTs not being independent of each other and making comparison of the effectiveness across BCTs challenging. As a next step, a meta analysis could be carried out to address this gap. Those individuals responding to the Delphi exercise were specifically encouraged to consider findings of the literature review when rating BCTs, where information regarding study effectiveness were provided in the form of a ratio (calculated by dividing the total study numbers by numbers of effective studies).

Learning points from this work which could inform future research

The review demonstrates the necessity for more transparent reporting of frameworks (for example the BCTTv.1) that inform the intervention design, and

precise coding of behaviour change techniques in alignment with existing taxonomies, including a clear description of how they have been applied.

Further insight is required to determine which BCTs are effective, that is associated with successful weight management in families. It is essential to develop such knowledge so that family weight management intervention designers, service commissioners and service designers can improve the provision of behaviour change support in a context where weight management is a critical outcome.

Research is required to understand under what conditions and in what context BCTs are more effective, for example in combination with specific other BCTs, or particular delivery mode.

BCTs should be increasingly tailored and adapted to children's specific needs in order to facilitate uptake in interventions that actively involve children as the main agent of change. Additionally, more research is required to consider relevant age-appropriate adaptions for children at the lower end of the age range (that is 4-5 years as this age range is covered less frequently in the current evidence based), or to identify effective BCTs targeting the parent for this particular group.

BCTs that are less commonly embedded into behaviour change interventions, such as Exposure, Self-talk and Comparative imagining of future outcomes, require further exploration and specification regarding their applicability in the family context to target weight management, as they could offer innovative and effective alternative and/or supplementary approaches to more frequent BCTs, such as Goal-setting and Self-monitoring.

Suggested behaviour change techniques for the whole family, parents/caregivers and children

Table 1. Suggested Behaviour Change Techniques that specifically target the whole family

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Goals and planning	Goal-setting (behaviour)	Set or agree on a behavioural goal defined in terms of the behaviour to be achieved	• regularly support family to select goals from a menu (for example eating more fruit) and develop a plan. The provider should give families autonomy around their goals by providing choice and respecting families' ability to select what is the right approach for them. Each family member may have their own goals they are working towards • service provider explores families' current lifestyle behaviours and, considering family needs, supports setting of achievable and realistic behavioural goals • provider ensures families set goals that are 'SMART' (that is small, measurable, achievable, relevant, timely), considering that global goals (for example writing shopping lists) will slightly differ from an individual goal (for example not buying sweets)

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Goals and planning continued	Problem solving (includes Relapse prevention and Coping planning)	Analyse, or prompt the person to analyse, factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators	• explore personal (for example boredom) and environmental barriers (for example lack of outdoor space) when healthy eating and getting active. Consider various scenarios in life, such as on the way to and from school, weekends, holidays etc. Support the family in coming up with solutions and coping skills, for example preplanning the behaviour and spending quality time together • encourage families to identify obstacles that could prevent them from reaching the goal, and how these could be prevented or overcome • provide support on managing challenging situations that can trigger less healthy behaviours (for example eating out of boredom, excessive screen time, lack of outdoor activity opportunities during winter) with regular refreshers about the importance and strategies on how to keep up the behaviour change
	Action planning	Prompt detailed planning of performance of the behaviour (must include at least one of context, frequency, duration and intensity). Context may be environmental (physical or social) or internal (physical, emotional or cognitive) (includes 'Implementation Intentions'	• prompt the planning of healthy habits, such as discussing the importance of planning in advance and choosing the healthier option in higher risk situations (for example, celebratory occasions including birthdays, when eating out etc.)

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Goals and planning continued			• provide simple options to support the families to identify and plan to be more active, for example go for a walk to the local park, use the stairs instead of the elevator or escalator, and ideas for both outdoor and indoor games • provide simple and affordable meal plans (using, for example, Change4Life recipes), and instruct families to use these plans, along with shopping lists, to increase adherence to the diet weekly meal plans over time
Feedback and monitoring	Self-monitoring of behaviour	Establish a method for the person to monitor and record their behaviour(s)/ outcomes of the behaviour(s) as part of a behaviour change strategy	• advise families to keep a behaviour diary (non-digital or digital) in which diet, physical activity, and sedentary behaviours, and other potential behaviours (for example purchasing and food preparation behaviours) are recorded daily in alignment with previously set goals • support the use of monitoring records (non-digital or digital) of food, drinks and physical activity from baseline to the end of the service by visualising the foods and drinks consumed, and the average minutes of physical activity per day from week to week during the intervention to record changes. Changes could be visualised using progress bars. Over time (that is after 4 months) introduce a simpler weekly tick sheet that families can continue to use after completing the service

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Feedback and monitoring continued	Feedback on behaviour	Monitor and provide informative or evaluative feedback on performance of the behaviour (for example form, frequency, duration, intensity)	• identify ways in which families currently incorporate healthy eating and physical activity into their lives, and provide personalised feedback, reinforcing positive changes. For example, provide parents/caregivers with feedback about how the nutritional quality of the meals they prepare for their children differs from recommendations in the Eatwell Guide. This could be based on the outcomes of activities based on the BCT self-monitoring of behaviour. For families who have not started to take steps to change behaviour, feedback should be provided in a positive manner that highlights opportunity for change
Social support	Social support (unspecified)	Advise on, arrange or provide social support (for example from friends, relatives, colleagues,' buddies' or staff) or noncontingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour	• encourage parent/ caregiver to organise common (healthy) family activities with opportunities for shared positive experiences and exchange, for example going to the cinema or an outdoor trip at the weekend • facilitate group discussions between families who are using the service, encouraging them to offer suggestions to the group • advise families on how they might get support from their social network to manage gaps between sessions, such as peer support groups (digital and face to face) or having a family member or friend take their child to a play session for an afternoon

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Shaping knowledge	Instructions on how to perform a behaviour	Advise or agree on how to perform the behaviour (includes ‘Skills training’)	• provide suggestions on how each behavioural goal might be reached, for example how to plan and prepare healthier meals • provide information and resources on how families can increase health behaviours, for example physical activity at home and as part of their everyday life. Child-specific material should be in the form of active play and discussion in age-appropriate manner • provide handouts for all family members, incl. siblings, relatives and grandparents, with information of how to change health behaviours (see Change4Life materials) • prompt use of an interactive whole-family quiz that contains questions about health behaviours to reinforce families’ understanding and confidence. This could include information about the Eatwell Guide; 5 a day; and raising awareness of the amount of sugar in food and drinks (see Change4Life food scanner app)
Comparison of behaviour	Demonstration of the behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly for example via film, pictures, for the person to aspire to or imitate (includes ‘Modelling’).	• demonstrate through videos, in-person, or family testimonials, practical behaviours families can do every day, for example how to prepare healthy meals and snacks and how to plan meals and encourage families to try these behaviours at home

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Associations	Prompts/ Cues	Introduce or define environmental or social stimulus with the purpose of prompting or cueing the behaviour. The prompt or cue would normally occur at the time or place of performance	• provide salient reminders that reinforce healthy eating information, for example shopping baskets with the Eatwell Guide, to encourage healthier choices during food shopping and meal preparation • prompt families to post their action plan in a prominent place in their home as a reminder to continue working towards their health goals
Repetition and substitution	Behavioural practice/ rehearsal	Prompt practice or rehearsal of the performance of the behaviour one or more times in a context or at a time when the performance may not be necessary, in order to increase habit and skill	• facilitate the practice of preparing healthy meals in a group setting, for example through interactive cooking classes with culturally diverse meals • offer guided supermarket tours to families with healthy shopping tips • prompt parents' and caregivers' engagement in agreed activities with their child/children between sessions to practice newly acquired skills and behaviours, such as grocery scavenger hunts • provide links to community-based activity programmes based on existing local offers • facilitate physical activity sessions such as dance classes with providers participating regularly in the training sessions, to encourage the children and provide practical examples

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Repetition and substitution continued			• facilitate role play to teach children and parents/caregivers how to communicate effectively, for example how to negotiate and set screen limits, and how to motivate and encourage each other in a positive manner
	Behaviour substitution	Prompt substitution of the unwanted behaviour with a wanted or neutral behaviour	• encourage families, throughout the programme, to replace sedentary behaviours (for example television viewing and video game use) with alternative more active behaviours (for example dancing, hula-hoop) • suggest healthier substitutions for less healthy eating habits, such as healthier alternatives to commonly consumed high-sugar foods and drinks
	Graded tasks	Set easy-to perform tasks, making them increasingly difficult, but achievable, until behaviour is performed	• start introducing small changes towards the behavioural goal taking small steps with specific, incremental goals, for example increase fruit and vegetable consumption gradually towards at least 5 daily portions, or aim for more water to replace sugary drinks • support families in maintaining and/or further enhancing previously achieved goals, for example increasing 2 active sessions to 3 per week. Reinforce the importance of undertaking small changes at a time, for example, Change4Life 10 Minute Shake Up

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Antecedents	Restructuring the physical environment	Change, or advise to change the physical environment in order to facilitate performance of the wanted behaviour or create barriers to the unwanted behaviour (other than prompts/cues, rewards and punishments	• encourage families to modify their environment to maximise behaviour change, for example increase access to healthier food and drink items by placing a bowl of fruit in a visible and accessible place, reduce access to less healthy food and drink items by keeping snacks in a closed cupboard. Replace sedentary behaviours with more active ones by providing active video games or devices with augmented reality

Table 2. Suggested Behaviour Change Techniques that specifically target parents/caregivers

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Goals and planning	Goal setting (behaviour)	Set or agree on a goal defined in terms of the behaviour to be achieved	• prompt parents/caregivers to set specific goals that aim to support healthy behaviours in their child or the whole family, such as changing shopping habits or scheduling physical activity sessions (also see examples for Goal-setting in Table 1).
	Problem solving (includes Relapse prevention)	Analyse, or prompt the person to analyse, factors influencing the behaviour and generate or select strategies that include overcoming barriers and/or increasing facilitators	• identify and discuss potential threats/obstacles (situations, contexts or emotions) the parent/caregiver can see to maintaining the new behaviour and develop strategies to either avoid these situations (for example not buying cookies) or manage them • discuss and agree strategies how to maintain the behaviour(s) across time, for example by reflecting on benefits experienced through initial behaviour changes • introduce and reinforce the use of positive parenting and caring skills in order to cope with relapse-relevant critical situations to develop strategies to cope with (anticipated) barriers to relevant health behaviour, such as fussy eating • identify sources of support families can access after the service ends to help maintain behaviour changes over time and to prevent reverting to previous behaviours when facing obstacles and when motivation might fluctuate. Ideally this should come from someone who they have already built up a relationship with, and who they trust and respect

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Goals and planning continued	Behavioural contract	Create a written specification of the behaviour to be performed, agreed on by the person, and witnessed by another	• provider negotiates a behavioural contract with the parent/caregiver in which parents/caregivers (and potentially also their children) set goals. A behaviour change start date should be added to the contract and the parent/caregiver (and child) should commit to carrying out behavioural goal by writing statements in first-person language, for example “I will prepare family dinners from scratch 3 times every week, containing at least one serving of vegetables”, and adding their signature(s).
Feedback and monitoring	Self-monitoring of behaviour	Establish a method for the person to monitor and record their behaviour(s) as part of a behaviour change strategy	• encourage parents/caregivers to complete diaries (non-digital or digital) to record the family’s health-related activities during the day with relevant details (for example what, where, with whom). Examples of such activities might include healthier eating or being active, but also related behaviours that are relevant, for example shopping differently or stopping conflicts during mealtimes • encourage parents/caregivers to regularly log their progress against all goals set

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Social support	Social support (unspecified)	Advise on, arrange or provide social support (for example from friends, relatives, colleagues, 'buddies' or staff) or noncontingent praise or reward for performance of the behaviour. It includes encouragement and counselling, but only when it is directed at the behaviour	• support parents/caregivers to work with their child/ children as a 'team' and to join them in making healthy behaviour changes, for example by planning in regular time to spend together as 'quality time' • empower the parent/caregiver to identify and utilise their existing social network for support in carrying out and maintaining behaviour changes, for example by asking their partner/spouse to nudge them and help remember meal planning
Natural con-sequences	Information about health consequences	Provide information (for example written, verbal, visual) about health consequences of performing the behaviour	• discuss health benefits of being a healthy weight and eating in a healthy way, as well as risks associated with children being above a healthy weight

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Natural con-sequences continued			• explore the benefits of healthy eating behaviours (for example appropriate portion sizes, regular family meals, avoiding snacking during screen time) and being active (for example moderate physical activity, active play time) with the aim of providing essential knowledge and empowering parents/caregivers in making healthier choices. Interactive and visual methods should be used to reinforce information, for example the Eatwell Guide. Benefits can be health-related or in relation to behavioural and psychosocial outcomes (for example more energy and enjoyment after exercise). The importance of factors that indirectly influence weight management should be covered in addition (if relevant), such as sleep routines, and the parents/caregivers perceived child's self-esteem • information provision should focus on one topic at a time, and introduce new information gradually, for example in weekly sessions
Comparison of behaviour	Demonstration of the behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly for example via film, pictures, for the person to aspire to or imitate (includes 'Modelling').	• demonstrate solutions to challenges using role plays reinforcing positive parenting/caring skills, either in-person or through video clips, for example how to talk to their children about food and drink options. Offer alternative positive alternatives to less helpful strategies by using concrete examples • model to parents/caregivers how to incorporate more health behaviours, such as being more active, into their daily lives, either through films or in-person modelling

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Identity	Identification of self as role model	Inform that one's own behaviour may be an example to others	• increase the parent's awareness of their own food, physical activity and behavioural habits, in order to strengthen their modelling role to their child • if parents/caregivers require support to change then refer to other behaviour change techniques (for example *Goal-setting*) to help change their own behaviours, and thereby becoming a better role model for their child • ask parents/caregivers to reflect back on their own experiences of being parented that is when they were children. Identify good and less positive experiences (for example using material on family food rules). Generalise experiences to physical activity and other relevant health behaviours • reflect on how different family members or friends can set a positive example for healthy eating and physical activity, picking good and less examples. Discuss how they could take the good examples forward, for example by incorporating more vegetables into their own diet, or by walking instead of taking the car where possible, etc.

Behaviour Change Category	Behaviour Change Technique	Definition	Examples
Identity continued	Framing/ reframing	Suggest the deliberate adoption of a perspective or new perspective on behaviour (for example its purpose) in order to change cognitions or emotions about performing the behaviour (includes 'Cognitive structuring')	• challenge parents'/caregivers' beliefs, such as the need to have snacks and drinks high in fat, sugar and/or salt at hand for child constantly, viewing overweight children as healthy, reluctance to deny children additional helpings, and using food as a reward • discuss the impact of negative thoughts on feelings and how changing these thoughts can support behaviour change. Support parents/caregivers in identifying their unhelpful thoughts in relation to diet and exercise (for example "My child will never eat any vegetables I prepare") and then replacing these with alternative, more helpful thoughts (for example "It is challenging to get my child to eat vegetables, however there are different ways that can help address this, for example I could try introducing new vegetables we normally don't eat, or 'hide' vegetables in my child's favourite meal") • normalise children's challenging behaviours, stressing that this a natural development stage and help parents/caregivers create realistic expectations about change

Table 3. Suggested Behaviour Change Techniques that specifically target children

Behaviour Change Category	Behaviour Change Technique	Definition	Examples of application
Comparison of behaviour	Demonstration of the behaviour	Provide an observable sample of the performance of the behaviour, directly in person or indirectly for example via film, pictures, for the person to aspire to or imitate (includes 'Modelling')	• facilitate interactive sessions with cooking demonstrations to allow children to gain exposure to a variety of vegetables, observe cooking techniques, improve confidence about using cooking skills and experience the preparation of recipes using all 5 senses. Recipes should be culturally diverse and in alignment with the Eatwell guide • demonstrate physical activities to children and prompt them to imitate them. Activities should promote fun, active or competitive play led by instructors, using basic and affordable elements of vigorous activity, for example dancing, playing games and the Change4Life 10 Minute Shake Up.
Reward and threat	Social reward	Arrange verbal or non-verbal reward if and only if there has been effort and/or progress in performing the behaviour (includes 'Positive reinforcement')	• praise children for completing homework activities between sessions • reinforce child's positive steps of working towards healthy behaviours or by doing a family activity together. Different reward systems can be used, such as point charts or family activities (for example fun days out). Using food and drinks as a reward should be avoided

Annex 1: Literature review and Delphi Survey

Methods

The primary purpose of the initial literature review was to scope out BCTs being used in behavioural lifestyle interventions with complimentary information about their application, target group and delivery mode. These insights were compiled and shared with respondents from the Delphi survey (stage 2) for consideration and rating of the suitability of techniques in the family context for respondents. The criteria for the final decision was therefore based on the median score from 2 rounds of questionnaires to seek consensus between participants.

Literature scoping review

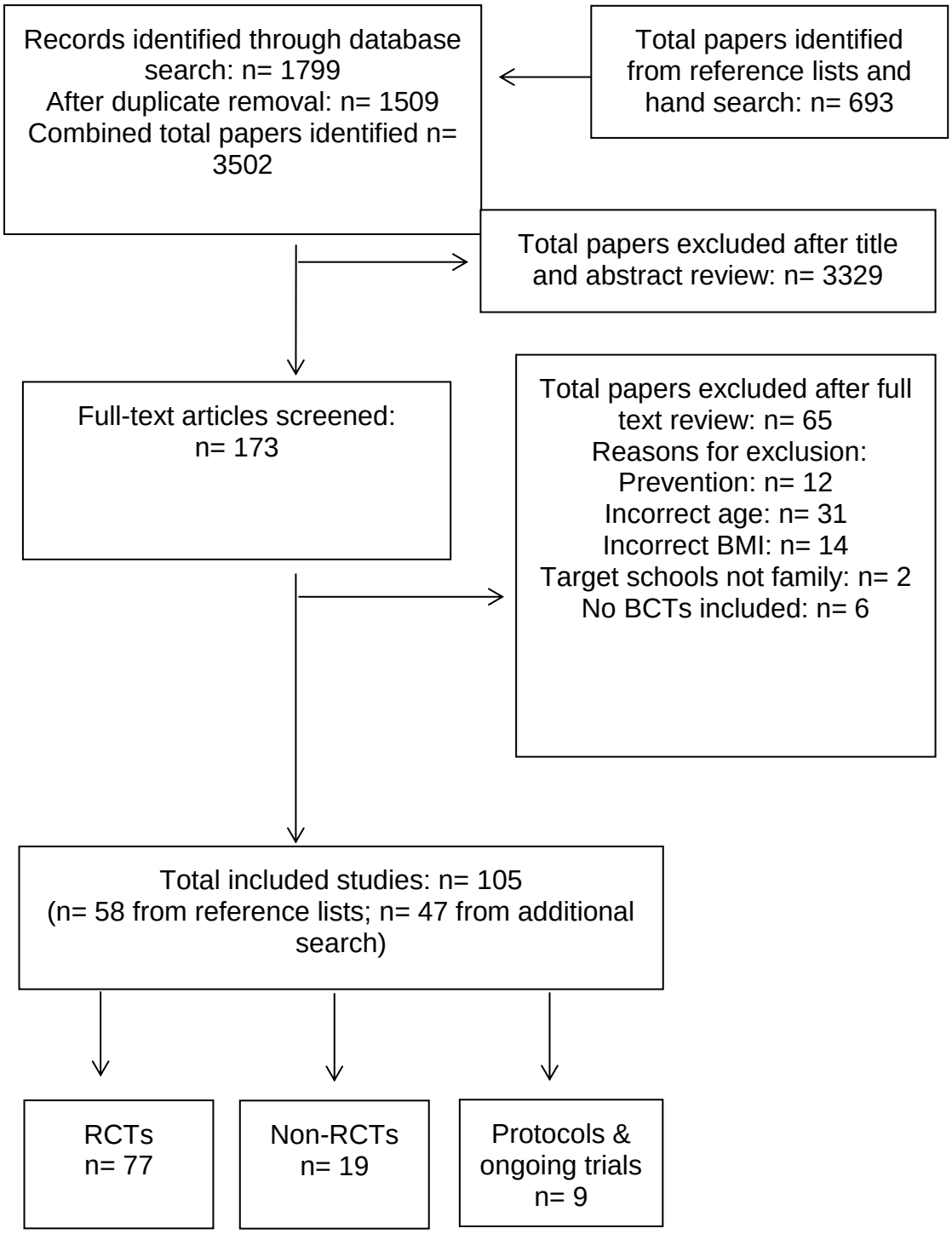
A literature scoping review was conducted initially to identify the use of behaviour change techniques from the BCTTv.1 (2) and CALO-RE taxonomy (9) for the treatment of overweight and obesity in primary school aged children. The CALO-RE framework was not included in the final list for the guide because the additional use of this framework did not offer any additional BCTs in addition to the BCTTv.1. Studies from a previous review were included, and an updated search was conducted using a similar search strategy with slight adjustments to the age range and specific terms relating to BCTs (4). The data bases Medline, PsycINFO and CINAHL were searched between 2nd and 6th July 2018, using the following search terms:

[Population:]
(Children OR paediatric OR pediatr* OR famil* OR “schoolchild* OR “schoolchild” OR boys OR girls OR parent* OR grandparent* OR sibling*)
AND
(obes* OR overweight)
[Intervention:]
“behaviour* change*” OR “behaviour change intervention*” BCT* OR “behaviour change strateg*” OR “behaviour* therapy” OR “behavior* change*” OR “behavior change intervention*” BCT* OR “behavior change strateg*” OR “behavior* therapy” family therapy OR “parent* intervention” OR “health promotion” OR “health education” OR prevention OR treatment OR “peer support” OR social support” OR psychotherapy OR “cognitive therapy” OR “lifestyle intervention*” OR “life style intervention*” OR “lifestyle change*” OR “life style change” OR treatment OR prevention)

AND
[Outcomes:]
(fitness OR health OR “weight management” OR “healthy weight” OR “weight changes” OR “weight loss” OR BMI OR “body mass index” OR “weight reduction” OR “weight gain” OR “body weight change*” OR “body weight” OR fitness OR nutrition* OR diet* OR vegetable* OR fruit* OR “unhealthy eating” OR “healthy eating” OR “physical education” OR “sedentary behaviour*” OR “sedentary behavior” OR “physical activity” OR “physical inactivity” OR exercise OR exercising)
AND
[Design:]
(“randomized controlled trial” OR RCT OR meta-analysis OR “systematic review” OR “experimental study” OR “intervention stud*” OR “controlled clinical trial” OR randomized OR placebo OR trial)

The list of identified papers was supplemented by a google scholar search including the first 100 hits, using the same keywords, and hand searches of reference lists from relevant reviews and papers. Searches were limited to English language. The main inclusion criteria were: the study described an intervention, which did not necessarily have to be an experiment with reported outcomes but could be in the form of an intervention protocol, the main target was overweight and obesity treatment in children between the ages of 4 and 11 years. Interventions that solely tested the impact of physical activity, education, and/or calorie-controlled diets with no behaviour change element were excluded, as were interventions that combined drug treatment or surgery with BCTs. Study selection was not limited by comparator group or experimental design, and both impact and process papers were included. Effective management trials were defined as trials in which the standardised difference in the mean effect sizes of BMI changes between groups at follow-up was significant ($p < .05$). Following the data extraction and interpretation of results, it was decided that effectiveness of the interventions would not be taken into account, as a critical criteria for inclusion of a BCT into the guide, due to the heterogeneity of study numbers across BCT, which varied significantly and would have likely led to distortion in favour of infrequent BCT, for example Commitment (n=4) in comparison to much more frequent BCTs, such as Self-monitoring (n=96). Due to lack of available resources and time constraints it was not possible to conduct a meta-analysis to overcome this gap. While the ideal and preferred study design was randomised controlled trials, additional quasi-experimental or recent protocols with no reported outcomes were included to identify promising examples of applied BCTs for further consideration. Interventions that did not provide weight-related outcomes for children were excluded from the effectiveness comparisons. As this was a rapid scoping review, only narrative extractions of the data are provided. The review was conducted in line with the PRISMA guidelines (see Figure 1 for more details) (20).

Figure 1: PRISMA flow of studies included in the scoping review



After identifying a total of 108 eligible studies based on titles and abstracts, intervention descriptions were read line-by-line in the full text articles and assigned a BCT label from the BCTTv.1 or the CALO-RE taxonomy where appropriate, if they were included in at least one of the intervention arm for each paper. It has been established that interventionists inconsistently report the use of behavioural concepts including BCTs(19), therefore in addition to BCTs that are included with

their original name from the taxonomy, BCTs were additionally considered if they were implicitly referred to, based on the description of the respective intervention component. By introducing this less stringent way of coding we hoped to identify a broader range of promising intervention components that describe relevant BCTs. We did this by restructuring the way that intervention manuals report intervention content in an effort to standardise the process of identifying active ingredients from the interventions.

All identified techniques were ranked in relation to frequency of application across studies and quality of the intervention trial. Individual quality assessment of each randomised controlled trial was carried out by 2 independent researchers, using the Joanna Briggs Institute appraisal tools for randomised-controlled trials (20). Studies with a score ≥8/13 were deemed as having a high quality. Although intervention effectiveness was assessed in the initial scoping review, effectiveness was not considered an essential criterion for BCT inclusion in the guide. Instead, Delphi experts were asked to consider the information regarding effectiveness in their ranking of BCTs.

Delphi survey

A 2-staged Delphi exercise was conducted to seek expert consensus regarding the suitability of BCTs for families with children aged 4-11 years. Considering the lack of existing guidance on the use of BCTs with children, this method is considered appropriate for health-related research in “new” areas with only small knowledge base [21]. The expert panel (n=7) consisted of academics who were predominantly behavioural scientists, and weight management service providers.

The aim of the first Delphi stage, which involved an online survey, was to validate whether BCTs identified from the literature (n= 29) were suitable for use within different contexts, including:

- the whole family where the BCT is used by the whole family - although the parent or primary caregiver may be the main agent of change, it is intended that all family members use the BCT
- parents/caregivers - the BCT is used by the parent or primary caregiver only, but the consequence of using the technique is an impact on child behaviour
- children - the BCT is used directed by the child to directly initiate positive behaviour changes

A 9-point scale was used to rate how essential participants consider each BCT for inclusion in this guide. The maximum score of 9 (‘Absolutely essential’) indicated that this BCT should definitely be included in the guide, while the minimum score

of 1 (‘Not important at all’) suggested that this BCT should definitely not be included in the guide.

The responses on the rating scales were analysed by calculating the median for each BCT and its use with parents/primary caregivers, the whole family, or the child alone. a cut-off value of ≥7 was deemed sufficient for a BCT to be included in the guide, and for the use with respective target groups. This approach was loosely based on one taken by Orbai et al, who used a nominal group technique approach to consensus, and more closely based on a modified approach by Haywood et al (22, 23).

The survey also provided an option for participants to add written comments to their responses to provide more context and rationale, for example referring to supporting evidence or highlighting specific behaviours. Additionally, participants were asked to specify the resource that guided their response, using a multiple-choice format to understand whether given responses were based on evidence or personal view.

In the second Delphi round a list of suggested examples (based on evidence from the scoping review) was shared with the expert panel for consideration. The aim of this exercise was to reach consensus about how each technique might be applied in practice, given the use within different contexts, that is the whole family, parents/ primary caregivers, and children. Participants were asked to provide free text comments to suggest refinements, changes and additions to the provided examples for each BCT.

Additionally, participants were given the opportunity to re-validate ranking of BCTs which had received a mixed response in the first round.

Findings

Literature scoping review

Three thousand, five hundred and two title and abstracts were screened from the database search and combined with reference lists of eligible systematic reviews (see Figure 1). A total of 105 papers were identified for final inclusion. Details about the study design and key findings are provided in the supplementary document: Characteristics of studies included in the scoping review. Overall, from the 105 studies, 38 BCTs were coded, which included 35 from the BCT Taxonomy v1 and 3 additional BCTs that are specific to the CALO-RE taxonomy. A total of 26 BCTs were explicitly referred to by their original name in at least one intervention manuscript. BCTs that were identified through implicit coding but were not explicitly referred to, included (n= 12):

- restructuring the social environment
- adding objects to the environment
- self-reward
- social reward
- credible source
- salience of consequences
- information about health consequences
- self-monitoring of behavioural outcomes
- feedback on behavioural outcomes
- framing/reframing
- information about emotional consequences
- use of imagery

As the CALO-RE Framework states that the technique Motivational Interviewing should only be coded if explicitly named (11), this was considered for this specific BCT.

Each paper was coded according to their key target group within their family they were designed for, which included children, parents (or caregivers), child and parent/caregiver dyad, as well as to the entire family system (for example both parents/caregivers, siblings and other relatives). Although in some cases children were described as the main target group, the intervention was coded as ‘parent-child dyad’ for the target group, as the parent/caregiver supported the child in completing the intervention activities.

In total, 29 BCTs were coded from study protocols in total, including 26 BCTs from the BCT Taxonomy v1 and 3 BCTs specific to the CALO-RE taxonomy (see Table 1 for the full list of identified techniques).

Techniques that were identified less than 4 times were excluded for the list of BCTs considered for the Delphi survey. The decision to exclude rarely used BCTs was made because it was assumed that these would not offer sufficient guidance on relevant examples as these were extracted and based on intervention manuals prior to Delphi experts’ additional input. This resulted in the exclusion of the following BCTs: Information about emotional consequences, Monitoring of emotional consequences, Self-monitoring of behavioural outcomes, Exposure, Comparative imagining of future outcomes, Self-reward, Self-talk, and Prompt use of imagery.

The effectiveness of the interventions was considered as a criterion in the review and was defined as a significant standardised difference in the mean effect sizes of BMI changes between groups at follow-up ($p < .05$). The majority of interventions that were deemed to be effective were delivered face to face and were primarily targeted at caregivers or child-parent dyads.

For the final appraisal of whether BCTs should be included in the guide, effectiveness was, however, no longer considered as a criterion in the final decision of including a BCT in the recommendations. The frequency of BCTs across papers differed significantly, ranging from 4 up to 96 (see Table 4), and a number of studies did not include or report weight-related outcomes which limited comparability.

Delphi survey

In the first Delphi phase, 5 out of 7 respondents indicated they would prefer the guide to be structured by the suggested target groups, including the whole family, parents/caregivers, and children alone. Generally, respondents reported basing their ranking from evidence and own opinion or experience without any notable differences. A total of 17 BCTs were deemed suitable for inclusion in the guide as they were ranked with a median ≥7 (see Table 4). BCTs with a score ≤7 were excluded from the final list.

In the second Delphi phase a number of additional BCTs that were ranked with a median ≥7: one for parents/caregivers (Demonstration of the behaviour), 4 BCTs for the whole family (Social support, Action planning, Demonstration of the behaviour, Prompts/Cues), and 2 BCTs for the use with children (Social reward, Demonstration of the behaviour). Additional examples were identified from intervention protocols, which were reviewed by the 3 authors and 3 independent peer reviewers. The final independent review concluded the additional inclusion of 2 BCTs for the use for parents only, including Information about health consequences and Framing/Reframing. Based on the defined criteria for inclusion in the guide, these techniques had only marginally lower medians than the cut-off value and were deemed essential elements that were present in effective interventions from the UK, including the MEND programme (24). Validated examples of each BCT for the whole family, parents/caregivers and children are detailed in Table 1, 2 and 3.

Table 4. Identified BCTs from literature and Delphi method

BCTs (N= 29)	**No of studies used** (Total: N= 108)	**No of studies with sign. BMI reduction (%)**	**No of high quality RCTs*** **	**Rated Suitability for inclusion** (Median)	**Rated suitability for parent/ caregiver** (Median)	**Rated suitability for the whole family** (Median)	**Rated suitability for children** (Median)
Self-monitoring of behaviour/ behavioural outcomes	96	47	17	8	7	8	6.5*
Goal-setting	72	30	17	8	7	8	5
Instruction on how to perform a behaviour	54	28	14	8	5	8	5
Information about health consequences**	52	22	13	6	6	6	5
Problem solving	49	23	8	8	6**	7	6.5*
Social support	38	18	7	7	7	7	5
Demonstration of the behaviour	37	31	13	7	7*	7*	7.5*
Feedback	36	24	8	8	5	7	5
Behavioural practice	32	16	9	7	5	7	5
Restructuring the physical environment	30	18	9	9	5	8	5
Action planning	27	12	8	8	6*	7*	6.5*

BCTs (N= 29)	**No of studies used** (Total: N= 108)	**No of studies with sign. BMI reduction (%)**	**No of high quality RCTs*** **	**Rated Suitability for inclusion** (Median)	**Rated suitability for parent/ caregiver** (Median)	**Rated suitability for the whole family** (Median)	**Rated suitability for children** (Median)
Non-specific reward	27	10	7	6	4	5	6
Identification of self as role model	25	10	7	7	8	6*	2
Framing/ Reframing**	19	6	4	5	5	5	4
Prompts/ cues	20	6	5	8	5	8*	5
Relapse prevention/ Coping	19	9	5	9	7	8	5.5*
Review behavioural goals	15	5	5	8	5	7	5
Salience of consequences	13	8	5	4	4	3	3
Social reward	13	6	3	7	5	7*	8*
Behavioural substitution	10	4	4	7	6	7	5
Behavioural contract	10	6	5	7	7	5	5
Reduce negative emotions	7	2	2	6	5	6	5
Motivational Interviewing	7	3	3	5	5	4	4
Credible source	7	1	3	7	6*	5	5
Material incentive/ Material reward	7	2	1	6	4	5	6

BCTs (N= 29)	**No of studies used** (Total: N= 108)	**No of studies with sign. BMI reduction (%)**	**No of high quality RCTs*** **	**Rated Suitability for inclusion** (Median)	**Rated suitability for parent/ caregiver** (Median)	**Rated suitability for the whole family** (Median)	**Rated suitability for children** (Median)
Pros and cons	6	2	3	6	6	6	5
Graded tasks	6	3	3	7	5	7	5
Adding objects to the environment	6	1	2	5	5	6	5
Commitment	4	4	2	5	5	6	2

Note: *= This BCT was revalidated in the 2nd Delphi round; BCTs with green highlight indicate sufficient score for inclusion for target group. **= These techniques did not meet the inclusion criteria for the Delphi process, however they were included based on the strong evidence and independent external review of the guide prior to finalisation. ***= Joanna Briggs Institute Critical Appraisal Tools were used to rate effectiveness, using relevant tool depending on study design. RCTs with a score of ≥ 8/13 were deemed as effective.

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