A MIXED-METHOD EXPLORATION OF BEHAVIOUR CHANGE TECHNIQUES FOR CHILDREN AGED 5 TO 15 YEARS LIVING WITH OVERWEIGHT OR OBESITY

Srila Satoh

Submitted to the University of Hertfordshire in partial fulfilment of the requirements of the degree of PhD

October 2024

Acknowledgments

ALHUMDULILLAH, I would like to express my gratitude to the almighty “ALLAH” for blessing me with knowledgeable, sincere and kind people during my PhD journey, and giving me the strength and patience to soon complete this journey.

I am deeply thankful to my incredible principal supervisor, Dr. Angela Madden, for her valuable guidance and insightful feedback throughout my PhD journey. Her understanding, encouragement, and caring nature, especially during COVID-19, have enriched me with valuable knowledge. I appreciate her time, help and patience. I am also very thankful to my second supervisor, Dr. Rosalind Fallaize, for her helpful advice, feedback and support. I would like to thank Jasmine Crisp, Darren Sills, Yasmin Nicholas and Nicky Wyer for their support in the systematic review. I am thankful to all the participants who participated in this study; without them, this thesis would not have been completed.

I also would like to express my gratitude and loving appreciation to my family (Dad, Mom, my two sisters and their families, my sweet niece and nephew) for their support and love. Thanks to my friends for their encouragement and assistance. ALHUMDULILAH.

Lastly, I would like to acknowledge The Royal Thai Government scholarship provided by the Ministry of Science and Technology, Thailand and Prince of Songkla University Pattani Campus, Thailand, for supporting this PhD study.

Abstract

Background: High prevalence of overweight and obesity in children and adolescents and the associated health risks are a global concern. Behaviour change interventions have been investigated in many studies to address excess weight and to improve health. These use a range of structured methods to change behaviour, which are referred to as behaviour change techniques (BCTs) and include components, e.g., goal setting. As behaviour change interventions are often complex and interrelated, a common language is needed to optimise communication and to effectively evaluate and replicate interventions. This has been done through the development of a series of taxonomies, and the most comprehensive and widely used is known as BCT Taxonomy version 1 (BCTTv1), which defines 93 individual BCTs. This taxonomy facilitates the systematic review and meta-analysis of behaviour change interventions in adults and has the potential to be used in evaluating studies in children living with overweight or obesity. This thesis uses BCTTv1 for the first time to examine BCTs used in weight management programmes in children both in 'research' and 'real-life' settings.

Aim: To identify the use of BCTs and effectiveness of published interventions and in one family weight management programme in a real-life setting for children aged 5-15 years living with overweight or obesity in England.

Methods: A four-phase mixed method approach and the BCTTv1 were used across 'research' and 'real-life' settings: (1) a systematic review and meta-analysis of randomised controlled trials (RCT) of behaviour change interventions for managing overweight and obesity in children aged 5-15 years following PRISMA guidelines; (2) a qualitative exploration of BCTs used in an intervention described by ten staff who delivered a family weight management programme in a public health setting in England using audio-recorded semi-structured interviews and analysed using thematic analysis using a codebook; (3) a quantitative comparison of BMI z-score before and after an intervention using a database provided from the same family weight management programme using SPSS statistical software; (4) a qualitative exploration of the perspectives of two families who participated in the family weight management programme using audio-recorded semi-structured interviews and analysed using thematic analysis.

Results: (1) Four studies met the systematic review inclusion criteria and, in these research settings, twenty-eight different BCTs were used across the studies (range 12-19 BCTs per study). Meta-analysis showed that the interventions were effective in improving BMI z-score at six months after intervention finished compared to control group, with an overall standardized mean difference -0.27 (95% CI = -0.52 to -0.02, I^2=0%, p=0.03). The most frequently used BCTs were goal setting (behaviour), problem solving, self-monitoring of behaviour, social support (unspecified) and demonstration of behaviour. However, the four RCTs were identified as either being at high risk of bias or of some concern of bias and the evidence was rated as having low or very low certainty. (2) In a real-life setting, twenty-four BCTs were described as used in the weight management intervention and two groups of BCTs were often used

together, i.e., goal setting (behaviour) group and instruction on how to perform behaviour group. The programme was delivered face-to-face to families with children aged 5-15 years by UK-registered nutritionists and sport coaches over twelve weeks with one two-hour session each week and online support between sessions. (3) The programme was associated with improved BMI z-score in children living with overweight and obesity, with a median (range) reduction in BMI z-score -0.08 (-1.13 to 0.71, $p<0.001$. (4) The two families who participated in the programme and in semi-structured interviews described their satisfaction in the programme and valued the practical ways in which they were supported to change their families' behaviour in a non-judgmental manner.

Conclusion: There were similarities and differences in BCTs used in the 'research' and 'real-life' settings. The 'real-life' setting focused more on BCTs relating to the behaviour itself and less on those relating to the measurable outcomes of the behaviour which were used more in 'research' settings. Using BCTs in combination were effective in helping to improve overall BMI z-scores both in the 'research' and 'real-life' settings. However, more research is needed to confirm which combination of BCTs is most effective in helping children living with overweight or obesity to change their behaviour toward a healthy lifestyle.

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

CONTENTS (cont.)

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (cont.)

BLANK PAGE

CHAPTER I

THESIS INTRODUCTION

This thesis focuses on introducing behaviour change techniques (BCTs) used in children aged 5-15 years living with overweight or obesity in research settings and one real-life setting, as well as exploring the effectiveness of the BCTs.

1.1 Thesis overview

This thesis includes seven related chapters as follows;

Chapter I: **Thesis introduction**

This chapter describes an overview of the thesis, the background of the topics investigated including diagnosis, prevalence, causes and risk factors, tracking of obesity, health consequences, prevention and management of overweight and obesity in children.

Chapter II: The complex science of behaviour change techniques

This chapter describes the complex science of behaviour change techniques including development of behaviour change taxonomy, behaviour change techniques taxonomy version 1 (BCTTv1), measuring human behaviour, justification for the need of interventions, thesis aim and objectives, and thesis research questions.

Chapter III: **Study one - A systematic review**

This chapter describes a comprehensive review of BCTs used in published weight management randomized controlled trials (RCT) in children. RCT were selected as they are considered a gold standard for evaluating interventions (Hariton & Locascio, 2018). The review investigated the use of BCTs categorised using the Behaviour Change Technique Taxonomy version 1 (BCTTv1) (Michie et al., 2013). The findings from the review highlight the knowledge gaps about BCTs used in children living with overweight or obesity as published studies that met the study's inclusion criteria were limited and the systematic review only identified *which* BCTs were used but not *how* effective individual BCTs were or how they were delivered.

Chapter IV: **Study two – A qualitative interview with staff who delivered a family weight management programme in England.**

To address the gap from the systematic review i.e., limited evidence of how BCTs were delivered, staff who were delivering a family-based weight management programme, to families as part of a public health intervention were interviewed. Qualitative interviews helped improve understanding on which and how BCTs were delivered in an intervention in a real-life setting. This chapter provides evidence of which BCT were used and how they were delivered to children living with overweight or obesity and their families from the prospective of the programme staff.

Chapter V: **Study three – A quantitative analysis of outcome data from a family weight management programme in England.**

Following the results from study two which explored BCTs used in a family weight management programme, it is important to test whether the programme was effective i.e., they can successfully help families change their behaviours in ways compatible with health. A pre-post observational quantitative analysis of data from children who attended the family weight management programme, described in Chapter V, was undertaken using a database provided by the programme. This chapter outlines the assessment of whether the family weight management programme assisted families in modifying their behaviour to achieve better health outcomes, i.e., weight and BMI z-score.

Chapter VI: Study four – A qualitative exploration of participants' perspective of the family weight management programme in England

In addition to examining the health outcomes of the family weight management programme by analyzing data collected from participants, the families' perspectives are crucial. As the individuals responsible for maintaining or altering their behaviour, their experiences and satisfaction with the programme can influence its achievements. If the families find the programme enjoyable and satisfactory, they are more likely to make sustainable changes to their behaviour, leading to healthier outcomes (Kwasnicka, Dombrowski, White & Sniehotta, 2016). Therefore, in this study, families' perspectives were explored using qualitative semi-structured interviews to determine how acceptable and valuable the programme was to two families who participated.

Chapter VII: Overall thesis discussion.

The final chapter presents discussion of four related research studies, including the implications of the findings as a whole and draws a conclusion for the thesis. Finally, this chapter provides recommendations for future research.

To summarise, four related research studies were undertaken. The results from the systematic review (study one) were used to inform a qualitative interview with staff who delivered a family weight management programme (study two). Then, the programme was evaluated to determine whether it helped families change their behaviour toward better health outcomes (study three). Finally, participants' perspectives on participating in the programme were explored (study four) (**Figure 1.1**).

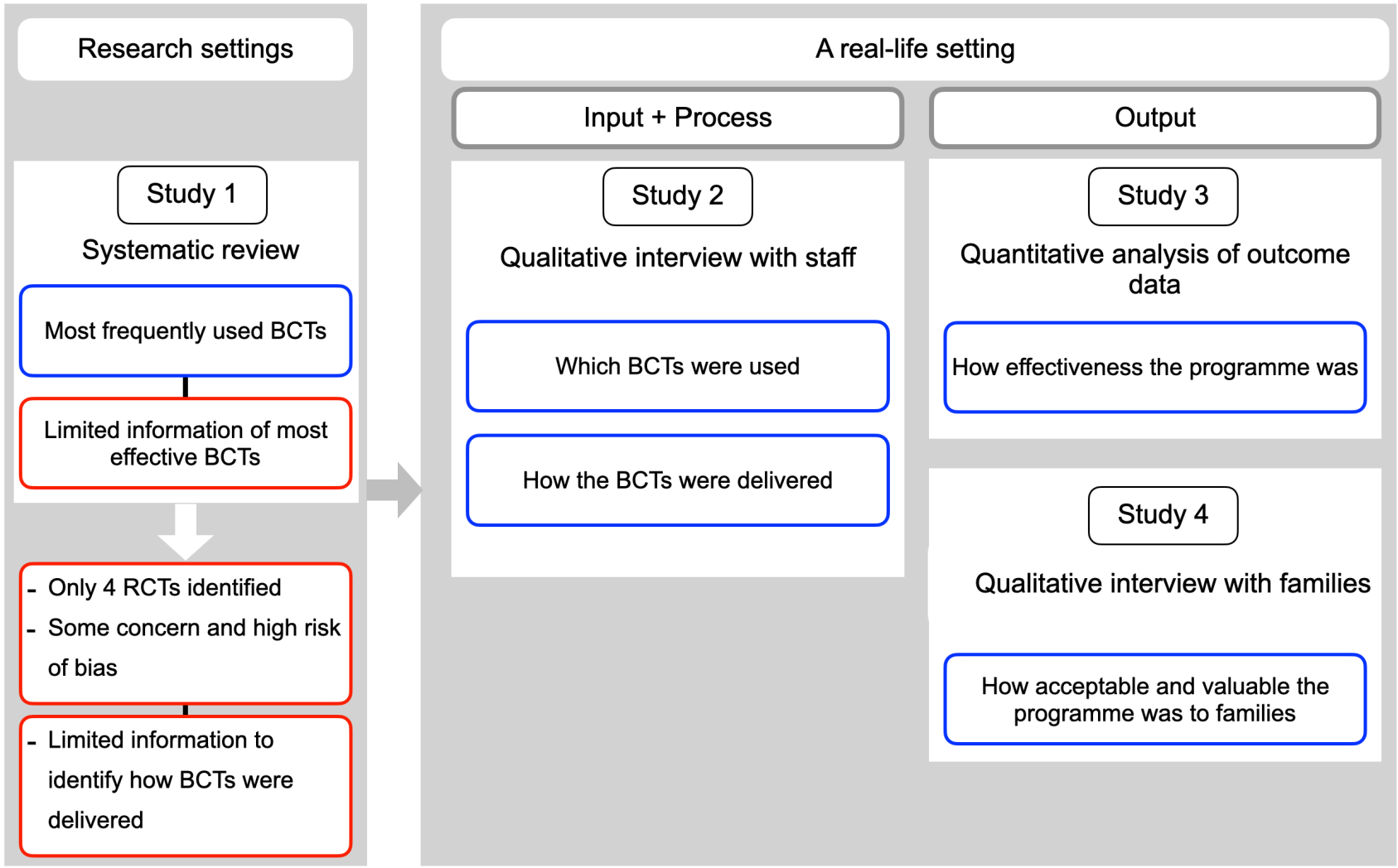


Figure 1.1 Summary of four related studies presented in this thesis

1.2 Overview of overweight and obesity

1.2.1 Diagnosis of overweight and obesity

Overweight and obesity is a medical condition which is defined as a chronic complex disease, characterized by excessive or abnormal adiposity that could negatively impact health (WHO, 2022a). Using two-component body composition analysis, the human body comprises two components i.e., fat mass and fat-free mass (Mahan & Raymond, 2017). Various sophisticated body composition techniques can be used to measure fat accumulation, including dual-energy x-ray absorptiometry, densitometry, computed tomography, magnetic resonance imaging, bioelectric impedance analysis (Holmes & Racette, 2021; Lemos & Gallagher, 2017). These techniques are useful in research settings but also have several disadvantages which include high cost, complicated equipment, radiation exposure and some require skilled personnel to operate them. As a result, they are not considered clinical tools.

Body mass index (BMI) is a simple criterion for classifying overnutrition based on weight (in kilograms) divided by height (in metres) squared (WHO, 2022b). This criterion is widely used, inexpensive, simple and practical for practitioners and researchers (WHO, 2022b; Styne et al., 2017; Jensen, Camargo & Bergamaschi, 2016), especially at population level. Many studies reported that BMI correlated with body fat (Calvo, Galarraga & Gonzalez, 2016; Field et al., 2003). However, BMI also has limitations including its inability to differentiate between muscle and fat, potentially misclassifying muscular individuals or athletes as obese (Etchison et al., 2011). It also fails to distinguish between visceral and subcutaneous fat, despite the higher health risks associated with visceral fat.

For adults, BMI between 25.0-29.9 kg/m^2 is classified as overweight and BMI from 30.0 kg/m^2 is classified as obese (WHO, 2020a). However, in children, comparing BMI with simple categories is complicated due to the impact of growth and development. This complexity arises from changes in children's body composition and fat distribution as they grow, and variations in growth spurts at different ages, which can affect their BMI. Thus, using a single BMI category to accurately assess children's weight and health is challenging. Children's BMI may not provide an accurate reflection of their muscle mass or body fat percentage, limiting the effectiveness of BMI categories in evaluating their weight status. As a result, sex-age-specific BMI values, usually expressed as percentiles or z-score derived from population data, are used in children to evaluate their degree of adiposity (Freeman et al., 1990; Wright & Cole, 2011). This has been used to indicate whether a child is living with overweight, normal weight or underweight.

There are various cutoff points, specific values used to categorise individuals into different weight status, for BMI percentile such as WHO (WHO, 2024), the UK (Royal College of Pediatric and Child Health; RCPCH, 2013), Centre for Disease Control and Prevention; CDC (CDC, 2017) and International Obesity Task Force; IOTF (Cole & Lobstein, 2012). Based on WHO, overweight and obesity are defined as a child who has a BMI from 85th to 97th and above 97th, respectively. The BMI can vary across populations due to differences in body composition, including muscle mass, fat mass, bone density, genetic factors, and dietary patterns (NCD Risk Factor Collaboration, 2017; NCD Risk Factor Collaboration, 2020; NCD Risk Factor Collaboration, 2024; Silventoinen et al., 2017). As a result, varying body composition exists in different populations, influencing BMI values. Additionally, certain ethnic groups may have

different health risks associated with specific BMI ranges, leading to the need for population-specific BMI values (NCD Risk Factor Collaboration, 2020; Paciorek et al., 2013; Stommel & Schoenborn, 2010). Different cutoff points are shown in **Table 1.1**

Table 1.1 Classification of adiposity in children based on BMI

Classification	Organisations			
	WHO	**UK**	**CDC**	**IOTF***
Age (years)	**5-19**	**2-20**	**2-20**	**2-18**
	BMI-percentiles	BMI-percentiles	BMI-percentiles	BMI (kg/m^2)
Severe thinness	< 3^{rd}	< 0.4^{rd}	-	≤16.0
Thinness	3^{rd} – 15^{th}	0.4^{th} – 2^{nd}	<5^{th}	16.1 – 18.4
Normal	15^{th} – 85^{th}	2^{nd} – 91^{st}	5^{th} – 85^{th}	18.5 -24.9
Overweight	85^{th} – 97^{th}	91^{st} – 98^{th}	85^{th} – 94^{th}	25.0 – 29.9
Obesity	> 97^{th}	> 98^{th}	≥95^{th}	≥30.0

WHO: World Health Organisation; UK: United Kingdom; CDC: Center for Disease Control and Prevention; IOTF: International Obesity Task Force; *BMI: Body mass index (kg/m^2)

Furthermore, waist circumference is a measure of adiposity that indicates abdominal fat accumulation (Alberti et al., 2009; Zimmet & Shaw, 2005). The waist circumference is a better indicator of metabolic risk than body fat percentage in some studies in adults (Aswell & Gibson, 2016; Farhangiyan, Latifi, Rashidi & Shahbazian, 2019; Shen et al., 2006). The waist circumference has been used as a criterion to define metabolic risk in adults and children aged 6-16 years (Al-Hamad & Raman, 2017; Alberti et al., 2009; Fredriksen, Skar & Mamen, 2018; Zimmet et al., 2007). It is also practical and easy to measure in clinical and public health settings.

1.2.2 Prevalence of overweight and obesity

Overweight and obesity have become a global health concern, affecting a significant proportion of the world's adult population. According to the WHO report (WHO, 2024), there are 2.5 billion adults (aged ≥18 years) classified as overweight, with 890 million of these individuals classified as obese. It also affects children and there are estimated to be more than 390 million aged 5-19 years living with overweight, including 160 million living with obesity. Additionally, 37 million preschool children (under five years) are living with overweight. This prevalence is a concern because of the future impaired health outcomes that are anticipated in a large number of these children.

Based on the Health Survey for England conducted over the year in 2018 and 2019, in England, the prevalence of obesity (BMI percentile >95th) and overweight (BMI percentile between >85th and <95th) in children aged 2-15 years was 16% and 13%, respectively (NHS Digital, 2020). In the latest report by NHS Digital released in 2023, it was reported that 9.2% and 22.7% of children aged 4-5 years (school reception class) and 10-11 years (school year 6) are living with obesity, based on having a BMI percentile greater than 95th. Additionally, 12.2% and 13.9% of children aged 4-5 years and 10-11 years are living with overweight, based on having a BMI percentile between >85th and <95th (NHS Digital, 2023).

1.2.3 Causes and risk factors of overweight and obesity

Overweight and obesity stem from an energy imbalance caused by a discrepancy between calorie intake and expenditure, i.e., energy intake exceeds energy expenditure (Romieu et al., 2017). The imbalance may arise due to complex interactions between various factors. The factors contributing to this issue can be

classified into two main categories: non-modifiable and modifiable, which include emerging factors i.e., sleep duration and microbiome. **Table 1.2** shows the complexity of factors associated with obesity (Butland et al., 2007). An overview of each of these factors briefly described below.

Table 1.2 Non-modifiable and modifiable risk factors of overweight and obesity

Non-modifiable	Modifiable
• Genetics	• Diet • Physical activity and sedentary behaviour • Environmental and socioeconomic factors • Sleep duration • Microbiome

Genetics

Numerous studies have demonstrated that genetics, a non-modifiable factor, significantly determines an individual's weight status and three studies are described here. A recent systematic review and meta-analysis of 23 studies (Lee, Jin & Lee, 2022) involving 102 parent-child pairs found a significant association between the children's weight status and the weight status of one parent, with a pooled odds ratio (OR) [95%CI] = 1.97 [1.85 to 2.1], I^2 = 97.4%. This association may be attributed to both their shared food intake and their genetics. The association between the children's and parents' weight status was significantly higher when both parents were obese (OR [95%CI] = 3.53 [2.68 to 4.65], I^2 = 97.4%, compared to when only one parent was obese. A cross-sectional study of 23,043 Iranian children aged 6-18 years and their parents (Bahreynian et al., 2017) reported that the BMI of children living with

overweight or obese was significantly associated with parental obesity (boys: OR [95%CI] = 2.79 [2.44 to 3.20]; girls: OR [95%CI] = 3.46 [3.03 to 3.94]). A retrospective cohort study of 854 children and their parents (Whitaker, Wright, Pepe, Seidel & Dietz, 1997) reported that if at least one parent was living with obesity, children were at greater risk of developing obesity in adulthood. This risk was particularly high in children who are already living with obesity. However, these studies have not studied the separate effects of genetic and home environmental impacts, i.e., intake and activity, on obesity. The distinction between the contribution of genetic and environmental factors to obesity is crucial for a comprehensive understanding of the condition and its management.

A study of twins reared apart indicated that genetic factors contribute to approximately 67% of the variability in BMI (Ravussin et al., 2000). According to this study, genetics play a crucial role in the risk of obesity risk, regardless of external factors. Additionally, a longitudinal study of 3227 like-sexed twin pairs over 36 years, started at age around 30 years in 1975 (Berntzen et al., 2023), reported that in pairs of identical or non-identical twins who had significant differences in BMI, the twin with higher BMI in 1975 was more likely to exceed the expected BMI over time. By 2011, individuals who began below, within, and above the expected BMI were at a normal weight, overweight, and obese, respectively. The average increase in BMI between 1975 and 2011 was 4.5 [95%CI = 4.3 to 4.8].

In summary, genetics play a significant role in determining an individual's weight status regardless of external factors; individuals with higher BMI are more likely to experience ongoing weight gain. Children with parents living with overweight or obesity face an

elevated risk of developing obesity themselves as adults, even if they are currently maintaining a healthy weight. These findings underscore the complexity of obesity as a condition influenced by multiple factors, which can complicate treatment efforts, particularly in environments where children are raised by parents living with overweight or obesity. While genetics play an important role in determining body weight, it is unmodifiable but is not the only risk factor so health interventions must consider other factors that may be modifiable to try to improve health through reducing risk.

Diet

Diet plays a role in energy balance and the development of obesity. Individual dietary choices regarding food type and portion size directly impact energy intake, establishing a critical connection between eating habits and weight control. Consumption of high-calorie, low-nutrient foods can result in an energy surplus, where energy intake significantly exceeds energy expenditure. This energy imbalance is a key factor contributing to weight gain and, ultimately, obesity.

A national survey of 4,636 children and adolescents aged 1-18 years in the UK reported that children consumed more high-energy and high-fat food (i.e., chocolate & confectionary, biscuits & cakes, processed meat) and low-fibre food (i.e., fruits & vegetable, legumes, low fibre bread) than fresh fruits, vegetables, high fibre cereals, yoghurts and legumes (Johnson, Toumpakari and Papadak, 2018). This dietary pattern raises concerns due to its potential to lead to health issues such as obesity when energy intake exceeds expenditure. Another longitudinal study in 6772 children aged 7-13 years in the UK reported that dietary habits formed in childhood have been

correlated with elevated levels of adolescent adiposity, with specific emphasis on dietary energy density, fat consumption, and low fibre intake (Ambrosini et al., 2012). Additionally, a cross-sectional study of 1,158 British adolescents aged 14-18 years from urban areas i.e., Birmingham and Coventry, reported that 18% and 6% of them were overweight and obese, respectively (Al-Hazzaa et al., 2013). This study reported that food high in fat, sugar and salt were frequently consumed, with half eating sweets or chocolate on >4 days per week (50%) followed by sugar-sweetened drinks (49%), cake/doughnut/biscuits (40%), French fries/potato chips (35%), fast food (24%), and energy drinks (22%). These findings indicated that children often consume diets high in calories but low in nutrients. This dietary pattern can easily lead to an imbalance in energy intake and expenditure.

In summary, in the UK, children and adolescents frequently consume high-energy, high-fat, and low-fibre foods, which can contribute to increased levels of adiposity and potentially lead to energy imbalance and obesity. This high consumption of energy-dense, nutrient-poor food choices may impact the development of unhealthy eating habits and weight-related problems in young individuals. Addressing these dietary patterns is essential for promoting healthier lifestyles and preventing obesity among youth.

Physical activity and sedentary behaviour

Physical activity refers to any body movement that requires energy expenditure due to the contraction of skeletal muscles (Caspersen et al., 1985; Sharif et al., 2018). On the other hand, sedentary behaviour is defined as any waking activity that requires minimal energy expenditure (less than or equal to 1.5 metabolic equivalents) while in

a sitting, reclining, or lying position (Tembley et al., 2017). Many individuals, especially young people, engage in less than recommended physical activity levels and spend considerable time in sedentary activities such as screen time and gaming. This combination can lead to an imbalance in energy, increasing the risk of weight gain and related health issues. Addressing these behaviours is needed to promote healthier lifestyles and to contribute to preventing obesity.

A survey of self-reported physical activity in 7,078 children aged 2-15 years in England reported that informal physical activity, such as play, walking, cycling, and dancing, steadily declines throughout childhood (Sims et al., 2022). Boys tend to offset this decline by engaging in more formal physical activities like sports, and older girls do not exhibit the same compensatory behaviour, leading to decreased overall physical activity levels. This survey highlights a concerning trend regarding decline in physical activities in children in England, especially in girls. In a cross-sectional study of 425 children aged 9-11 years in the UK reported that only 53% of participants met the moderate-to-vigorous physical activity requirement of 60 minutes daily (Wilkie et al., 2018). The average (mean $\pm$ SD) daily physical activity of vigorous, moderate and light were 20.9$\pm$11.5, 43.3 $\pm$13.0 and 286.3 $\pm$ 45.2 minutes/day, respectively. The study indicated that children may prefer less intense physical activities, that do not contribute as effectively to energy expenditure, than moderate and vigorous exercises. Further emphasizing this issue, a cross-sectional study involving 1,158 British adolescents aged 14-18 years reported that approximately 91% adolescents spent more than two hours per day engaged in viewing screen time i.e., computer and TV (Al-Hazzaa et al., 2013). This excessive screen time exacerbates the energy imbalance, replacing opportunities for physical activity and increasing the risk of obesity.

In summary, insufficient physical activity with prolonged periods of sedentary behaviour, can disrupt an individual's energy balance, resulting in positive energy balance and subsequent weight gain.

Environmental and socioeconomic factors

Various environmental factors play a role in shaping a child's dietary habits, physical activity levels and lifestyle choices. Urban design, the availability of nutritious foods, access to opportunities for physical activity, and socioeconomic elements contribute to promoting or impeding healthy living.

A cross-sectional study of obesity, socio-cultural and socio-economic environment by Aprilia et al. (2018) of 225 high school students (58% were obese) in Indonesia, investigated the relationship between risk of obesity and socio-cultural views. They found that students who lived in a place where they were surrounded by a healthy diet had a lower risk of obesity than those who live in a place where a unhealthy diet was more available ($p<0.001$). This study emphasised the importance of a supportive dietary environment. In addition, a cross-sectional study by Hilpert et al. (2017) in 781 children aged 6-7 years (9% overweight and 7% obese) in Germany reported that in the obese group, the prevalence of obesity was highest (11.3%) in children whose father or mother had $\leq$9 years of schooling (low socioeconomic status; SES), followed (6.6%) by children whose father or mother had ten years of education (middle SES), and then (2.6%) by children whose father or mother had completed >10 years at school (high SES). However, this only considered educational entertainment to measure SES, while others studies have also considered

income levels as being a factor influencing obesity prevalence (Diddana, 2021; Kim et al., 2018).

A systematic review and meta-analysis involving 1,575 children aged 5-12 years reported that exposure to advertising impacted food consumption (Boyland et al., 2016). The study demonstrated that children consumed more food after exposure to food advertisements than a control condition, with a mean difference of the amount of food 0.56 [95%CI = 0.18 to 0.94], I^2 = 98%. These findings emphasised a significant concern about the potential impact of advertising on children's eating behaviours, highlighted the influence of marketing on children's food choices and underscored the necessity for regulating food advertising targeted at children. Additionally, obesogenic environmental factors such as plentiful fast food availability, limited access to healthy food, and restricted access to recreational areas and parks, play a crucial role in childhood obesity (Jia, 2020; Mei et al., 2021). These findings demonstrated that the plentiful availability of fast food and limited access to healthy food creates a challenging landscape for children, making it easier for them to choose unhealthy foods. Similarly, a lack of recreational areas and parks reduces opportunities for physical activity, further contributing to a sedentary lifestyle. These behaviours can are associated with increased risk of obesity.

In summary, obesity prevalence in children is influenced by environmental factors such as availability of healthy food, education levels of parents and food advertisements.

Sleep duration

Quality sleep is crucial for children's optimal development and significantly impacts their physical, emotional, and cognitive well-being (Taveras et al., 2017). Insufficient sleep has been identified as a notable risk factor for obesity (Deng et al., 2021; Miller et al., 2018; Morissey et al., 2020), as it can disrupt metabolic processes including modifying hunger-regulating hormones, which can lead to increase energy intake (Lin et al, 2020).

A meta-analysis of 12 cross-sectional studies involving 30,002 children aged 2-20 years reported that inadequate sleep duration (equal or less than 10 hours in children) increased risk of obesity in children (Cappuccio et al., 2008). The pooled odds ratio (OR) was 1.89 (95%CI = 1.46 to 2.43, $p<0.001$). Further evidence of increasing the risk of obesity comes from a meta-analysis of 33 prospective cohorts conducted by Deng et al., 2021, involving 57,848 children aged 1-16 years, which reported a significant association between short sleep duration and obesity (adjusted relative risk = 1.57, 95%CI = 1.36 to 1.81, $p<0.001$), particularly among children aged 3-13 years. Furthermore, a systematic review of three RCTs and 30 observational studies involving children aged 0-19 years (Felso, Lohner, Hollody, Erhardt and Molnar, 2017). They reported that children with short sleep durations i.e., <10 hours per night, measured by wrist or waist-worn accelerometers, consumed more energy-dense foods, added sugar, and sugar-sweetened beverages and exhibited an increased risk of developing insulin resistance due to decreased insulin sensitivity compared to those children who slept for >10 hours. Additionally, the review reported that limiting sleep to around 6.5 hours or reducing sleep by 1 to 1.5 hours per day can lead to unhealthy

eating habits and increased health risks. However, it should be noted that this systematic review did not include meta-analysis.

According to a recent systematic review and meta-analysis of 16 experimental (one RCT, six randomised crossover, nine self-controlled studies) and five cross-sectional studies, inadequate sleep leads to higher blood levels of ghrelin and leptin, hormones that regulate hunger and satiety in children and adults (aged 7-78 years) (Lin et al., 2020). The review reported that individuals who slept for shorter durations (<9 hours per day in children, 6-13 years, and <8 hours, 14-17 years, had statistically significant higher blood levels of ghrelin and leptin than those who slept for longer. A pooled effect size of the association between short sleep duration and ghrelin level was 0.14 (95%CI = 0.02 to 0.27, I^2 7%, p=0.03, n=1119, in 3 cross-sectional studies) and a pooled effect size of the association between short sleep duration and leptin level was 0.19 (95%CI = 0.03 to 0.35), I^2 = 0%, p=0.02, n=597, in 13 experimental studies). Additionally, those who slept less than 5 hours per day (defined as sleep deprivation) had statistically significant higher blood levels of leptin and ghrelin than those who slept normal duration, effect size = 0.24, 95%CI = 0.10 to 0.39, p=0.001, I^2 0%, n= 1023 and effect size = 0.18, 95%CI = 0.04 to 0.33, p =0.01, I^2 0%, respectively. This suggests that sleep duration is crucial in regulating ghrelin and leptin hormones, which could influence on energy balance.

In summary, inadequate sleep duration is now widely acknowledged as a significant contributor to obesity. Insufficient sleep can disrupt metabolic processes, leading to increased appetite and preference for high-calorie, unhealthy foods, ultimately contributing to weight gain in children.

Microbiome

The microbiome encompasses the genetic material of microorganisms, including bacteria, archaea, eukaryotes, and viruses and their respective environmental factors (Marchesi & Ravel, 2015; National Institute of Environmental Health Sciences, 2024). In humans, the microbiome exhibits considerable diversity, with unique microbial communities residing in different body sites such as the gut, skin, and oral and nasal cavities (Shreiner et al., 2015; Human Microbiome Project Consortium, 2012; Hou et al., 2022). This diversity is influenced by genetics, diet, environment, lifestyle, age, and health status, leading to variation between individuals (Aggarwal et al., 2023). Additionally, differences in geographical location, cultural dietary practices, and environmental exposures contribute to the diversity observed within human populations.

The microbial community residing in the intestine is known as the gut microbiota and although it consists of many different phyla, there are predominantly two phyla that are important in obesity: Firmicutes and Bacteroidetes (Human Microbiome Project Consortium, 2012; Ejtahed et al., 2016; Neu, 2021). Children living with overweight or obesity had significantly elevated levels of Firmicutes phyla compared to normal weight children ($p=0.001$) (Da Silva et al., 2020). Additionally, an increased ratio of Firmicutes to Bacteroidetes (F:B) has been associated with obesity in children, while a lower ratio is often observed in individuals with a healthier weight (Ejtahed et al., 2022; Indiani et al., 2018; Ley et al., 2006).

A recent systematic review of 18 studies reported that children's gut microbiota varies based on their body weight (Morgado et al., 2023). Numerous studies have indicated

a high F:B ratio in children living with obesity (Houtman et al., 2022; Idiani et al., 2018). For example, a cross-sectional study in 53 children aged 6-16 years in Belgium reported that children living with overweight or obese (n=26, BMI z score= 2.69+0.80) had a significantly higher F:B ratio compared to normal weight children (n= 27, BMI = -0.43+0.96) (Bervoets et al., 2013). Similarly, a study involving 78 Italian children aged 6-16 years found that the F:B ratio was significantly higher in children living with obesity (n=42, BMI z score = 2.14 to 5.00) compared to those with normal weight (n=36, BMI z score = -2.12 to 1.56), with a p-value <0.0001 (Riva et al., 2017). Another case-controlled study involving Chinese children aged 6-16 years found that the F:B ratio was significantly higher in children living with obesity (n=47, F=64%, B=19%) compared to normal weight (n=17, F=50%, B=38%) (Wang et al., 2024). This finding was also reported in 330 Mexican children that the Firmicutes phyla was positively associated with obesity (p=0.013) while Bacteriodetes phyla was negatively associated with obesity (p=0.009) (Vazquez-Moreno et al., 2021). However, another study involving 138 Mexican children aged 6-12 years discovered that the F:B ratio did not vary significantly between children living with obesity (n=71) and normal weight children (n= 67) (Lopez-Contreras et al., 2018). This inconsistency may be due to differences in study populations, methodologies, and environmental factors. Additionally, the complexity of the gut microbiome and its interactions with host genetics and physiology can contribute to variability in research findings (Daniel et al., 2021; Hou et al., 2022; Kinross et al., 2011; Yatsunenko et al., 2012). It is important to note that evidence from a systematic review is considered more robust than an individual study.

The studies described above do not identify the direction of influence between the microbiome and obesity or the possible mechanisms of action. The gut microbiota plays a crucial role in communication with the gut-brain axis, a bidirectional communication system between the gastrointestinal and central nervous systems (Afzaal et al., 2022; Hou et al., 2022). This interaction has been found to significantly influence appetite and food cravings and ultimately, impact food intake and energy balance. An imbalance of gut microbiota, known as dysbiosis, can result in metabolic alterations, such as increased energy extraction from food and inflammation, potentially impacting weight regulation (Riva et al., 2017), leading to an increased risk of obesity.

In summary, a range of different causes or risk factors for obesity have been identified. This multifaceted nature of obesity complicates treatment efforts to prevent or manage obesity and interventions must consider a range of modifiable factors as described above.

1.2.4 Tracking of obesity from childhood into adult life

Research indicates that children living with obesity are at a greater risk of remaining obese in adulthood. In a birth cohort study of 500 individuals, findings revealed that at age 50 years, individuals who had been obese at age 5 years exhibited a mean BMI score 6.51 kg/m^2 higher (95%CI = 3.67 to 9.35) compared to those who had a normal weight during childhood (Rundle et al., 2020). Moreover, the study indicated that children with obesity at age 5 years had a moderate positive predictive value for predicting obesity at age 50 (0.67, 95%CI = 0.49 to 0.85), while those with obesity between aged 15-17 years had a higher positive predictive value (0.86, 95%CI = 0.73

to 1.00). Furthermore, a longitudinal study reported that children who experienced excessive weight gain by age five years were significantly more likely to continue gaining weight by age nine years, indicating that early and excessive weight gain, particularly between ages 0-5 and 5-9 years, was shown to predict metabolic risk by the age of nine (Gardner et al., 2009).

In summary, children living with obesity are more likely to become obese in adulthood, leading to a wide range of chronic health problems. This emphasises the importance of early intervention and the need to implement effective strategies for preventing and managing childhood obesity to enhance long-term health outcomes throughout their lives.

1.2.5 Health consequences of overweight and obesity

Overweight and obesity in children are associated with several consequences both short-term and long-term that can significantly adversely affect their health and well-being.

In the short-term, immediate health complications as children living with obesity are at an increased risk of developing high blood pressure, type 2 diabetes, and breathing difficulties. They are also more likely to experience social and psychological problems. If not addressed during childhood, it can lead to several long-term consequences.

Long-term consequences in children living with obesity can be more severe and can impact their health throughout their lives. These can include a higher risk of developing chronic health conditions as adults such as heart disease, stroke, certain types of

cancer, and type 2 diabetes (Mazur et al., 2022). Furthermore, they are also at a higher risk of developing joint problems, sleep apnea, and liver disease. Moreover, they can have negative impact on mental health, leading to depression, anxiety and low self-esteem (Topcu, Orhon, Tayfun, Ucakturk and Demirel, 2016; Sepulveda et al., 2019; Lindberg, Hagman, Danielsson, Marcus and Persson, 2020). Further details on these points will be discussed in the following sections, which include mental and physical health.

Mental health

Children living with overweight or obesity experience a range of negative consequences, including weight stigma, depression, anxiety and low self-esteem. Numerous studies have shown that children living with overweight or obesity are often stigmatized and bullied at school, or in their community (Puhl and Lessard, 2022; Palad, Yarlagadda, and Standford, 2019; Pont, Rebecca, Cook, and Slusser, 2017). These experiences are associated with other problems such as binge eating, reduced physical activity and social isolation which potentially affect their body weight status. Many studies have demonstrated that children living with obesity are at higher risk of experiencing depression, anxiety and low self-esteem (Topcu, Orhon, Tayfun, Ucakturk and Demirel, 2016; Sepulveda et al., 2019; Lindberg, Hagman, Danielsson, Marcus and Persson, 2020).

For example, a case-control study was conducted on 367 children aged 9-16 years to assess the impact of obesity on their mental health (Topcu et al., 2016). The total score of Children's Depression Inventory (CDI) was significantly higher in 167 children living with obesity compared to 200 children living with normal weight, with median

scores of 12 (range = 4-39) and 8 (3-19) respectively, p<0.001. Similarly, the State-Trait Anxiety Inventory for Children (STAIC) median scores were higher in children living with obesity (37 (range = 20-55)) than in those with normal weight (28 (20-42)), p<0.001. Similarly, another case-control study evaluated 100 children aged 8-12 years to assess early risk factors for children living with obesity (Sepulveda et al., 2019). The CDI scores were significantly different between children living with obesity and children living with normal weight, with median (interquartile range) scores of 8(10) and 7(4) respectively, p<0.005. Similarly, the median (interquartile range) STAIC (composed of two scale i.e., state (STAIC-S) and trait anxiety (STAIC-T)) score was higher in children living with obesity (STAIC-S = 25(10), STAIC-T = 32(9)) than those with normal weight (STAIC-S = 24(5), STAIC-T = 30(8.5)), p<0.05. Furthermore, a nationwide Swedish cohort study of 12,507 children living with overweight and 60,063 general children aged 6-17 years reported that an estimated risk of anxiety and/or depression in children living with obesity was higher than those in normal weight children (adjusted hazard ratios (HR) [95%CI]: boys = 2.04 [1.64 to 2.54], p<0.0001; girls = 1.56 [1.31 to 1.87], p<0.0001) (Lindberg et al., 2020).

These findings highlight the presence of mental health concerns in children living with obesity and support the need to prevent and manage excessive body weight. These mental health considerations are relevant to the development and delivery of weight management interventions.

Physical health

Children living with overweight or obesity are at heightened risk of metabolic and cardiovascular conditions such as prediabetes and type 2 diabetes, dyslipidemia, polycystic ovary syndrome, and arterial hypertension (Mazur et al., 2022).

An international cohort study involving 98 centres and more than 26,000 European children aged 12.6±2.9 years (l'Alleman et al., 2008) reported that children with BMI > 99.5th percentile had at least one cardiovascular condition, including elevated blood pressure, abnormal lipid profiles (cholesterol, LDL, HDL, and triglyceride) and impaired carbohydrate metabolism. In addition, the severity of obesity showed an inverse relationship with HDL-cholesterol levels (odds ratio (ORs) [95%CI] for children with BMI > 99.5th percentile compared to normal weight = 6.2 [1.9 to 19.6]) and a direct correlation with a cluster of three or more risk factors (OR>10 [5.8 to 40.0]), including impaired glucose metabolism, high blood pressure, and elevated triglyceride levels. Similar findings were also observed in other studies such as a group of 1004 German children aged 4-8 years from four obesity centers (Reinehr et al., 2005), a cross-sectional study of 780 school-aged students in Greece, aged 6-13 years (Kollias et al., 2011) and a cross-sectional survey of 214 school-aged children living with overweight or obesity aged 8-10 years in Costa Rica (Holst-Schumacher et al., 2009). Furthermore, a cross-sectional survey in Asia of 1366 children living with obesity, aged 12-16 years reported that 70% of boys and 55% of girls had one cardiovascular risk factor, and 27% of boys and 23% of girls had two or more cardiovascular risk factors (Chu et al., 1998).

In summary, living with overweight or obesity is associated with a range of adverse health outcomes in both the short and long term. Effective prevention and intervention strategies are urgently needed to address this issue and mitigate its associated health risks.

1.2.6 Prevention and management of overweight and obesity

Numerous guidelines have been established to support children living with overweight and obesity. These guidelines come from reputable national and international organisations such as the National Institute for Health and Care Excellence (NICE, 2023; NICE, 2016; NICE, 2015; NICE, 2013), the World Health Organization (WHO, 2023), the Center for Disease Control and Prevention (CDC, 2011; CDC, 2009) and American Psychological Association (APA, 2020).

Currently, three primary treatment approaches are considered suitable for children and adolescent living with overweight and obesity i.e., lifestyle interventions (diet, physical activity and behavioural change) (Maffeis et al., 2023; Mazur et al., 2022; Valerio et al., 2018; Styne et al., 2017), pharmacotherapy (Singhal, Sella & Malhotra, 2021), and bariatric surgery (Herouvi et al., 2023). All approaches have benefits and risks, which should be carefully considered based on the individual child's needs and circumstances (Maffeis et al., 2023; Styne et al., 2017) and resources available. Lifestyle interventions are often considered to be a first line treatment which include behavioral modification including dietary adjustments and increased physical activity. If these interventions do not produce the desired results, pharmacotherapy may be considered as the next step. However, if pharmacotherapy is also ineffective, bariatric

surgery can be considered (Maffeis et al., 2023; Valerio et al., 2018; Styne et al., 2017).

The NICE public health guideline, and the WHO, CDC and APA recommendations have emphasised the need for a multiple component approach to addressing childhood obesity. This approach should involve implementing multiple strategies, such as behavioural modification including dietary adjustments, increased physical activity and reduced sedentary behaviour by using behaviour change techniques (NICE, 2013; WHO, 2023). It is important to address childhood obesity using a holistic approach that involves the child and their family members to help develop healthy habits and promote long-term behaviour change. A summary of the multi-component recommendation for addressing obesity in children from those four organisations is shown in **Table 1.3.**

Table 1.3 Summary of the multi-component recommendations of four organization for addressing childhood obesity

Components	NICE	WHO	CDC	APA
Diet	X	X	X	X
Physical activity	X	X	X	X
Sedentary behaviour	X	X	X	X
Behavioural strategies	X	X	X	X
Optimised sleep pattern		X		
Emotional regulation		X		

X = recommended

NICE: National Institute for Health and Care Excellence; WHO: World Health Organisation; CDC: Center for Disease Control and Prevention; APA: American Psychological Association

Lifestyle intervention (multi-component)

A systematic review and meta-analysis of RCTs of interventions to prevent obesity in children reported that a combination of diet and physical activity can reduce BMI z-score in children aged 0-5 years (mean difference (MD) = -0.07 (95% CI -0.14 to -0.01), p = 0.02, , I^2 = 66%, n = 6261, 16 RCTs) and in children aged 6-12 years (MD = -0.05 (95%CI -0.1 to -0.01), p = 0.01, I^2 = 87%, n=24043, 20 RCTs) (Brown et al., 2019).

A systematic review and meta-analysis of 70 RCTs of lifestyle interventions (diet, physical activity, behavioural intervention) for treating children living with overweight or obesity aged 6-11 years reported that lifestyle behavioural interventions significantly reduced BMI z-score, effect size 2.76, p=0.0058, MD -0.08 (95%CI -0.13 to -0.02), I^2 = 66, n=152, 2 RCTs) (Mead et al., 2017).

A systematic review of 66 meta-analyses of intervention and observational studies, which included over 900,000 children and adolescents, reported that integrating enhanced nutrition and increased physical activity strategies is the most effective intervention for preventing and treating childhood obesity (Psaltopoulou et al., 2019).

The three systematic reviews and meta-analyses mentioned earlier provide evidence that interventions combining diet, physical activity and/or behavioural strategies can effectively prevent and treat childhood obesity (Brown et al., 2019; Mead et al., 2017; Psaltopoulou et al., 2019). However, these reviews did not investigate the specific behaviour change techniques utilised in the interventions using BCTTv1, which are

the active components of the interventions. As a result, there exists a gap in the evidence regarding the effectiveness of BCTs.

This chapter provides a general overview of childhood obesity, addressing key aspects such as diagnosis, prevalence, causes and risk factors, tracking, health consequences, and prevention and management strategies. The next chapter will explore the complex science of behaviour change techniques, focusing on developing behaviour change taxonomies, the latest BCTTv1, and methods for measuring human behaviour.

CHAPTER II

THE COMPLEX SCIENCE OF BEHAVIOUR CHANGE TECHNIQUES

2.1 Development of behaviour change taxonomy

Behaviour can be defined as any action of a person in response to external (i.e., anything around you, food adverts) or internal (i.e., anything within the person e.g., hunger) events (Davis et al., 2015). Behaviours may be hidden (covert; can be measured only by a person engaging in the behaviour) or shown openly (overt; can be measured by a person engaging in the behaviour or by others). Behaviour is controlled by the brain but exhibited covertly or overtly by the body (Davis et al, 2015; Miltenberger, 2016). Briefly, behaviour is what a person does.

Behaviour change interventions can be defined as an intervention that may include one or more techniques to bring about a positive change in the health behaviour of individuals, groups or populations (NICE, 2014a). The term 'health behaviours' is used to describe behaviours that impact health and wellbeing including eating, physical activity, smoking (Short & Molborn, 2016).

A behaviour change taxonomy is a classification or agreed descriptors of behaviour change techniques. A behaviour change technique can be defined as a structured method used in an intervention which contains an active ingredient that can change human behaviour (Michie & Johnson, 2013). One of the first taxonomies of specific behaviour change techniques was the 26-item BCT taxonomy (Abraham & Michie, 2008), which was defined to be used with interventions. An 'item' refers to a discreet

BCT described within the taxonomy. The development process involved six steps. Abraham and Michie conducted a comprehensive review of existing behaviour change literature to identify techniques previously used in health behaviour intervention, drawing from three sources i.e., transtheoretical model (ten processes of behaviour change), a review of weight gain prevention interventions (19 behaviour changes) and a meta-analysis of interventions to increase physical activity (twenty intervention components). They then sought input from experts in psychology, health behaviour change, and intervention design to validate the relevance of identified techniques. Through literature review and discussions, numerous techniques were identified and grouped together to minimize redundancy. Pilot testing involved categorising BCTs from 195 published intervention descriptions related to physical activity, healthy eating and changing intention and behaviour. Feedback from the pilot testing was used to refine the definition and classifications of the techniques, resulting in the 26-item BCT taxonomy. The mean of the interrater reliability was 0.79, which is considered good reliability (McHugh, 2012), and with 93% agreement among the research team for coding 26 techniques. As of October 10, 2024, the taxonomy has been cited in 1891 papers according to Scopus.

Subsequently, the “Coventry, Aberdeen & London – Refine” (CALO-RE) taxonomy (Michie et.al, 2011) which includes 40 items, focusing on healthy eating and increased physical activity, was developed from 26-item taxonomy described above. It included 72 studies with a variety of behaviours, populations and settings. This 40-item taxonomy was good in terms of reliability (mean kappa value = 0.79) and was coded by five psychology researchers. This was found useful and used to evaluate some

interventions (Martin, Chater & Lorencatto, 2013) and as of October 10, 2024, the taxonomy has been cited by 1247 times according to Scopus.

Further development by identifying BCT labels and definitions from six relevant articles led to an enhanced and more detailed scheme known as the Behavior Change Technique (BCT) Taxonomy (v1) (BCTTv1) (Michie et.al, 2013). BCTs were coded by 14 cross-disciplinary experts comprising 11 psychologists, a cognitive behaviour therapist, a health scientist and a community health worker. These experts labelled and described 124 BCTs which were then grouped on the basis of 'sameness of active ingredients' by 18 experts in behaviour change intervention. This resulted in sixteen groups of BCTs which were then subdivided into 93 individual BCTs. As of October 10, 2024, the BCTTv1 has been cited 4605 times according to Scopus. It is more widely cited than earlier taxonomies even though it has been available for a shorter time. As the BCTTv1 is the latest version of the taxonomy, developed and tested using experts from different disciplines and from seven countries to trial and test reliability, it is considered to be more specific and precise than earlier taxonomies (Michie et al., 2013). Thus, the 93-item BCTTv1 will be used throughout the studies of this thesis to identify and categorise BCTs.

Using taxonomies to identify BCTs in interventions and in practice will help researchers, practitioners, and intervention designers develop, implement and replicate behaviour change interventions that are consistent and comprehensive (Michie and Johnson, 2013). This is highly relevant to interventions to prevent and manage overweight and obesity in children.

2.2 Behaviour change taxonomy version 1 (BCTTv1)

The BCTTv1 is a widely accepted tool used to identify and label the active components of interventions that have been designed to change behaviour. It consists of 16 groups of techniques, each comprising a varying number of individual behaviour change techniques. In total, the taxonomy includes 93 individual techniques (Michie et al., 2013). For instance, the first group “Goal and Planning” contains nine individual techniques. **Table 2.1** provides an overview of the groups and examples of BCTs. For the full version of the taxonomy, see BCTTv1

Using the BCTTv1 is potentially useful because it provides a standardised approach for categorizing BCTs, promoting consistent communication and comparison among researchers and practitioners which facilitates the development, implementation, and evaluation of interventions. The BCTTv1 allows for tailored intervention by enabling the targeted selection of techniques suitable for specific behaviours. Furthermore, it provides a structured approach to evaluate the effectiveness of various techniques, enhancing intervention assessment. By implementing BCTTv1, interventions can be customized to individual needs and evidence-based, ultimately promoting sustainable change in health behaviour related to childhood obesity.

Table 2.1 Groups and example of BCTs from BCTTv1 (Michie et al., 2013)

Group	Label	An example BCT	
1	Goal and planning	1.1	Goal setting (behaviour)
2	Feedback and monitoring	2.1	Monitoring of behaviour by others without feedback
3	Social support	3.1	Social support (unspecified)
4	Shaping knowledge	4.1	Instruction on how to perform the behaviour
5	Natural consequences	5.1	Information about health consequences
6	Comparison of behaviour	6.1	Demonstration of behaviour
7	Associations	7.1	Prompts/cues
8	Repetition and substitution	8.1	Behavioural practice/rehearsal
9	Comparison of outcomes	9.1	Credible source
10	Reward and threat	10.1	Material incentive (behaviour)
11	Regulation	11.1	Pharmacological support
12	Antecedents	12.1	Restructuring the physical environment
13	Identity	13.1	Identification of self as role model
14	Schedule consequences	14.1	Behavioural cost
15	Self-belief	15.1	Verbal persuasion about capability
16	Covert learning	16.1	Imaginary punishment

2.3 Measuring human behaviour

Human behaviours can be evaluated directly and indirectly (Miltenberger, 2016). These behaviours can be assessed across four dimensions: frequency, duration, intensity and latency.

Comparing direct and indirect methods

Direct assessment involves observing and recording behaviours when they occur, while indirect assessment involves gathering information from the individual displaying the behaviour or others closely associated with them (Miltenberger, 2016).

Direct assessment methods offer the advantage of obtaining accurate and reliable data on human health behaviours while minimising errors associated with self-reported information. These methods enable objective measurements and detailed information collection on specific behaviours. However, drawbacks include the possibility of being observed, which could impact how individuals act, and the need for specialised personnel to conduct the assessments.

Indirect methods, such as questionnaires, interviews, and rating scales, allow for collecting subjective data from individuals exhibiting the behaviour or others who are close to them, such as researchers. These methods are typically less intrusive than direct methods and may lead to more natural responses from the assessed individuals. Additionally, they can be more cost-effective and accessible to administer especially at the community level. However, drawbacks include heavy reliance on self-reported information, which can be subjective and prone to biases or inaccuracies.

The following methods have been used to assess health behaviours, including dietary behaviour, physical activity and sedentary behaviours and sleep.

Dietary behaviour

Data on dietary behaviour has been gathered through both direct and indirect methods. An overview of each method is described below and more details of each method can be seen in **Table 2.2**

In summary, direct methods of measuring dietary behaviours offer advantages in accuracy and reliability. These qualities are particularly important in obesity research, where precise data on food intake can help identify dietary patterns, energy and nutrients composition, contributing to children's weight. On the other hand, indirect methods are often more accessible and cost-effectiveness. They allow for collecting data from larger populations, making them valuable for community-based studies. However, these methods may be influenced by biases associated with self-reported data, which can lead to inaccuracies in assessing children's eating behaviours. According to a systematic review of six cross-sectional studies in children 4-14 years, a 24-hour dietary recall and diet history interview were the most accurate methods (Walker et al., 2018). These methods aid the researchers in selecting the most appropriate approaches based on the specific research objectives and the characteristics of target population, ultimately contributing to a better understanding of children's eating behaviour, one of the risk factors of obesity in children.

Table 2.2 Dietary assessment methods that can be used, with parental or carer support, to assess intake in healthy children or children living with overweight or obesity

Method/ technique	Description	Advantages	Disadvantages	An example publication
1) Weighed food records	Individuals weigh and record everything they eat and drink over a specified period of time	-Useful for assessing actual or usual intakes of individuals -Accurate	-Time consuming -Expensive -Equipment is needed for weighing food -Required motivated and literate participants	Used in children (overweight/obese) Park et al., 2022
2) Duplicate diet	Individuals collect duplicate samples of all foods and beverages consumed over a specified period, normally over 24-hour. The sample is then analysed in a laboratory to determine nutrient composition	-Highly accurate on nutrient intake -Useful in research settings	-Not practical for large studies due to the resources required for food analysis -Expensive and complex -High participants burden	Used in children MRC Epidemiology Unit, 2024
3) Image-based food records	Individuals take photographs of their food and beverage before consumption.	-Useful for estimate portion sizes and identify overall dietary intake. -Easy and convenient	-Required camera or smart phone -Knowing that their intake will be photographed may lead participants to modify their eating behaviours.	Used in children (all BMI status) Olivier et al., 2017

Method/ technique	Description	Advantages	Disadvantages	An example publication
			-Errors may occur when estimating nutrient intake from photos	
4) 24-hour dietary recall	Individuals report all foods and beverages consumed in the past 24 hour often through interviews	-Useful for assessing average usual intakes of a large population	-Rely on memory which may lead to inaccuracies -It may not reflect habitual intake for individual unless repeated -Analysis may be inaccurate unless undertaken by experienced researcher	Used in children and adults (normal, overweight/obesity) Tomayko et al., 2016
5) Food frequency questionnaire (FFQ)	Individuals report how often they consume specific foods from a list over a defined period of time e.g., weekly, monthly and provide estimate of quantity eaten	-Useful for obtaining qualitative, descriptive data on usual intake of foods or nutrients -Low respondent burden -Digital FFQs that link to nutrient databases provide intake data efficiently	- FFQ must be validated in the population being studied -Accuracy may be lower than other methods	Used in children (normal, overweight/obesity) Kozakowska et al., 2020
6) Estimated food record/ food diary	Individuals record everything they eat and drink over a specified period of time from one to seven days using estimated portion sizes	-Useful for assessing actual or usual intakes of individuals -Lower participant burden than weighed food records	-Accuracy depends on how careful the individual is and their ability to estimate amounts of food -Record for longer time leads to more difficulty for	Used in children (all BMI status) Vieira et al., 2017

Method/ technique	Description	Advantages	Disadvantages	An example publication
			individuals and may reduce their willingness -Individual must be able to read and write -Translating records into nutrient intake is time consuming and depends on skilled interpretation	
7) Diet quality indices	Scoring systems that evaluate the quality of dietary intake based on established dietary guideline e.g., Healthy Eating Index (WHO, 2020)	-Useful for identifying overall dietary patterns, which can be indicative health outcomes	-Scores may be misinterpreted if researchers do not fully understand the index's construction	Used in children (all BMI status) Zheng et al., 2023

Physical activity and sedentary behaviour

Physical activity data and sedentary behaviour has been collected using both direct (electric device) and indirect (questionnaires) methods.

Direct method: Accelerometer and wearable devices, these instruments provide quantitative measurements of physical activity by recording movement data, which can be analysed to determine the intensity, duration and frequency of activities. For example, the ActiGraph accelerometer (ActiGraph, LLC., Pensacola, Florida) is widely used in research settings with children (Ridgers et al., 2021; Janicke et al., 2013;) due to their ability to offer precise, real-time data and capture a broad spectrum of activities throughout the day, thereby reducing the reliance on subjective self-reported measures, which may be prone to bias. However, it is important to note that these devices may have limitations, some users may find uncomfortable, potentially impacting compliance. It is crucial to consider these limitations alongside the benefits when using these tools in children. Other examples of accelerometer use in research with adults and children are The TracMorD (Philips DirectLife, Amsterdam, The Netherlands) (Morales et al., 2017; Sijtsma et al., 2013), SenseWear Pro Armband mini (BodyMedia Inc., Pittsburgh, Pennsylvania, USA) (Samdal et al., 2019), the Actical accelerometer (MiniMitter; Respironics Co., Bend, OR, USA) (Tomayko et al., 2016), and the ActiHeart (CamNtech Ltd, Papworth, UK) (Adab et al., 2018).

Indirect methods: Self-reported questionnaires offer a subjective evaluation of physical activity and sedentary behaviours. These methods are subjective and cost-effective, making them a practical choice for rapidly gathering data from large populations. However, self-reported questionnaires are susceptible to biases such as overreporting

due to social desirability, recall bias, and varying interpretations of activity intensity. Different types of questionnaires have been used in research setting, for instance, the self-reported Baecke physical activity questionnaire (Morales et al., 2017), the self-efficacy physical activity questionnaire (Samdal et al., 2019), the rapid assessment of physical activity questionnaire, a validated Minnesota REGICOR (Registre Gironi del Dor) Short Physical Activity Questionnaire, the validated Spanish version of the Nurses' Health Study questionnaire for sedentary behaviour (Alfaro et al., 2020), the validated EPIC Physical Activity Questionnaire (Dambha-Miller et al., 2019), the validated European Prospective Investigation into Cancer -Norfolk Physical Activity Questionnaire (Estlin et al., 2021), exercise diaries (Markkanen et al., 2023), and the validated Godin leisure time physical activity questionnaire (Little et al., 2016).

Combining both direct and indirect methods allows a more comprehensive understanding of physical activity and sedentary behaviours. For example, using accelerometer in addition to self-reported questionnaires can help validate and enhance the collected data. Many research studies have employed a combination of both direct and indirect methods, such as using the TracMorD and the self-reported Baecke physical activity questionnaire (Morales et al., 2017), the electronic accelerometer and the International Physical Activity Questionnaire (Parker et al., 2019), the SenseWear Pro Armband mini and the self-efficacy physical activity questionnaire (Samdal et al., 2019), the ActiGraph Activity Monitor and screen time diary (Janicke et al., 2013), the Actical accelerometer and screen time recorded (Tomayko et al., 2016). This approach addresses the limitations of each method by providing both objective data and subjective context, leading to more robust

conclusion. However, this method can be resource-intensive, requiring more time for data collection and analysis, and may complicate the interpretation of results.

In summary, a combination approach to collecting physical activity and sedentary behaviours data is essential for understanding these complex behaviours in children. While direct methods provide objective insights, indirect methods offer context that is valuable. The strengths and limitations of each method should be carefully considered, aiming for a combination that best suits the study objectives and target populations. This includes validation of the method in children living with overweight and obesity. Obtaining reliable data on physical activity and sedentary behaviour is particularly crucial in helping to address obesity issues, where understanding the interplay of different behaviours is key to developing effective interventions.

Sleep

Sleep data is typically collected using indirect questionnaires and direct electronic devices. One widely used questionnaire for evaluating sleep quality in individuals aged 12-25 years old is the Pittsburgh Sleep Quality Index (PSQI) (Parker et al., 2019). This tool is valuable for capturing subjective sleep experiences, including issues with falling asleep and disturbances during sleep. The PSQI is advantageous because it is relatively simple to use, cost-effective and can address various sleep related problems. It enables researchers to efficiently collect data from large populations. However, a limitation is that self-reported measures may introduce bias. Factors such as social desirability or lack of awareness can lead individuals to under- or overreport their sleep duration and quality.

The ActiHeart device (CamNtech Ltd, Papworth, UK) is commonly employed to monitor sleep in younger populations, such as children aged 6-7 years (Adab et al., 2018). This device provides objective data by recording movement and physiological parameters, offering insights into sleep duration and quality. The use of objective measurement from the ActiHeart reduces reliance on subjective reporting leading to more accurate data on sleep patterns. Furthermore, the device enables continuous monitoring, capturing variations in sleep that may be missed by questionnaires. However, the use of electronic devices may be challenging, including issues of compliance, wearer discomfort, and the necessity for technical expertise in data analysis. In a study by Mazza et al. (2020), both subjective (sleep diary) and objective (Actigraphy) methods were used to evaluate sleep in 80 children aged 8-9 years. The study found that children's self-reported sleep diaries offer valuable insights into their perception of sleep, while Actigraphy provides additional information about nighttime wakefulness. This finding suggested that by combining a sleep diary with Actigraphy, researchers can better understand the factors that affect the alignment between subjective and objective sleep measurement.

In summary, sleep data collection can use subjective questionnaires and objective devices. Combining these methods provides a comprehensive understanding of sleep patterns, which is crucial for children living with overweight or obesity. Poor sleep quality is often linked to weight management and overall health (Felso et al., 2017; Miller et al., 2018). Enhancing sleep assessment in children may improve obesity interventions and outcomes.

2.4 Justification for the need for interventions

Children living with overweight and obesity are a global health concern. Overweight and obesity are complex and multifactorial problem that requires a comprehensive approach to address all contributing modifiable factors, such as poor dietary habits, physical inactivity, sedentary behaviours, and inadequate sleep. Multi-component interventions, that combine dietary, physical activity and behavioural strategies, have effectively addressed children with obesity (Psaltopoulou et al., 2019; Brown et al., 2018; Mead et al., 2017). However, the precise active components of these interventions, i.e., the individual behaviour change techniques used, have not been investigated using a comprehensive taxonomy i.e., BCTTv1, and there needed to be more data for recommending which BCTs were more effective than others. To facilitate researchers or practitioners in designing interventions, implementing, monitoring, evaluating and replicating the interventions in the future, it is essential to clearly define the BCTs used in the intervention using BCTTv1.

2.5 Thesis aim and objectives

The overall aim of the thesis was to identify the use of BCTs and effectiveness of published interventions and one real-life setting of family weight management programme for children aged 5-15 years living with overweight or obesity in England.

The objectives of this thesis were:

- To identify the use of BCTs and effectiveness of published interventions, categorised using the BCTTv1 (Michie et al., 2013) in RCT for children aged 5-15 years living with overweight or obesity (Study 1, a systematic review).

- To explore the use of BCTs in a public health intervention (not research study) and how they were reportedly delivered in one real-life setting in England for children aged 5-15 years living with overweight or obesity who attended a family weight management programme (Study 2, a qualitative interview with staff).

- To compare the use of BCTs, categorised using BCTTv1 (Michie et al., 2013), identified in research settings and a 'real-life' setting for children aged 5-15 years living with overweight or obesity (Study 1 and 2).

- To undertake an initial exploration of the perspectives in terms of acceptability and value to participants who attended a family weight management programme which used BCTs in England (Study 4, a qualitative interview with families).

2.6 Thesis research questions

- *Which* BCTs, categorised using BCTTv1, were **most frequently used** and *which* published interventions were **effective** in RCT 'research' settings for children aged 5-15 years living with overweight or obese? (This question is addressed by study 1, a systematic review)

- *Which* BCTs, categorized using BCTTv1, were **used** in a 'real-life' setting and ***how* were they reportedly used** for children aged 5-15 years living with overweight or obese? (This question is addressed by study 2, a qualitative interview with staff)

- ***What* were the similarities and differences** of BCTs, categorized using BCTTv1, in RCT 'research' settings and a real-life setting? (This question is addressed by studies 1 and 2)

- ***How* effective** were family weight management programmes? (This question is addressed by study 1 and study 3, a quantitative database analysis)

- ***How* acceptable and valuable** was a family weight management programme to families? (This question is addressed by study 4, a qualitative interview with families)

CHAPTER III

STUDY1; A SYSTEMATIC REVIEW OF BEHAVIOUR CHANGE TECHNIQUES USED IN WEIGHT MANAGEMENT INTERVENTIONS IN CHILDREN AGED 5-15 YEARS

3.1 Introduction

3.1.1 Background and rationale

One of the principal components of weight management programmes for children and adolescents is behaviour change strategies (NICE, 2013). As behaviour change interventions are often complex and interrelated, a common language is needed to optimize communication and to effectively evaluate and replicate interventions. This has led to the development of a series of taxonomies designed to identify behaviour change techniques (BCTs), starting with 26-items of individual BCTs (Abraham & Michie, 2008), followed by a 40-items taxonomy (Michie et.al, 2011) and then a 93-items taxonomy (Michie et.al, 2013). Behaviour change taxonomies have been used in systematic reviews and meta-analysis of interventions in adults and children living with overweight and obesity. Michie, Abraham, Whittington and McAteer (2009) used the 26-items of BCTs taxonomy (Abraham & Michie, 2008) in a meta-analysis of 101 experimental or quasi-experimental behaviour change interventions to improve healthy eating and physical activity in a total of 44,747 adults, pooled overall effect size of healthy eating and physical activity interventions was 0.31 (95% confidence interval (CI) 0.26 to 0.36, I^2=69%). They found that interventions containing the BCTs, self-monitoring of behaviour combined with at least one other technique, e.g., prompting intention information, prompting specific goal setting, providing feedback on

performance or prompting review of behaviour goals, was significantly associated with improving physical activity as well as healthy eating in adults living in the community, a pooled effect size of healthy eating and physical activity of self-monitoring plus other techniques was 0.42 (95% CI = 0.30 to 0.54, I^2=71%, p=0.003).

Similarly, Dombrowski et al. (2012) used the 26-item BCT taxonomy (Abraham & Michie, 2008) in a systematic review of 44 randomised control trials (RCTs) about behavioural interventions in adults (number of participants ranging between 26-3234) who were obese and had related co-morbidities. The findings showed that the interventions were more successful in decreasing weight when they included the use of prompt practice, relapse prevention, provision of instructions, and self-monitoring of behaviour techniques compared to the control group (mean difference in kg -4.8 (95% CI = -6.2 to -3.4), -4.5 (95% CI = -6.2 to -2.8), -4.3 (95% CI = -5.8 to -2.8), and -4.2 (95% CI = -4.2 to -5.5).

Based on the 40-item taxonomy, also described as the CALO-RE taxonomy (Michie et.al, 2011), a systematic review without meta-analysis by Martin, Chater and Lorencatto (2013) evaluated nine RCTs for management of obesity in children and adolescents aged 2-18 years and defined effectiveness as a standardised mean difference in BMI $\geq$ -0.13 kg/m^2. Six BCTs were delivered only in effective interventions but not in ineffective interventions and these were providing information on the consequences of behaviour to the individual, environmental restructuring, prompt identification as role model/position advocate, stress management/emotional control training, general communication skills training and prompt practice. One other BCT, providing information on the consequences of behaviour in general, was present only

in ineffective interventions. This analysis provides useful information about BCTs which might potentially be useful or not for future weight management interventions in children. However, it is important to note that the review methodology of combining results from different studies without conducting a meta-analysis, may not provide clear and conclusive evidence on which BCTs might be most effective. This is because the effectiveness of a particular BCT cannot be determined solely based on its presence or absence in a successful intervention as each study may have variations in sample size, outcomes measures and intervention design. By pooling data from difference studies, a meta-analysis would provide more accurate estimates of their effect size and potential impact on outcomes.

Samdal, Eide, Barth, Williams and Meland (2017) used the 93-item taxonomy, also described as behaviour change technique taxonomy version 1 or BCTTv1 (Michie et.al, 2013), in a systematic review and meta-analysis of 48 RCTs investigating healthy diet and physical activity in a total population of 11183 adults living with overweight or obesity, effect size of the interventions containing combined BCTs was 0.37 (95% CI = 0.26 to 0.48, I^2 = 71%) and 0.24 (95% CI = 0.15 to 0.33, I^2 =59%) in the short term (50 reports, measured outcomes at $\leq$ 6 months after randomisation) and long term (32 reports, measured outcomes $\geq$ 12 months after randomisation), respectively. The findings showed that the interventions containing BCTs, goal setting behaviour (effect size = 0.48, 95% CI = 0.26 to 0.71, p<0.001 in the short term and the effect size was still significant at long term follow-up) and self-monitoring of behaviour (effect size =0.39, 95% CI = 0.16 to 0.63, p = 0.001 in the short term and the effect size was still significant at long term follow-up) were the most effective techniques for promoting positive change in diet and physical activity.

The above systematic reviews of behaviour change technique interventions using taxonomies which clearly define each BCT are helpful in identifying the effectiveness of different behaviour change techniques. However, the reviews by Michie et al (2009), Dombrowski et al (2012) and Samdal et al (2017) evaluated RCTs in adults so may have limited application to children. Although the review by Martin et al (2013) was undertaken in children and adolescents, it only considered papers published up until December 2009 and used an earlier and less comprehensive taxonomy which defined only 40 individual BCTs. Since 2009 there has been ongoing concern about overweight and obesity in children and more intervention studies have been published. As a result, it can be concluded that the current evidence about which are the most effective behaviour change techniques based on BCTTv1 in children and adolescents is limited and requires further evaluation.

3.1.2 Aim and objectives

This study aimed to identify the use of BCTs and evaluate the effectiveness of published interventions in managing overweight and obesity in children aged 5-15 years.

This systematic review had two objectives:

- To assess which BCTs, categorised using the BCTTv1, are most frequently used in interventions to evaluate the management of overweight and obesity in children aged 5-15 years.
- To assess the effectiveness of interventions in managing overweight and obesity in children aged 5-15 years reported in published RCTs.

3.2 Methodology

3.2.1 Study design

This systematic review included randomized control trials (RCTs) of interventions incorporating behaviour change techniques for managing overweight and obesity in children. A protocol for this systematic review was published on the Prospero website, registration number CRD42019141417 (Satoh, Madden & Falliaze, 2019).

3.2.2 Participants

Children aged between 5-15 years old who were identified as overweight or obese using any recognized diagnostic criteria for overweight and obesity in children and who were otherwise healthy (**Appendix 3A, otherwise healthy criteria**).

3.2.3 Intervention

RCTs were included if they evaluated an intervention that included at least one of the 93 hierarchically-clustered behaviour change techniques described in the BCTTv1 (Michie et al., 2013). Alternatively, if the studies provided sufficient information (simply stating the name of a BCT would not be sufficient; examples for explaining BCTs were provided in **Appendix 3B, Examples of explaining BCTs**) to enable the reviewers to categorise the intervention using this taxonomy. These interventions included any mode of delivery (e.g., individual or group, face-to-face, electronic device and online); any providers (e.g., dietitian, nutritionist, nurse or doctor); any community setting (e.g., school, community centres but not hospitals). Studies using medication or nutrients supplementation as part of the intervention were excluded unless these are provided equitably to both intervention and control groups.

3.2.4 Comparator

Control groups did not receive any behaviour change techniques or were on a waiting list to receive the intervention after the study completed.

3.2.5 Outcomes

Outcomes included body mass index (BMI), BMI Z-score, weight, waist circumference (WC), percentage of body fat (%BF) or other methods of body composition analysis determined using method validated in children with overweight and obesity. Outcomes were included if they had been measured before the intervention and again at least two months after the intervention finished. A period of two months was used allowing the behaviour to continue to change in response to the intervention or to revert to original behaviour. Although some behaviours can change quickly, two months was the average time required for a person's behaviour to become habitual (Lally, Van Jaarsveld, Potts & Wardle, 2010).

3.2.6 Data collection

Searches were conducted from six electronic databases i.e., PubMed, The Cochrane Library, Scopus, CINHL Plus, PsycARTICLES, and Thai Journal Online. All databases were searched from their respective inception dates to November 2019 with no restrictions on the language of publication. Only studies published in English and Thai language were identified during the screening process and other language were excluded.

Searched terms included a combination of keywords and their synonyms and MeSH terms where appropriate by using Boolean operators, e.g., AND, OR. The keywords included, for example behavio(u)r change technique(s); behavio(u)r change intervention(s); behavior(u)r change modification; behavior(u)r therapy; any behaviour change techniques from BCTTv1 (Michie et al., 2013), e.g., goal setting, problem-solving, action planning, feedback on behaviour, self-monitoring; obesity; obese; overweight; weight management; weight loss; weight control; weight reduction (**Appendix 3C, search strategies**).

Search results were imported into the Rayyan systematic review online application (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016), and duplicates were removed by the first researcher (SS). Titles and abstracts were screened by SS with a random 10% screened independently by a second researcher (JC) (**Appendix 3D, protocol for a random 10% screening titles and abstracts**). Potentially relevant of full-text studies were independently screened by the first researcher (SS) and one second researcher (AM, RF, JC, DS, YN or NW). The second researchers were briefed about the search process and trained in Rayyan by the first researcher before starting in order to maintain consistency in the screening process (**Appendix 3E, documents for training the research team**). Any disagreements were resolved by discussion or by consultation with another researcher (AM or RF).

3.2.7 Data extraction

Data were extracted from full text papers and supplementary data of all studies that met inclusion criteria using a data extraction table which was developed specifically

for the purpose and based on the Cochrane data collection form for RCT intervention review (Li, Higgins & Deeks, 2020). This included eight items:

1) general information
2) study eligibility
3) method
4) participants
5) intervention and control condition
6) behaviour change techniques coded using BCTTv1
7) results and findings
8) limitation and mitigation strategy

(**Appendix 3F, data extraction table form; Appendix 3G, protocol for coding BCTs; Appendix 3H, data extraction**)

Intervention and control conditions (item 5) were coded by using the template for intervention description and replication (TIDieR) checklist and guide (Hoffmann et al., 2014). This included twelve items i.e.name of intervention, rationale, materials used, procedure, providers, mode of delivery, locations, duration and intensity, tailoring, modification, how well (planned) and how well (actual). By using the TIDieR, researchers, practitioners and intervention designers can describe interventions in a clearer manner, allowing them to utilize information or replicate interventions. Additionally, this tool was proposed as a method of evaluating the quality of reporting intervention across studies (Hoffmann et al., 2017).

BCT (item 6) were coded using BCTTv1 (Michie et al., 2013) by two researchers (SS, AM) after they completed training in the use of the BCTTv1 and achieved coding

competence to specify the content of complex behaviour change interventions (University College London: UCL, 2014)

All data from included studies were extracted by the first researcher (SS) and all extracted data, except BCT, were checked by a second researcher (RF). BCT data were extracted independently by a second researcher (AM) (**Appendix 3G; Appendix 3I, BCTs coding**). Any disagreements in extracted data or BCT coding were resolved by discussions (SS, AM, and RF) and a decision made by agreement (**Appendix 3I**).

Risk of bias (RoB) of included studies was assessed by using an amended version of the Cochrane risk-of bias tool for RCT (RoB2) (Sterne et al., 2019). This included five domains i.e., randomization process, intended intervention, missing outcome data, measurement of the outcome and selection of the report results. The final RoB judgments were low, some concern and high risk of bias (**Appendix 3H, Data extraction, item 9**).

Quality of evidence was assessed by using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) pro and the Guideline Development Tool (GDT) (Schunemann, Brozek, Guyatt & Oxman, 2013). This included six domains i.e., study design, risk of bias, inconsistency, indirectness, imprecision and other considerations. All four outcomes were assessed i.e., BMI z-score at post-intervention, BMI z-score at follow-up, WC at post-intervention and WC at follow-up. The quality of evidence was categorized into four levels i.e., very low, low, moderate and high (Schunemann et al., 2013).

3.2.8 Data analysis

A narrative synthesis of data from the included studies is presented as summary tables of extracted data which included study participants, intervention description, control description, follow-up duration, attrition rates and main outcomes. Meta-analysis was conducted by using Review Manager 5.3 (RevMan). Means, standard deviations, and sample size at baseline, post-intervention and follow-up of control and intervention groups were entered into RevMan for analysis. As all included studies reported continuous outcomes, this used Inverse Variance for statistical method, random effects for analysis model, standard mean difference for effect measure as outcomes using different scales (Deek, Higgins & Altman, 2022) and 95% confidence intervals (CI).

3.3 Results

3.3.1 Study selection and geographical location

The search identified 37,964 articles from six databases. After removing duplicates, 26,680 articles remained. After screening by title and abstracts, 1,251 articles remained and 1,247 full-text articles were excluded because they did not meet the inclusion criteria and the reasons were recorded in the study flow diagram (**Figure 3.1**). Therefore, the final review included four randomised controlled trials (Ahmad, Shariff, Mukhtar, and Lye, 2018; Croker et al., 2012; Golley, Magarey, Baur, Steinbeck and Daniels, 2007; Janicke, Sallinen, Perri, Lute, Huerta, et al., 2008). Data were extracted from the four full text, related papers (Ahmad et al., 2016; Golley et al., 2007; Janicke et al., 2008) and supplement files.

The four studies were conducted in four different countries, i.e., Malaysia (Ahmad et al., 2018), the United Kingdom (Croker et al., 2012), Australia (Golley et al.,2007), and the United States of America (Janicke et al., 2008). The articles were published between 2007 and 2018.

3.3.2 Participant and intervention characteristics

Participant characteristics

The total number of participants from the four included studies was 410 children, aged between 6-14 years. No participants aged 5 years or 15 years were included in these four studies. The number of participants per study ranged from 72 to 134. All studies included parents or guardians or caregivers as participants with the children in the interventions. Different cut-offs for BMI were used for inclusion criteria, namely BMI z score >1 SD (Ahmad et al., 2018), the International Obesity Task Force (IOTF) criteria

(Croker et al., 2012; Golley et al., 2007) and BMI above the 85th percentile for age and sex (Janicke et al., 2008) (**Table 3.1**). The mean BMI z scores in the intervention groups at baseline ranged between 2.0 and 3.1 (**Table 3.1**), indicating that the participants had varying levels of excess body weight.

Intervention characteristics

The duration of the interventions ranged between 4 and 6 months and all had follow-up at six months after the intervention finished. The intervention groups were compared with waiting list control groups where participants did not receive any BCTs in all four studies (**Table 3.1**).

Two studies had one intervention group (Ahmad et al., 2018; Croker et al., 2012). Two studies had more than one intervention group (Golley et al., 2007; Janicke et al., 2008). The Golley et al., 2007 study had two intervention groups, i.e., Parent-skills training (P), only parents attended the sessions, and Parenting-skills training plus intensive lifestyle education (P+DA), which include parents and children. The study by Janicke et al., (2008) also had two intervention groups, i.e., the family-based intervention (FB) and parent-only intervention (PO). In the Golley and Janicke studies, the intervention groups that included both parents and children (P+DA and FB) were compared with control groups. As another two studies were also family-based which included both parents and children (Ahmad et al., 2018; Croker et al., 2012). Therefore, P+DA and FB were used to analyse in this systematic review.

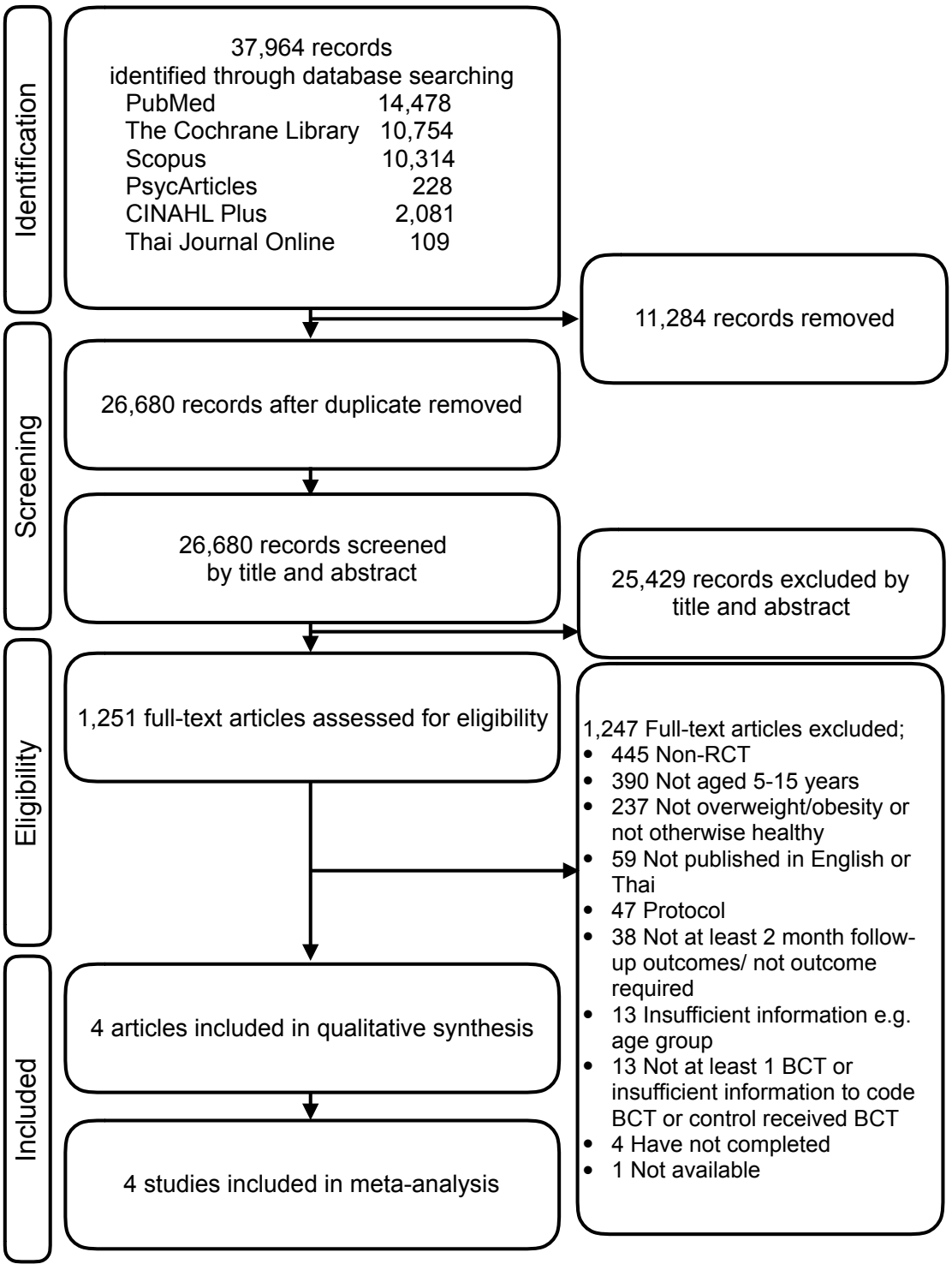


Figure 3.1 Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) flowchart (Page, et.al., 2021)

Table 3.1 Intervention characteristic of the four included studies

Study ID/ Country	Participants	Intervention description	Control description	Follow-up duration	Attrition rates	Main outcomes
Ahmad, 2018 Malaysia	Total number of participants (children) at baseline: n =134 Intervention group n=67 Control group n=67 Age 7-10 years Gender (female): 58% Inclusion criteria: BMI z score>1 SD (WHO Anthroplus software, 2006) BMI z score at baseline Intervention 2.0(0.4) Control 2.1(0.4) NS Intervention was delivered to parent-child dyads	The REDUCE (REorganise Diet, Unnecessary sCreen time and Exercise) intervention programme. Duration of intervention 4 months Face-to-face sessions combined with Facebook and WhatsApp. Intervention delivered by a public health physician and a sport medicine specialist	Waiting list Duration of control period 10 months	At 3 and 6 months after intervention finished	Children Intervention: 0% Control: 0% Parents Intervention: 5% Control: 13%	BMI z score assessed at 0, 4, 7 and 10 months

NS= No significant different

Table 3.1 Intervention characteristic of the four included studies (cont.)

Study ID/ Country	Participants	Intervention description	Control description	Follow-up duration	Attrition rates	Main outcomes
Croker, 2012 UK	Total number of participants (children) at baseline n =72 Intervention group n=37 Control group n=35 Age 8-12 years Gender (female): 69% Inclusion criteria: International Obesity Task Force (IOTF) (Cole, Bellizzi, Flegal, and Dietz, 2000). BMI z score at baseline: Intervention 3.1(0.6) Control 3.3(0.6) NS Intervention was delivered to child + at least 1 parent/guardian	A family-based behavioural treatment Duration of intervention 6 months Face-to-face, group Intervention delivered by psychologist, family therapist or experienced dietitian with experience of working with parents and families for parents' groups and a dietitian with experience of working with children for children's group	Waiting list Duration of control period 6 months	At 6 months after intervention finished (Only in intervention group)	At the end of the intervention in children Intervention: 11% Control:14% At follow-up Intervention: 49-54% Control: NI	BMI z score assessed at 0,6, and 12 months In control group only assessed at 0 and 6 months

NS = no significant different, NI = no information

Table 3.1 Intervention characteristic of the four included studies (cont.)

Study ID/ Country	Participants	Intervention description	Control description	Follow-up duration	Attrition rates	Main outcomes
Golley,2007 Australia	Total number of participants (children) at baseline n =111 Intervention group -Parenting-skills training with intensive lifestyle education (P+DA) n=38 -Parenting-skills training alone (P) n=37 Control group n=36 Age 6-9 years Gender (female): 63% Inclusion criteria: International Obesity Task Force (Cole, Freeman, and Preece, 1990; Cole, Bellizzi, Flegal, and Dietz, 2000) BMI z score at baseline: Intervention -P+DA 2.74(0.58), -P 2.76(0.58) Control 2.75(0.39) NS Intervention was delivered to parents only in both groups but in P+DA group while parents attend the session, their children attended structured, supervised activity sessions.	A family-focused child weight-management program Duration of intervention 6 months Group Intervention delivered by a dietitian for parents' sessions and nonexpert staff for lifestyle sessions (developed by physical activity experts) for children	Waiting list Duration of control period 12 months	At 6 months after intervention finished	Intervention: -P+DA: 18%, -P: 22% Control:14%	BMI z score and waist circumference (WC) assessed at 0, 6 and 12 months In control group only assessed at 0 and 12 months

NS=no significant different

Table 3.1 Intervention characteristic of the four included studies (cont.)

Study ID/ Country	Participants	Intervention description	Control description	Follow-up duration	Attrition rates	Main outcomes
Janicke, 2008 USA	Total number of participants (children) at baseline n =93 Intervention group -Family-based (FB) n=33 -Parent-only (PO) n=34 Control group n=26 Age 8-14 years Gender (female): 46% Inclusion criteria: BMI above the 85th percentile for age and sex. BMI z score at baseline: Intervention -FB 2.133(0.43) -PO 2.160 (0.35) Control 2.015(0.41) NS Intervention was delivered to children + parents in FB group and only parents in PO group	Behavioural family-based (FB) and parent-only (PO) intervention Face-to-face, group Duration of intervention 4 months Intervention delivered by family and consumer sciences (FCS) staff in collaboration with postdoctoral psychologist and graduate students in clinical psychology	Wait-list Duration of control period 10 months	At 6 months after intervention finished Data collection at baseline, month 4 (at the end of the intervention, and month 10	Intervention: -FB: 27%, -PO: 24% Control:19%	BMI z score assessed at 0, 4 and 10 months

NS=no significant different

3.3.3 Behaviour change techniques (BCTs)

The interventions in the four included studies included between 12 – 19 different BCTs, with an overall total of 28 different BCTs used across the four studies (**Table 3.2**). The numbers in square brackets after the name of BCTs, in the following text and throughout the thesis, are the numbers used to identify BCTs in the BCTTv1. The five most frequently used BCTs were identified in all the four studies and included *goal setting (behaviour) [1.1], problem-solving [1.2], self-monitoring of behaviour [2.3], social support (unspecified) [3.1]* and *demonstration of the behaviour [6.1]*. There were five BCTs used in at least three studies, i.e., *action planning [1.4], instruction on how to perform the behaviour [4.1], credible source [9.1], social reward [10.4]* and *identification of self as a role model [13.1]*. Another six BCTs were used in at least two studies, i.e., *review outcome (goal) [1.7], monitoring of outcome(s) of behaviour without feedback [2.5], feedback on outcome(s) of behaviour [2.7], information about health consequences [5.1], behavioural practice/rehearsal [8.1]* and *graded tasks [8.7].* The remaining twelve BCTs were used in only at least one study. It was observed that three BCTs were frequently used together including *instruction on how to perform the behaviour [4.1], demonstration of the behaviour [6.1]*, and *behavioural practice/rehearsal [8.1].*

Table 3.2 BCTs used in intervention groups for the four included studies

Individual BCT	Study ID			
	Ahmad 2018	Croker 2012	Golley 2007	Janicke 2008
Total number of BCTs in study	**12**	**13**	**15**	**19**
1.1 Goal setting (behaviour)	X	X	X	X
1.2 Problem solving	X	X	X	X
1.3 Goal setting (outcomes)				X
1.4 Action planning		X	X	X
1.5 Review behaviour goals				X
1.7 Review outcome goals			X	X
1.8 Behavioural contract				X
2.1 Monitoring of behaviour by others without feedback			X	
2.2 Feedback on behaviour		X		
2.3 Self-monitoring of behaviour	X	X	X	X
2.5 Monitoring of outcomes of behaviour without feedback		X		X
2.7 Feedback on outcomes of behaviour	X	X		
3.1 Social support (unspecified)	X	X	X	X
4.1 Instruction on how to perform the behaviour	X		X	X
5.1 Information about health consequences	X		X	
6.1 Demonstration of the behaviour	X	X	X	X
6.2 Social comparison			X	
8.1 Behavioural practice/rehearsal			X	X
8.2 Behaviour substitution			X	
8.7 Graded tasks	X			X
9.1 Credible source	X	X	X	
10.2 Material reward (behaviour)				X
10.4 Social reward		X	X	X
10.10 Reward (outcome)	X			
12.1 Restructuring the physical environment		X		
12.2 Restructuring the social environment				X
12.5 Adding objects to the environment				X
13.1 Identification of self as role model	X	X		X

Note: Green: BCTs identified in all four studies, Yellow: BCTs identified in three studies, Red: BCTs identified in two studies

3.3.4 Intervention effects on objective measurement outcomes

The most frequently reported outcomes in the four included studies were body mass index (BMI) z- score and waist circumference (WC). Of the four studies, all reported BMI z-score, and only three reported WC outcomes: Golley et al., 2007; Croker et al., 2012; and Ahmad et al., 2018. All four studies expressed BMI as BMI z-score, while WC was presented differently, i.e., z-score (Golley et al., 2007 and Croker et al., 2012) or percentile (Ahmad et al., 2018). Other outcomes were reported, e.g., total body fat, blood pressure, serum total cholesterol, and serum triglycerides.

The measurement outcomes in intervention groups and control groups were collected at baseline and post-intervention (at four or six months after baseline) and follow-up at six months after intervention finished.

3.3.4.1 Body mass index (BMI) z-score

At post-intervention (at four to six months after baseline)

Four studies reported BMI z-scores in the intervention groups at post-intervention. Three studies also reported BMI z-score in the control groups at post-intervention, while Golley et al. (2007) did not report these data. Therefore, data from only three studies were analysed for change in BMI z-score in the meta-analysis (Ahmad et al., 2018, Croker et al., 2012 and Janicke et al., 2008) where the measurement in both intervention and control groups in each study was at the same time point, i.e., at baseline and at four to six months after baseline.

Two individual studies showed an effect on BMI z-score in favour of control (Croker et al., 2012; Janicke et al., 2008), while only one individual study showed an effect in favour of the intervention (Ahmad et al., 2018) (**Figure 3.2**).

There was no evidence of a significant intervention overall effect on the change of BMI z-score at post-intervention in the combined groups who received interventions compared to the control groups (p= 0.67), yielding a pooled population of 242 children with an overall effect was -0.05 (-0.31, 0.20) and I^2 = 0% which indicated low heterogeneity (**Figure 3.2**).

At follow-up (six months after intervention finished)

Four studies reported BMI z-score in the intervention groups at follow-up. Three studies also reported BMI z-score in the control groups at follow-up, while Croker et al. (2012) did not report these data. Therefore, data from only three studies were analysed for change in BMI z-score in the meta-analysis (Ahmad et al., 2018, Golley et al., 2007 and Janicke et al., 2008) where the measurement in both interventions and control groups in each study was at the same time points i.e., baseline and follow-up at six-months after intervention finished.

All three individual studies showed the effect on BMI z-score in favour of the intervention (Golley et al., 2007; Janicke et al., 2008; Ahmad et al., 2018) (**Figure 3.3**).

There was a significant intervention effect on change in BMI z score in the combined groups who received interventions compared to control groups (p = 0.03), yielding a

pooled population of 253 children with an overall effect was -0.27 (-0.52, -0.02) and 0% of heterogeneity which indicated low heterogeneity (**Figure 3.3**).

3.3.4.2 Waist circumference (WC)

At post-intervention (at four to six months after baseline)

Three studies reported WC either as z-score or percentile in the intervention groups at post-intervention (Ahmad et al., 2018, Croker et., 2012 and Golley et al., 2007). Two studies also reported WC in the control groups at post-intervention, while Golley et al. (2007) did not report these data. Therefore, the data from only two studies were analysed for change in WC in the meta-analysis (Ahmad et al., 2018 and Croker et., 2012) where the measurement in both interventions and control groups in each study was at the same time points i.e., baseline and at four to six months after baseline.

Only one study showed an effect on waist circumference in favour of the intervention (Ahmad et al., 2018) (**Figure 3.4**).

There was no evidence of a significant intervention effect on change of WC at post-intervention in the combined groups who received interventions compared to the control groups ($p = 0.23$), yielding a pooled population of 197 children with an overall effect -0.26 (-0.67, 0.16) and $I^2 = 50\%$ which indicated moderate to substantial heterogeneity (**Figure 3.4**).

At follow-up (six months after intervention finished)

Three studies reported WC in the intervention groups at follow-up (Ahmad et al., 2018, Croker et al., 2012 and Golley et al., 2007). Two studies also reported WC in the control groups at follow-up, while Croker et al. (2012) did not report these data. Therefore, the data from only two studies were analysed for change in WC in the meta-analysis (Ahmad et al., 2018 and Golley et al., 2007) where the measurement in both interventions and control groups in each study was at the same time points i.e., baseline and follow-up at six months after intervention finished.

The two individual studies showed an effect on waist circumference in favour of the intervention (**Figure 3.5**)

There was a significant intervention effect on WC in the combined groups who received intervention compared to control groups ($p = 0.005$), yielding a pooled population of 208 children with an overall effect was -0.39 (-0.67, -0.12) and 0% of heterogeneity which indicated low heterogeneity (**Figure 3.5**).

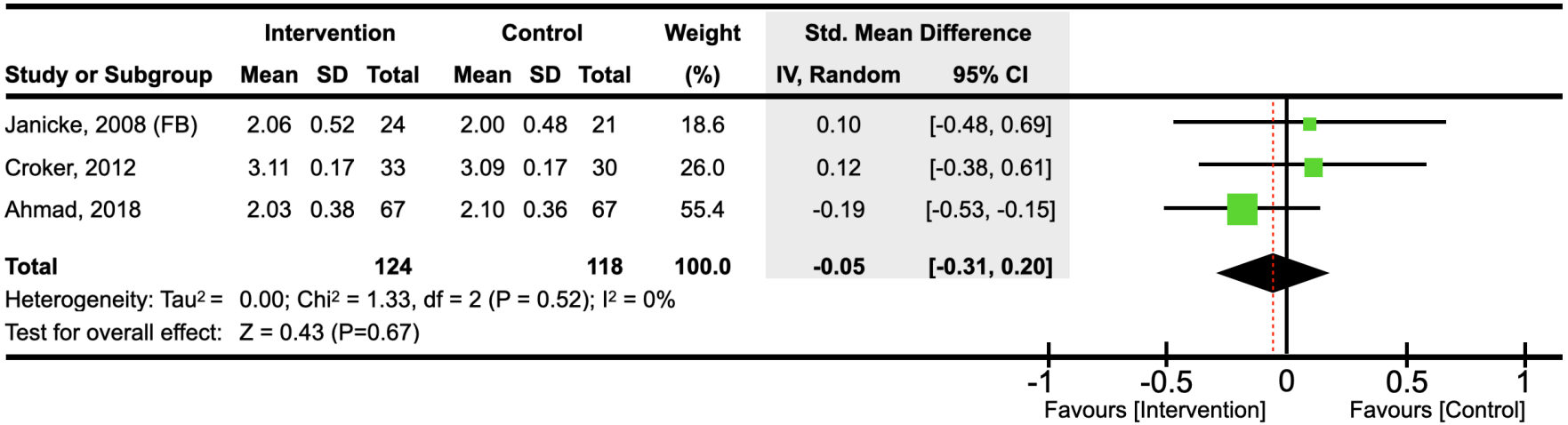


Figure 3.2 Forest plot of BMI z score outcome at post intervention (intervention range between 4 to 6 months) in interventions and control groups in three included studies with combined population of 242 children

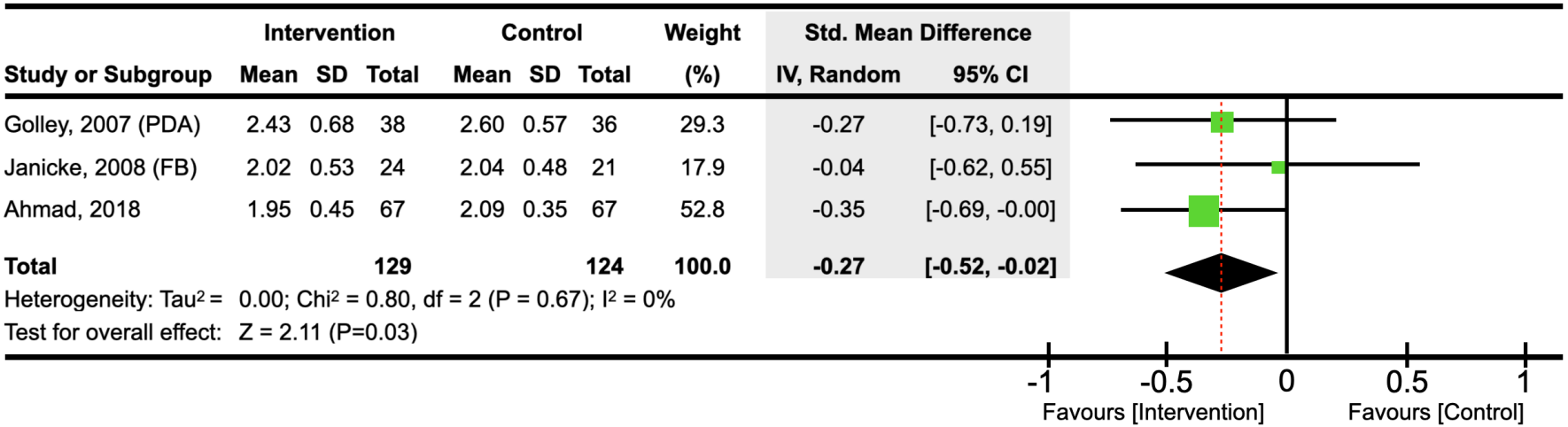


Figure 3.3 Forest plot of BMI z score outcome at follow-up (6 months after intervention finished) in interventions and control groups in three included studies with combined population of 253 children

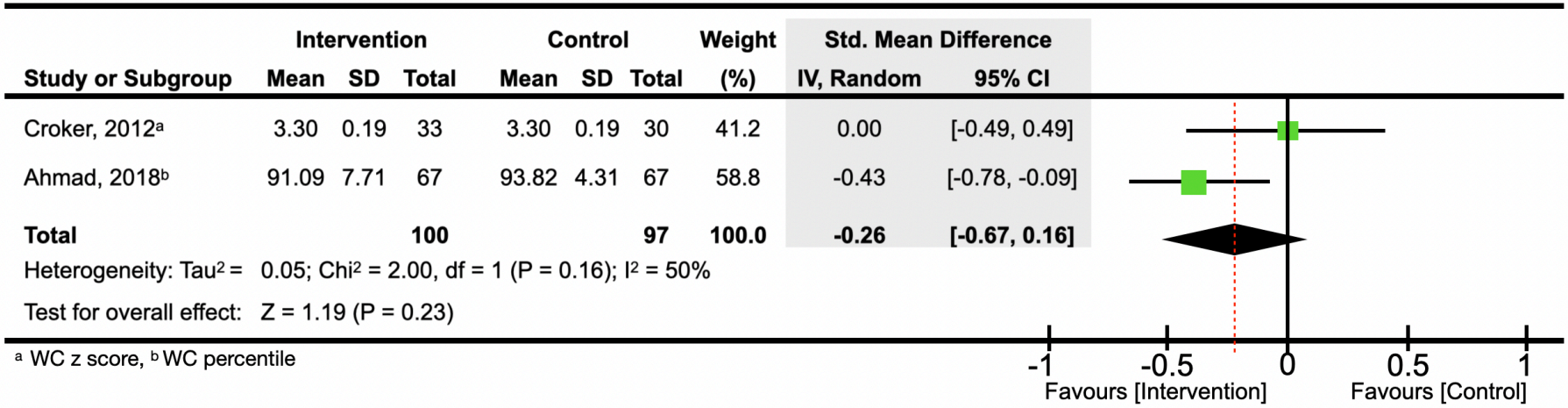


Figure 3.4 Forest plot of WC outcome at post intervention (intervention range between 4 to 6 months) in interventions and control groups in two included studies with combined population of 197 children

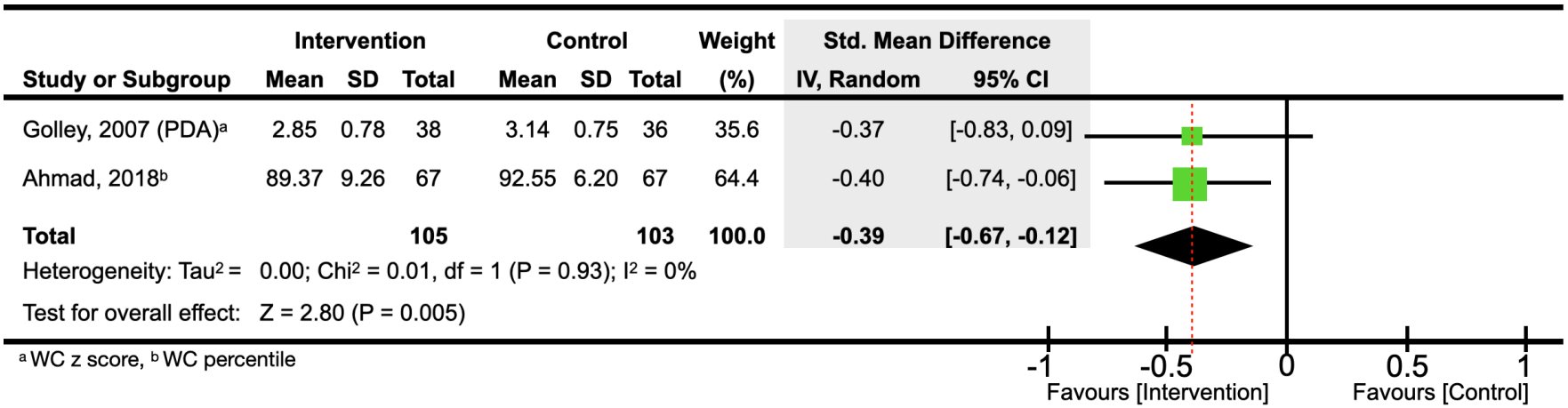


Figure 3.5 Forest plot of WC outcome at follow-up (6 months after intervention finished) in BCT interventions and control groups in two included studies with combined population of 208 children

3.3.5 Evaluation of the intervention description of the included studies using TIDieR checklist

The TIDieR checklist recommends that a minimum of twelve items are used to describe interventions (Hoffmann et al., 2014). None of the four included studies reported all 12 items on the TIDier checklist (**Table 3.3**). All studies reported item 1-8, and three reported item 9 (tailoring). No studies reported item 10 (modification during trial), two studies reported item 11 (planned intervention adherence) and two studies reported item 12 (actual intervention adherence) (**Appendix 3H, item 5**).

3.3.6 Evaluation of the risk of bias within included studies

The studies by Ahmad et al., (2018) and by Croker et al., (2012) were judged to be of some concern with regard to risk of bias overall while those by Golley et al., (2007) and by Janicke et al., (2008) were judged to be of high risk of bias overall when assessed using the RoB2 tool (**Table 3.4**). The two studies of some concern overall had only one domain, *intended intervention* domain, that was judged to be at some concern while all other domains were judge to be at low risk of bias. The reasons for this concern were either because the providers of the intervention were aware of whether participants were assigned to the intervention or control (Ahmad et al., 2018) or because both participants and providers were aware of their assignment intervention (Croker et al., 2012). Among the studies which were judged to be at high risk, the study of Golley et al. (2007), had one domain, *intended intervention,* which was judged to be at some concern because there was limited information about some aspects of the intervention while the domain, *measurement of outcome* was judged to be at high risk because there were a different time points for measuring outcomes in the intervention and control groups at 6 months. Four domains were judged to be at

high risk of bias in the study of Janicke et al. (2008) i.e., *randomization process, intended intervention, missing outcome data* and *measurement of the outcome*. This was because the participants were notified and aware of their group assignment and outcomes were analysed only who completed the interventions (**Appendix 3H, item 9**).

3.3.7 Evaluation of the quality of evidence across studies

The quality of evidence was assessed using the GRADE approach (Schunemann et al., 2013). Overall, outcomes were rated as moderate to low certainty (**Table 3.5**). BMI z-score outcome at post-intervention was rated as low certainty. This was downgraded by two levels because inconsistency of risk of bias between three studies and small sample sizes. BMI z-score at follow-up was rated as very low certainty. This was downgraded by two levels because inconsistent risk of bias between studies and downgraded by one level because small sample size. Waist circumference at post-intervention was rated low certainty. This was downgraded by two levels because moderate to substantial heterogeneity and small sample size. Waist circumference at follow-up was rated as low certainty. This was downgraded by two levels because inconsistent risk of bias between two studies and small sample size.

Table 3.3 TIDieR items in intervention groups for each included study

Study ID	Items											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Ahmad, 2018	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NI	Yes	Yes
Croker, 2012	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NI	NI	Unclear	Unclear
Golley, 2007	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NI	Unclear	NI
Janicke, 2008	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NI	Yes	Yes

Note: TIDieR: the template for intervention description and replication (Hoffman et al., 2014).
Yes= clear description; Unclear = unclear description; NI=no information description,

Table 3.4 Summary of risk of bias for each included study

Risk of bias domains	Study ID			
	Ahmad, 2018	**Croker, 2012**	**Golley, 2007**	**Janicke, 2008**
Randomization process	Low	Low	Low	High
Deviations from Intended intervention	Some concern	Some concern	Some concern	High
Missing outcome data	Low	Low	Low	High
Measurement of the outcome	Low	Low	High	High
Selection of the report results	Low	Low	Low	Low
Overall bias	**Some concern**	**Some concern**	**High**	**High**

Note: Risk of bias (Sterne et al., 2019)

Table 3.5 Summary of quality of evidence of four outcomes from the four included studies

Certainty assessment							Summary of finding			
No. of studies	Study design	Risk of Bias	Inconsistency	Indirectness	Imprecision	Other considerations	No of patients		Effect	Certainty
							Interventions	Controls	Absolute (95% CI)	
BMI z-score at post intervention (range between 4 to 6 months)										
3	RCTs	Serious[a]	Not serious	Not serious	Serious[b]	-[c]	124	118	SMD **0.05** **lower** (0.31 lower to 0.2 higher)	⊕⊕◯◯ Low[a,b]
BMI z-score at follow-up (6 months after intervention finished)										
3	RCTs	Very serious[d]	Not serious	Not serious	Serious[b]	-[c]	129	124	SMD **0.27** **lower** (0.52 lower to 0.02 lower)	⊕◯◯◯ Very low[b,d]
WC at post intervention (range between 4 to 6 months)										
2	RCTs	Not serious	Serious[e]	Not serious	Serious[b]	-[c]	100	97	SMD **0.26** **lower** (0.67 lower to 0.16 lower)	⊕⊕◯◯ Low[b,e]
WC at follow-up (6 months after intervention finished)										
2	RCTs	Serious[f]	Not serious	Not serious	Serious[b]	-[c]	105	103	SMD **0.39** **lower** (0.67 lower to 0.12 lower)	⊕⊕◯◯ Low[b,f]

Notes:
a = Inconsistent of risk of bias between three studies, two studies were bias due to deviations from intended interventions (providers or participants aware of participants assigned intervention) and one study was bias in all four domains except selection of reporting outcomes. However, most information is from first two studies (81%). Therefore, this was downgraded by one level due to risk of bias.
b = Relatively small sample size (<400 in total) (Schunemann et. al., 2013). Therefore, this was downgraded by one level due to imprecision.
c = Did not consider other considerations (publication bias) because it was only 2-3 studies included in the analysis. As per Schunemann et al., 2013 stated that when at least ten studies (some suggested at least five) are included in a meta-analysis, funnel plots and statistical test of asymmetry should be used to detect publication bias.
d = In consistent risk of bias between three studies, one studies was bias due to deviations from intended interventions (providers aware of participants assigned intervention); one study was bias due to deviations from intended interventions (no information whether providers or participants aware of participants assigned intervention) and measurement outcome data (no information about outcome assessors aware of intervention received, assessment have been influenced by knowledge of intervention and likely that assessment was influenced by knowledge of interventions); and one study was bias in all four domains except selection of reporting outcomes. Information is from two later studies which had risk of bias in many domains nearly 48%. Therefore, this was downgraded by two levels due to high risk of bias.
e = Moderate to substantial level of heterogeneity, I^2=50% (Higgins et al., 2022). Therefore, this was downgraded by one level due to heterogeneity.
f = Inconsistent of risk of bias between two studies, one studies was bias due to deviations from intended interventions (providers aware of participants assigned intervention); and one study one study was bias due to deviations from intended interventions (no information whether providers or participants aware of participants assigned intervention) and measurement outcome data (no information about outcome assessors aware of intervention received, assessment have been influenced by knowledge of intervention and likely that assessment was influenced by knowledge of interventions).

3.4 Discussion

This systematic review investigated the use of BCTs and effectiveness of the interventions containing BCTs in published RCTs in children aged 5-15 years living with overweight or obesity and otherwise healthy. This section discusses the review's findings, focusing on three main points, i.e., the use of BCTs, the effectiveness of BCTs and use of BCTTv1 in children living with overweight or obesity. The strengths and limitations of the methodology of the review and idea for future research are also discussed.

3.4.1 Use of BCTs

In the current systematic review, the most frequently used BCTs used in all four included studies were *goal setting (behaviour) [1.1], problem-solving [1.2], self-monitoring of behaviour [2.3], social support (unspecified) [3.1]* and *demonstration of the behaviour [6.1]*. Three BCTs were found to be used together: *instruction on how to perform the behaviour [4.1]*, *demonstration of the behaviour [6.1]* and *behavioural practice/rehearsal [8.1]*.

Only four studies in children living with overweight or obesity that used BCT were included in the systematic review and, therefore, the findings from the systematic review were considered against the findings from other behavioural intervention studies in either similar age groups but with conditions other than obesity or in different age groups (adults) but same conditions (overweight or obesity).

Comparisons with studies in similar age groups but with conditions other than obesity

The result from this review, align with two previous systematic reviews in healthy children and adolescents, which found that goal setting (behaviour) *[1.1]* (Anselma, Chinapaw, Kornet-van der Aa & Altenberg, 2020; Hynynen et al., 2016), *demonstration of behaviour [6.1], and social support (unspecified) [3.1]* were frequently used BCTs *(*Hynynen et al., 2016). Three BCTs were consistently employed together in this systematic review, in line with previous systematic reviews (Anselam et al., 2020 and Hynynen et al., 2016), i.e., *instruction on how to perform the behaviour [4.1]*, *demonstration of the behaviour [6.1]* and *behavioural practice/rehearsal [8.1]*.

Comparison with studies in overweight and/or obesity but with different age groups

The results are consistent with three previous systematic reviews in adults living with overweight or obesity. These reviews found that commonly used BCTs were *goal-setting behaviour [1.1]* (Samdal et al., 2017; Villinger, Wahl, Boeing, Schupp, & Renner, 2019), *self-monitoring of behaviour [2.3]* (Flannery et al., 2019; Samdal et al., 2017; Villinger, Wahl, Boeing, Schupp, & Renner, 2019), and *social support (unspecified)* [3.1] (Samdal et al., 2017).

Summary of comparisons of frequency of BCT use in children and adults

From the comparisons, the only BCTs found both in healthy children, adolescents and adults living with overweight or obesity i.e., *goal setting (behaviour) [1.1].* However, there were limited studies conducted on children living with overweight or obesity. With limited evidence, these findings might be worth considering as a starting point for

children living with overweight or obesity. There are several possible explanations for this result. Firstly, the effectiveness of goal setting (behaviour) was reported in people with various conditions, for example, obesity (Carraca et al., 2021; Coupe et a., 2019; Perdew, Liu and Naylor, 2021; Samdal et al., 2017), dementia (Nyman, Adamczewska & Howlett, 2018), and in healthy people (Hynynen et al., 2016). Secondly, goal setting was one of many BCTs which was recommended by the National Institute for Health and Care Excellence (NICE) in public health and clinical guidelines to use in weight management programmes in children and young people (NICE, 2022; NICE 2013) and adults (NICE, 2022; NICE, 2014b). Lastly, setting goals may be considered easier and more positive i.e., looking towards achievement, than BCTs involving monitoring which may feel potentially threatening in some situations and may be time-consuming, which might add burden to participants, e.g., adults in weight loss programmes spent an average of 23 minutes completing an electronic dietary self-monitoring (Harvey et al., 2019). In addition, three BCTs, specifically providing *instruction on how to perform the behaviour [4.1]*, *demonstration of the behaviour [6.1]* and *behavioural practice/rehearsal [8.1]*, are widely employed in training, as noted by Michie. Atkins & West in 2014. These BCTs may be more effective for children in engaging them in activities rather than relying solely on verbal instruction and this is supported by systematic evaluation of studies investigating experiential learning interventions (Verman et al., 2021).

The BCTTv1 only allows the identification of which BCTs were used rather than how the BCTs were delivered (Michie and Johnson, 2013). Therefore, other factors should consider to fully understand behaviour change intervention which would enable researchers, practitioners, and intervention designers to replicate the interventions,

such as the delivery process, which includes mode, style, intensity, content etc. (Armitage et al., 2020; Michie et al., 2021) and which these might contribute to intervention effectiveness. The TiDIeR was used to report the interventions in this current systematic review. However, the details of delivery of specific BCTs could have been more explicit which would allow future researchers and practitioners a better opportunity to replicate the interventions.

3.4.2 Effectiveness of interventions

As only four studies were included in the current systematic review, it was not possible to identify the effectiveness of individual BCTs. As Deeks, Higgin and Altman (2022) stated that if there are less than ten studies in a meta-analysis, a meta-regression should not be considered. However, the intervention in four included studies, each incorporating various BCTs, demonstrated effectiveness in improving BMI z-score and waist circumference compared to control groups for at least six months post-intervention. This result showed that interventions which contained different combinations of BCTs helped to improve overall BMI z-score and waist circumference in children living with overweight or obesity.

3.4.3 Use of BCTTv1 in the current systematic review

Using clearly defined BCT taxonomies helps to identify the effectiveness of different BCTs because it uses standard terminologies which provide consistency for communication and facilitates replicating interventions (Michie & Johnson, 2013). In the current review, no studies described their interventions using BCTTv1 as three studies were published before the BCTTv1 was published in 2013 and only one study published after this date but the authors did not use the BCTTv1. As a result, BCTs

were coded by the researcher in all four included studies. Encouraging intervention designers or researchers to utilize the BCTTv1 to better describe their intervention will facilitate the comparison of interventions in the future (Jaka et al., 2020). Although the researcher (SS) was new to coding BCTs, the researcher successfully completed the online training in using BCTTv1 to specify the content of complex behaviour change intervention from the UCL Centre for Behaviour Change (UCL, 2014) before coding the interventions in the systematic review presented in this chapter.

Identifying which BCTs are ineffective in managing overweight and obesity in children is also essential because the BCTs which have been shown to be effective may only be effective because they are frequently used and that BCTs which are not frequently used, may be effective but have not been tested. Moreover, reporting ineffective BCTs and the detail of interventions where they have been used are also essential so we can fully understand what may not be helpful in practice. These details about the intervention that might impact on BCT effectiveness include the design, target behaviour, target population, length, duration, tailoring and frequency of BCT use within the intervention, the setting and by whom the intervention is delivered which may help future researchers and practitioners replicate the intervention and apply the finding to practice (Michie et al., 2021; Connell et al., 2019). Specifically, researching BCTs in comparable populations and conditions will help better understand what are effective in that specific population. An example of how some details of an intervention is not reported is highlighted in a systematic review of 193 studies by Jaka et al. (2016). They found that the length of sessions and content delivered were infrequently reported in obesity RCT intervention studies in children aged 2 -18 years, and few studies used BCTTv1 (6/190). This indicated that even with a gold standard

intervention, some aspects were poorly reported. Therefore, more information is needed to better understand about BCTs use in children living with overweight or obesity.

3.4.4 Strengths and limitations

There are several strengths of this review. Firstly, this is the first systematic review that has investigated the use of BCTs in RCTs in children living with overweight or obesity by using the latest and comprehensive taxonomy, i.e., BCTTv1 (Michie et al., 2013). Secondly, the systematic review was undertaken following the PRISMA guidelines to ensure transparency and a comprehensive report (Page et al., 2021). This included a title, abstract, introduction, methods, results, discussion and other information with a 27-item checklist (**Appendix 3J, PRISMA 2020 checklist**). Lastly, the most recent Cochrane Collaboration tool, RoB2 was used to assess the risk of bias as the tool reflects the current understanding of how the causes of bias can reflect research findings (Sterne et al., 2019).

There are several limitations. Firstly, only publications in English and Thai were included for pragmatic reasons i.e., there was no budget for translation. This means that some studies in other languages may have been excluded from the review. Secondly, the BCTs identified in the four included studies were coded by the researchers not the authors of the RCT which might have led to omissions or misinterpretation of the techniques used in the intervention. To minimize this, two researchers independently coded the BCTs, all available additional relevant supporting documents were scrutinized and the authors contacted. Thirdly, only four RCT studies were included which is a small number and as a result, the effectiveness

of individual BCTs could not be analyses by meta-analysis. Fourthly, there was inconsistency in reporting the outcomes of the included studies, so the overall effectiveness of the intervention containing BCTs was based on only three studies for BMI z-score and two studies for waist circumference. Agreement in the most important outcomes e.g., consistent use of BMI z-score in future RCTs in children living with overweight and obesity would facilitate this. Fifthly, it was challenging to decide on the inclusion criteria that participants were living with overweight or obesity but were 'otherwise healthy' as some of studies did not describe the health status of children that were recruited. To address this and ensure consistency, a protocol for deciding on what was 'otherwise healthy' was developed by the researcher and shared between the research team who screened articles (**Appendix 3A, otherwise healthy criteria**). If possible, ambiguous inclusion criteria should be avoided in future reviews. There is also an argument for considering participants who were not considered 'healthy' and analysing as a subgroup because in real-life settings, many children may have conditions that are either associated with or may predispose to overweight or obesity e.g., attention-deficit hyperactivity disorder, eating disorders (Smith, Fu & Kobayashi, 2020; O'Hara, Curran & Browne, 2020). Sixthly, a rigorous method was used to identify potential BCTs from the descriptions to ensure consistency. Simply stating the name of a BCT is not be sufficient, as it is important to ensure that the authors refer to the same BCTs and describe the BCTs with enough detail to meet the definitions in the BCTTv1 (Michie et al., 2013). Finally, only 10% of the screening of titles and abstracts was undertaken in duplicate due to the large number of records identified and the limited time available. Higgins et al., (2022) recommend this initial screening is done in duplicate. However, the screening was undertaken using a defined protocol to enable the comparison of screening by two people independently (**Appendix** 3**D,**

protocol for a random 10% screening titles and abstracts; Appendix 3E, documents for training the research team).

3.4.5 Implication for practice

Interventions, incorporating various BCTs, led to significant improvement in BMI z-score and waist circumference at the 6-month follow-up after completing the weight management programme. These findings indicated that interventions utilising diverse combinations of BCTs were effective in these children living with overweight or obesity within the studies' conditions and could potentially translate to meaningful results in other settings. However, it must be noted that all included studies were considered as being high risk or having some concern of bias (Sterne et al., 2019), and, as a consequence, there is very low certainty of the quality of evidence assessed by GRADE approach (Schunemann et al., 2013). Therefore, the systematic review's findings should be interpreted with caution. Better quality of evidence is needed before it can be applied to practice and, therefore, the implications for practice from this study are limited.

3.4.6 Implication for research

This systematic review identified four RCTs of intervention using BCTs for children living with overweight or obesity and, overall, the findings are limited in terms of quality of evidence. Further high-quality interventions using BCTs which are identified using the taxonomy, BCTTv1, are required to facilitate an enhanced meta-analysis with at least ten RCTs (Deeks et al., 2022). To improve the quality of future RCTs, attention should be given to measurement time points of outcomes in intervention and control groups, reporting the same outcomes (i.e., BMI z-score and WC) and blinding

providers or recipients of assigned intervention or control groups. The systematic review's findings highlighted several key implications for future research. These include the need for higher-quality evidence that clearly describes the BCTs used in the interventions and the use of BCTTv1 to ensure a standardized framework for categorising and analysing BCTs. Additionally, future research should aim for a larger sample size for meta-analysis to enhance statistical power and draw more robust conclusions about the effectiveness of interventions using BCTs, whether combined or individually. Standardized measurement and reporting using validated tools for assessing both behaviours and health outcomes, such as BMI z-score, will ensure the findings are comparable across studies. Furthermore, incorporating blinding procedures in a study can help reduce bias and improve the reliability of the results. As mentioned above, these findings emphasise a pathway for enhancing the quality and reliability of research in this field, ultimately leading to more effective interventions for managing overweight and obesity in children.

In the absence of good quality RCTs, careful analysis of weight management interventions delivered in real-life settings rather than as research studies may be helpful to fully understand which and how BCTs are used and are effective in children living with overweight or obesity. Using data from participants randomized to a waiting list as a control group allows researchers to compare individuals waiting to start an intervention with those actively participating (randomized to start intervention). This random assignment of potential participants to either start the intervention immediately or to a waiting list allows researchers to have two comparable groups and reduce external confounding factors, such as social influences. Evaluation in different countries and settings will allow potential cultural effects to be explored. Pooling data

sets of comparable interventions may provide a sufficiently large sample size to enable subgroup analyses by age groups, sex and other health conditions e.g., disabilities. For example, researchers could gather data from several studies implementing BCTs aimed at children living with overweight or obesity. These studies should use standard outcome measures, such as BMI z-score, to ensure consistency across the pooled data. Pooling data from multiple studies increases the sample size and enables more robust analyses. Subgroup analyses can then be performed to identify which specific interventions are most beneficial for different groups. Meta-regression can be applied to explore variations in effectiveness among subgroups, offering insights into how various factors influence outcomes.

3.5 Chapter conclusion

This systematic review has identified that the most frequently used BCT in RCTs undertaken in children aged 5-15 years living with overweight or obesity were *goal setting (behaviour), action planning, self-monitoring of behaviour, social support (unspecified)* and *demonstration of the behaviour*. The interventions significantly improved BMI z-score and WC. While acknowledging the value of BCTs in interventions, it is important to consider all factors in an intervention. The success of an intervention may arise from many factors, including a combination of BCTs, delivery methods, providers' expertise, readiness of participants, and other motivational elements. This complexity emphasises the importance of evaluating interventions holistically and using robust methodology e.g., an RCT, rather than attributing success solely to specific BCTs. Further well-described RCTs which use BCTTv1 to define the behaviour change techniques used in their intervention are required to identify individual BCTs that are effective in this population and in the specific circumstances in which they were investigated.

CHAPTER IV

STUDY 2: A QUALITATIVE EXPLORATION OF BEHAVIOUR CHANGE TECHNIQUES USED IN A FAMILY WEIGHT MANAGEMENT PROGRAMME IN CHILDREN AGED 5-15 YEARS IN ENGLAND

4.1 Introduction

4.1.1 Background and rationale

The results from the systematic review described in chapter III provide evidence about the behaviour change techniques (BCTs) used in four published intervention studies for children living with overweight and obesity with 28 different BCTs identified and between 12-19 BCTs per study. The most frequently used BCT in the four randomised controlled trials (RCTs) were goal setting (behaviour), problem-solving, self-monitoring of behaviour, social support (unspecified), and demonstration of behaviour. Four RCTs met the inclusion criteria for the review, which was limited, and the review only identified the BCTs used, not *how* the specific BCTs were delivered. Considering current practice where this information is available might be helpful. Weight management programmes delivered as part of current practice in a 'real-life setting' may differ from RCT studies in a research setting (Chodankar, 2021; Sherman et al., 2016). There is a need to explore the BCTs used in real-life settings where resources and staff may vary, and participants may be more heterogeneous than those included in research studies (Averitte et al., 2020). Interviewing staff with experience in delivering a weight management programme could provide a rich insight into which BCTs are used and how they are used to help achieve the programme's aim. Moving on to qualitative research aims to understand, explore, and generate profound insights

into specific topics and help answer the questions of what, how and why (Clark, Foster, Sloan, & Bryman, 2021; Renjith, Yesodharan, Noronha, Ladd & George, 2021).

Therefore, this study adopted a qualitative research approach by interviewing staff who delivered a family weight management programme in children living with overweight and obesity to explore BCTs used in the programme. This information was used to inform the understanding of the programme and categorised BCTs used in the programme using the BCTTv1 taxonomy (Michie et al., 2013).

4.1.2 Aim and objectives

This study aimed to explore behaviour change techniques (BCTs) used in a family weight management programme in children living with overweight and obesity and delivered as a public health intervention in England.

The objectives were:

- To explore which BCTs, categorized using the BCTTv1 (Michie et al., 2013), are reported by staff as used in one family weight management programme in children aged 5-15 years in England.
- To explore *how* the BCTs are reportedly delivered in practice in children aged 5-15 years in England.

4.1.3 Research questions

The Emphasis-Purposeful sample-Phenomenon of interest-Context (EPPiC) approach was used to develop the research questions (Moisey et al., 2022) and is shown in **Table 4.1** This question can be summarized as "Which BCTs are reported by staff as used in one family weight management programme in children aged 5-15 years in public health intervention in England between 2019 and 2021, and how are they reportedly delivered in practice?"

Table 4.1 Research questions following the EPPiC component (developed from Moisey et al., 2022).

EPPiC component	Research question descriptions
Emphasis	Which BCTs are reported as used by staff in one family weight management programme among families with overweight or obese children aged 5-15 years
Purposeful sample	Adult age $\geq$ 18 years who deliver the family weight management programme
Phenomenon of *i*nterest	Use of BCTs; What and how
Context	In a public health intervention in England between December 2019 and November 2021

4.2 Methodology

4.2.1 Study design

A qualitative descriptive approach (Moisey et al., 2022) was used to explore the use of BCTs (phenomena) in a family weight management programme in children aged 5-15 years living with overweight or obesity.

The Standards for Reporting Qualitative Research (SRQR) (O'Brien et al., 2014) were used to ensure transparency and quality of the report of this study. The SRQR included title and abstract, introduction, methods, context, result/findings, discussion and others, with a 21-item checklist (**Appendix 4A, SRQR**). It was decided to use the SRQR since it was published more recently than the Consolidated criteria for Reporting Qualitative research (COREQ) checklist (Tong, Sainsbury & Craig, 2007) and included data from 40 sources, including the COREQ. The COREQ included three domains i.e., research team and reflexivity; study design; and analysis and finding with a 32-item checklist in total, it was published in 2007 and included data from 22 sources.

4.2.2 Intervention

The family weight management programme investigated was a 12-week programme, which was delivered over 12-16 weeks depending on school holidays, for families with at least one child aged 5-15 years living with overweight or obesity and living in England. The programme aimed to help families change their behaviour towards a healthy lifestyle through better understanding of healthy eating and physical activity. The programme was game- and activity-based, including different topics of nutrition classes and physical activity classes. Each week, one 2-hour session was delivered,

including an hour of nutrition-related activity by a UK-registered nutritionist and an hour of physical activity by a sports coach. The nutrition topics included energy balance; breakfast; portion sizes; snacks; drinks, supermarket; takeaway; cooking and habits & routines. The physical activity classes included sports and game-based activities. All sessions were delivered as groups except for three sessions, i.e, at the initial appointment, midway review and final review, where these were individual i.e. between a UK-registered nutritionist and family. These three sessions were for measuring the height and weight of families. An overview of the programme is shown in **Figure 4.1.**

4.2.3 Research team characteristic

The first researcher (SS) is the PhD candidate. She has successfully completed online training for coding BCTs by using BCTTv1 (Michie et al., 2013; UCL, 2014) **(Appendix 4B, BCT Taxonomy v1 online training certificate)** and 'How to analyse qualitative data' and "From zero to NVivo 12 qualitative data analysis with NVivo' online from Udemy (Kriukow, 2022a; Kriukow, 2022b).

The second researcher (AM) is a clinical researcher in Nutrition and Dietetics and a UK Registered Dietitian. She has also successfully completed the same online training for coding BCTs by using BCTTv1**.**

The third researcher (RF) is a Senior Lecturer in Nutrition and Dietetics and a UK Registered Dietitian.

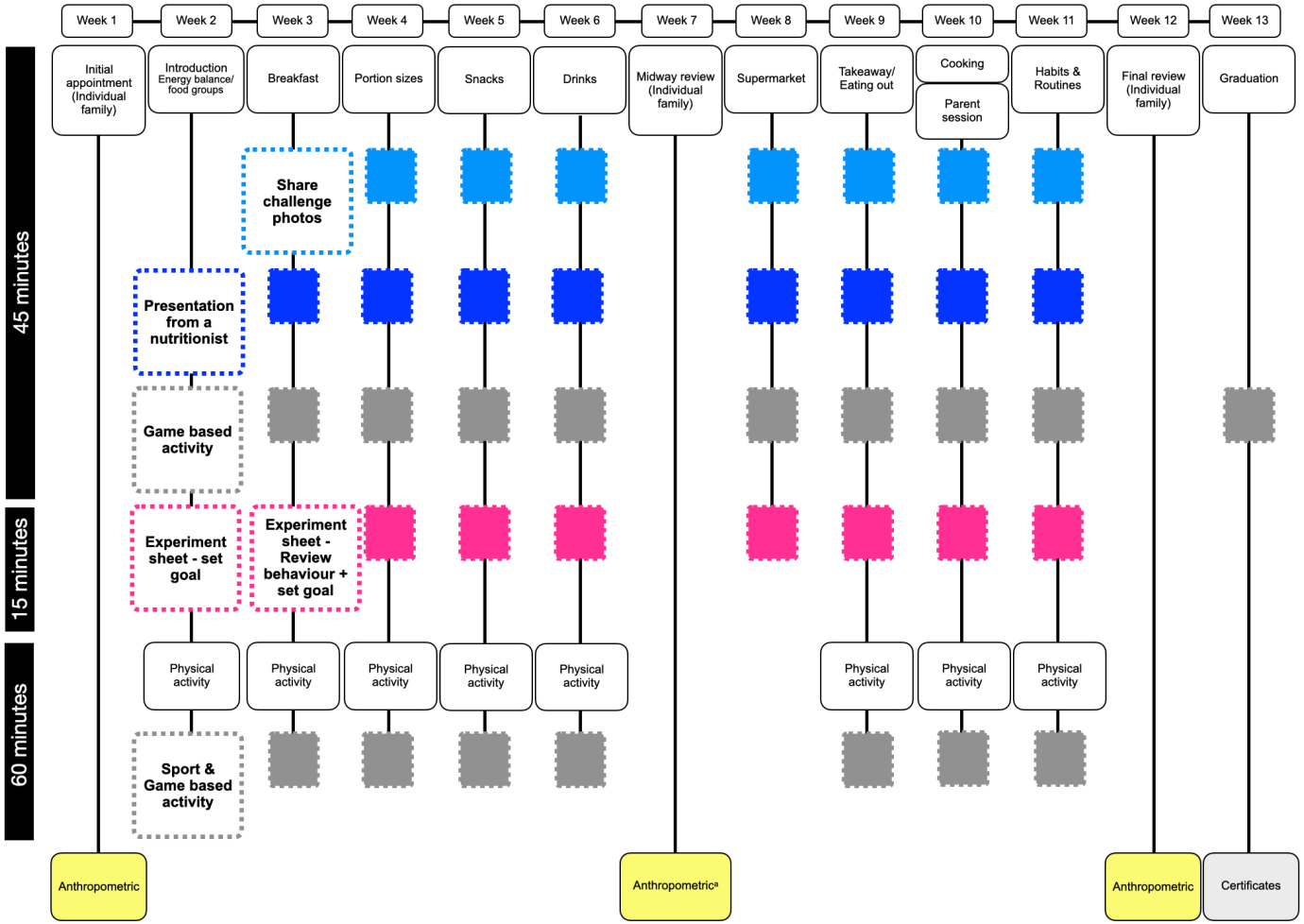


Figure 4.1 An overview of the delivery of the family weight management programme investigated in the study

[a] Data not recorded on the data system; The same-coloured squares indicated the same activity

4.2.4 Ethical considerations

This study was reviewed and approved by the Health, Science, Engineering and Technology Ethics Committee at the University of Hertfordshire. This was approved on 13/11/2019 with a protocol number LMS/PGR/UH/03866 (**Appendix 4C, Ethical approval**). The organization delivering the programme gave permission for their staff to be invited. All participants provided written consent and all names of individuals and organization were anonymized.

4.2.5 Sampling strategies and recruitment

A family weight management programme in England was selected based on availability. Therefore, a convenient sampling approach was used to recruit participants because they were conveniently accessible to the researcher and they were willing to participate.

The inclusion criteria were adults aged ≥18 years who delivered the family weight management programme in England and were willing to participate in the study. The exclusion criteria were staff who had delivered the family weight management programme for less than 12 weeks. The 12 weeks was used as a criterion because this was the minimum length of the programme. Participants were required to have experienced delivery of at least one complete programme to ensure they had observed or used all possible BCTs.

All staff who delivered the family weight management programme were informed about the study and invited by the programme manager to participate in an individual semi-structured interview. They were given a participants' information sheet

(**Appendix 4D, participant information sheet**) to read and opportunity to ask question before deciding to participate. Those who were willing to participate, were asked to sign a consent form (**Appendix 4E, consent form**). The recruitment process was undertaken via the programme manager to avoid direct contact with potential participants before interviews and to protect their identity and reduce any recruitment bias (Bhandari, 2023). After consent was provided, the researcher made an individual interview appointment for each participant.

4.2.6 Data collection

4.2.6.1 Topic guide development

Interview questions were formulated based on the research aim and objectives by the first researcher (SS). They were further developed after reflection and feedback from AM and used for the topic guide for use during the interviews (**Appendix 4F, topic guide)**. The main interview questions were about a family weight management programme's goal, the participants' role, and how they delivered the programme.

4.2.6.2 Interview process

Audio-recorded semi-structured interviews were conducted by the first researcher (SS) with participants individually either face-to-face at the company office in a quiet room or online via Microsoft Teams (Microsoft 365, United Kingdom). Data were collected between 2019 and 2021. Interviews were audio recorded using two digital recorders (Sony ICD-PX470, Tokyo) using one as a backup in case of equipment failure. The researcher met individual participants either in a quiet room at their worksite or online via Microsoft Team according to their preference or Covid-19 restrictions which were in place from 2020 onwards. Before starting each interview,

the researcher introduced herself, reminded the participant about the study's goals and the interview process, checked their consent form, ensured they were comfortable, and allowed them to ask any other questions they might have. Once the participants were ready, the researcher started the interviews. The topic guide was used to guide the interview with opening and follow up questions and this was further developed as the interviews progressed through the 12 participants and based on their responses. When participants' responses seemed to relate to BCTs, the researcher asked them to expand their reply and to provide more information and examples and, if their answers were not clear, asked them to clarify.

4.2.7 Data analysis

As this study sought to identify BCTs and categorize them using BCTTv1, thematic analysis using a codebook developed from BCTs was used (Braun & Clarke, 2022; Robert, Dowell & Nie, 2019) Thematic analysis can be defined as a strategy which is used to identify, analyze and explain the themes within qualitative data (Braun & Clarke, 2022) and typically has six steps:

Step 1 - Transcription: The anonymous recordings, identified using study numbers, were sent via a secure upload to a professional research transcription service (The Typing Works, London). After the anonymous transcripts were returned, they were uploaded to Nvivo 12, a computer software for qualitative data analysis for Mac (QSR International, Denver).

Step 2 - Familiarisation: The researcher familiarised herself with the data by listening and re-listening to the recordings and reading and re-reading through the transcripts. This step helped the researcher to form initial ideas for coding.

Step 3 - Generating initial themes: *A priori* themes, based on BCTTv1, were used as this study sought to identify BCTs used in the programme and categorize them using BCTTv1. This BCTTv1 specified 93 individual BCTs in 16 groups used to change behaviours.

Step 4 - Coding: The *a priori* themes were used to develop the initial codes to ensure that they could answer the research question of what BCTs were used. However, line-by-line coding (i.e., labelling all text) was used to make sure other data that did not fit *a priori* themes were not missed and to answer the second research question of how the BCTs were delivered. Then, the coded units were assigned to the *a priori* themes. The codes which not fit into *a priori* themes were checked and merged and then added into new sub-themes.

Step 5 - Reviewing themes: Themes were reviewed, and unused *a priori* themes were noted and deleted, new sub-themes were added into BCTs identified. Specifically, BCT themes were checked by AM, and disagreement was resolved by discussion until agreement was reached. This was done to ensure inter-rater reliability.

Step 6 - Writing the finding: The themes were written in the results section of this chapter, explained in more detail and a quote provided as an example of each theme.

This analysis used both deductive and inductive approaches (Braun and Clarke, 2012). As the researcher used *a priori* themes based on BCTTv1, deductive analysis was predominantly used. However, open-coding was used to identify how the BCTs were delivered, which then were added as sub-themes of BCTs identified.

4.3 Results

Audio-recorded semi-structured interviews were undertaken with ten staff who delivered a family weight management programme in England. These ten people represented 91% of the staff members who were eligible to participate. Seven interviews were conducted by the first researcher face-to-face and three were online via Microsoft Teams and interviews lasted between 15 to 65 minutes. Four staff were interviewed in 2019 and six new staff who delivered ≥12 weeks of the programme were interviewed in 2021. Interviews were undertaken over a 2-year period because of lockdowns due to the Covid-19 pandemic and, after staff returned to work, the online interviews were offered to provide a socially distanced alternative to the face-to-face interview (Brown and Wade, 2021).

The following section describes which behaviour change techniques (BCTs) were identified as being used, how they were reported as used, and describe the BCTs not used in the programme. The code number in a [bracket] after each BCT indicated its position within the BCTTv1.

4.3.1 BCTs used in the programme

Twenty-four individual BCTs categorised using BCTTv1 were identified as used in the programme (**Figure 4.2**). In this section, five BCTs with their related BCTs are described, which included *goal setting (behaviour) [1.1], Instruction on how to perform behaviour [4.1], credible source [9.1], Material reward (behaviour) [10.2],* and *social reward [10.4]* (**Figure 4.3**). The term 'related BCTs' is used in this chapter to describe the BCTs that usually used with the other BCTs. These BCTs were highlighted based on the frequency with which they were used in the programme. **Figure 4.4** shows the

most frequently used BCTs linked to the sessions in the family weight management programme. The term ‘most frequently used BCTs’ is used in this chapter to describe the frequency of sessions where the BCTs were used and not the absolute frequency of BCTs. For an example of the rest of the BCTs, see **Table 4.2.**

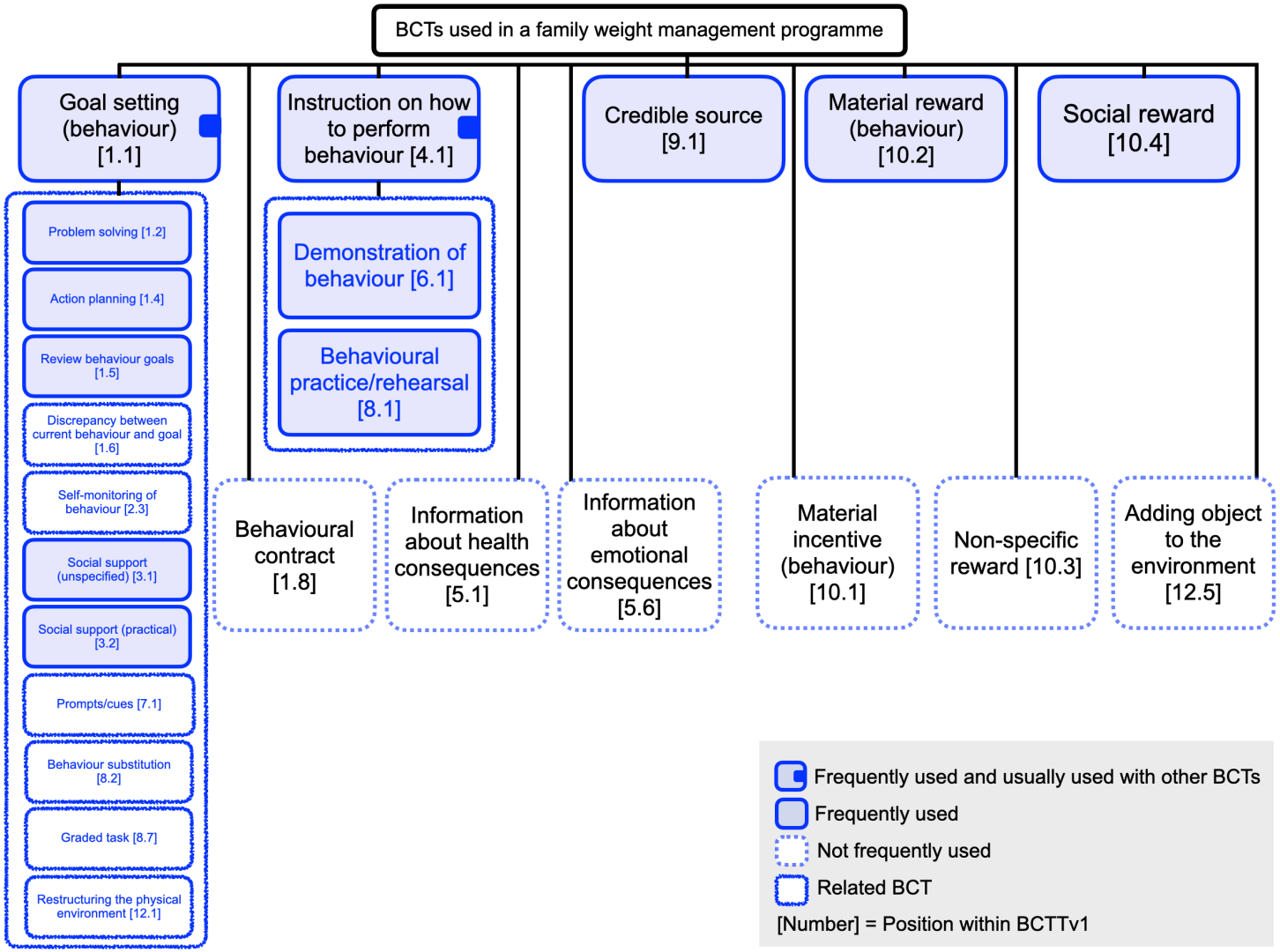


Figure 4.2 Thematic map exploring 24 BCTs used in a family weight management programme identified from staff interviews, categorized using BCTTv1 (Michie et al., 2013)

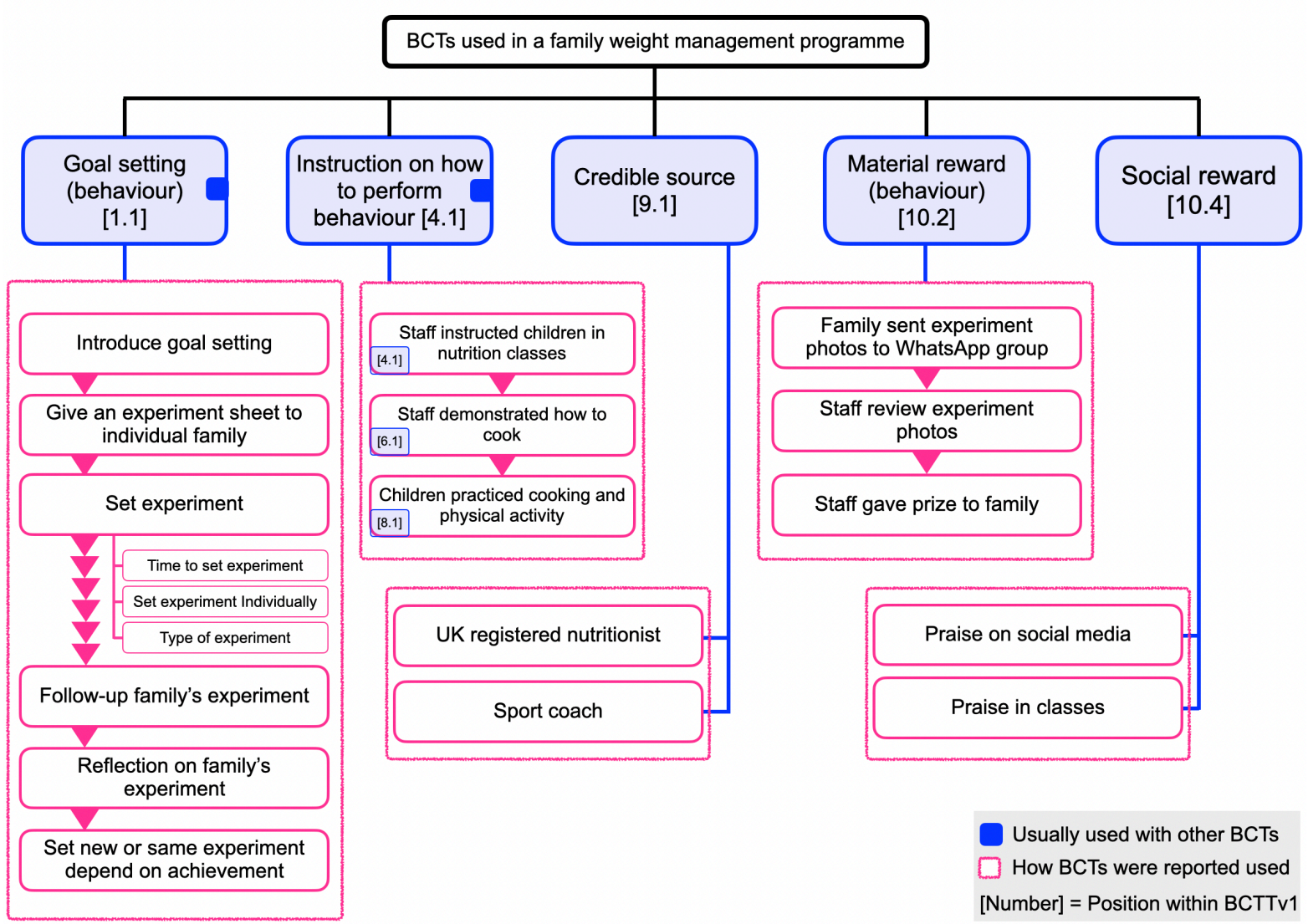


Figure 4.3 Thematic map exploring most frequently used BCTs and how the BCTs were reported used

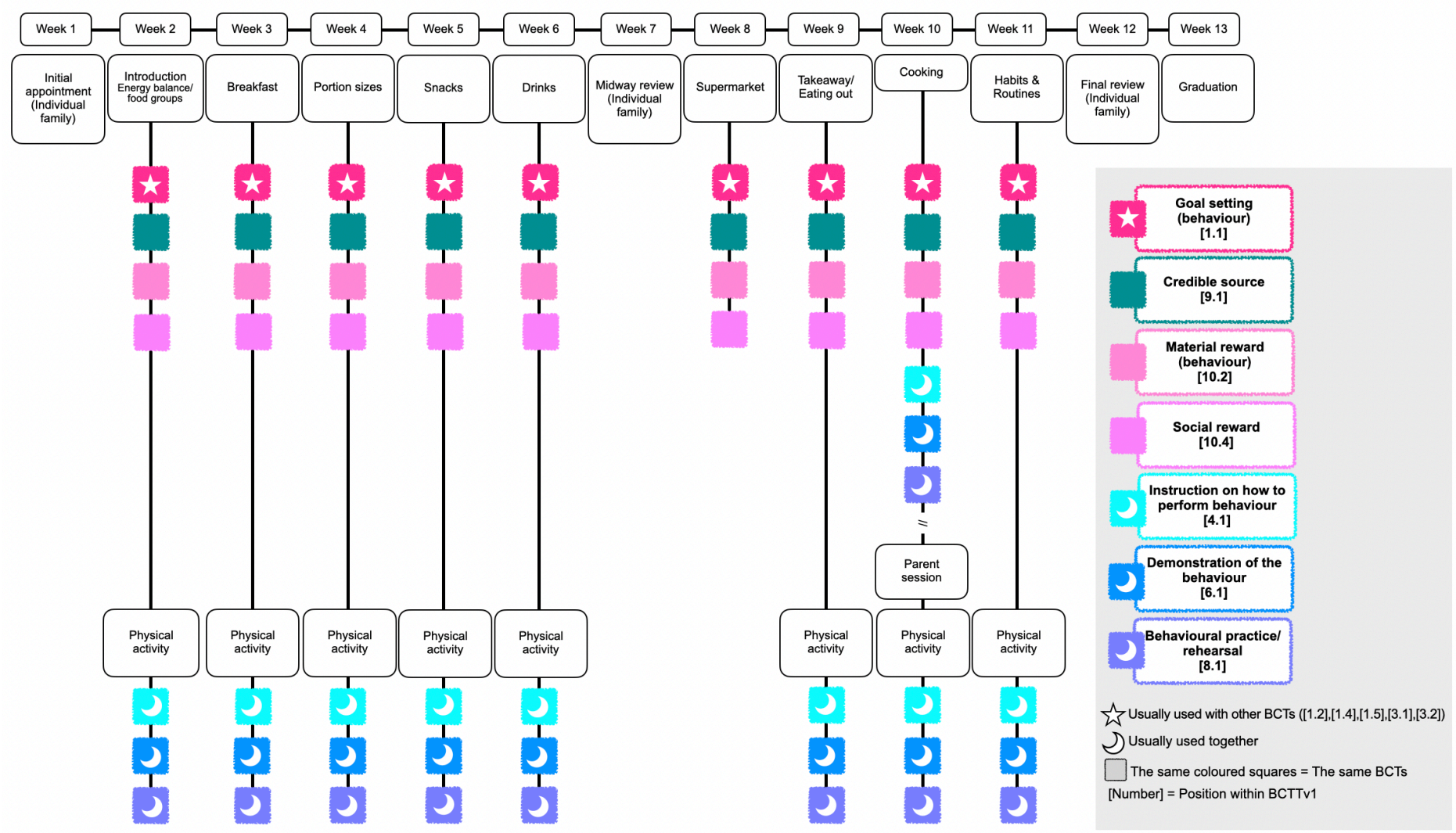


Figure 4.4 The most frequently used BCTs linked to the sessions according to weeks and the topics

Table 4.2 Twenty-four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interviews with quote to illustrate their use

No.[a]	Themes	Target behaviour	Example of BCT quotes from interviews	ID[b]
1.1	**Goal setting (behaviour)**	Diet ("eating healthy breakfast")	*to have a healthy breakfast four times a week [1.4][a], if they're not having it at all, or they might decide to go for every day*	05
1.2	Problem solving	Diet (having breakfast)	*okay so like 'on 2 days I managed to have breakfast', brilliant, okay, what didn't go so well, 'the other days I didn't'. Okay, what happened on those days, what was different basically, what was different on the days that it didn't go well compared to on the days that it did go well [1.5],* you know, whatever, *'I slept in, the alarm didn't go off' whatever [1.6]. And then okay, what would we do differently* and then are we going to re-run it, who needs to know, then you start the process again.	09
1.4	Action planning	See 1.1	See 1.1	
1.5	Review behaviour goal(s)	See 1.2	See 1.2	
1.6	Discrepancy between current behaviour and goal	See 1.2	See 1.2	
1.8	Behavioural contract	Sedentary behaviour (limiting gaming time)	kind of is *this joint problem-solving contract where the child, it's kind of like a bit of fun isn't it? The child signs it and then the parent signs it and says like, so say if they've got a disagreement about like video gaming or something and they both agree about "well let's cut it down to like one hour per day maximum", then the idea is that they kind of write it out, so this is a bit of a different sheet and* I haven't like used it a lot of the time but I've seen it and yeah, *the child signs it, the parent signs it, so that's quite like a contract signing thing.*	08

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

Table 4.2 Twenty -four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interview with quote to illustrate their use (Cont.)

No[a]	Themes	Example target behaviour	Example of BCT quotes from interviews	ID[b]
2.3	Self-monitoring of behaviour	Variable[c]	*So it's a whole process, you work through the sheet and it's a double sided one. So, when they write it the first week, the second week is a reflection on the back, so they use that sheet.* Note: sheet was an experiment sheet	02
3.1	Social support (unspecified)	Variable[c]	well okay how are you going to do that, *who else needs to know because it's very hard to, you know, we try and encourage them and say, look it's okay if it doesn't happen every day because it's really hard to make a change to your behaviour, so maybe if mum and dad know that this is what you're working towards they, would that help, how would that help, 'oh mum could remind me', okay so that's, you know, that's good.* Note: Staff advised children to get help from family	09
3.2	Social support (practical)	Physical activity (increasing walking time)	*a family had aimed to walk to school every day [1.4],* and *then they hadn't managed to do it because it was pouring down with rain and they realised, or it was freezing cold,* I can't remember which, but *they realised that the clothes that they had weren't, you know, weren't good enough for getting out in the freezing cold, they were like actually I'm going to make sure we've got some gloves and we've got some wellies and we're going to keep them by the door [1.2, 1.5, 3.2, 12.1].* So that kind of little change then meant that it was easier for them to insist on 'we're walking to school and we're not taking the car' [8.2].	09
4.1	**Instruction on how to perform behaviour**	**Diet (improving skill for cooking)**	***a nutritionist shows them how to do a cutting technique,*** and we use a claw so they don't, to stop them chopping their fingers. So ***we show them exactly how to do a cutting technique.***	02

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

Table 4.2 Twenty -four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interview with quote to illustrate their use (Cont.)

No.[a]	Themes	Target behaviour	Example of BCT quotes from interviews	ID[b]
5.1	Information about health consequences	Diet (reducing sugar)	***"one of the slides does say something like it can lead to***, you know, if you have too much sugar it can lead to kind of not, you know, bad health for your body and we really try and say it in a way that's like suitable for kids. So *for example* ***when we're talking about sugar we'll say like "it's really bad, it's like not good for your teeth"***	08
5.6	Information about emotional consequences	Diet and physical activity	*"Yeah. So we do talk about that kind of throughout the programme in the kind of way of, because we don't like to focus on, even though it's weight management we really actually can't focus on weight or calories for the kids, so we always say like "you'll feel,* ***it's all about feeling happier and feeling healthier*** *so, you know, why are we doing this? It's to feel stronger". And when, yeah, when we talk about exercise we'll say like "it's to, how does it make your body feel? You feel stronger, you can do more things, you can play more with your friends, you don't feel more out of breath".*	08
6.1	**Demonstration of behaviour**	Diet (Improving skill for cooking)	*"we show them how to do the passata, so that's in the demonstration as well"* *Note: A nutritionist demonstrate how to do passata in a cooking class*	02
7.1	Prompts/cues	Variable[c]	*"then what we talk about is them making it visible, so go home, put it on your fridge, you know, how do we make this happen"* Note: Staff advised family to put their experiment sheet visible so they can make it happen An example of the experiment: see 1.1 Goal setting (behaviour)	07

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

Table 4.2 Twenty -four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interview with quote to illustrate their use (Cont.)

No.[a]	Themes	Target behaviour	Example of BCT quotes from interviews	ID[b]
8.1	**Behavioural practice/rehearsal**	Diet (Improving skill for cooking)	*"they do cooking skills, so they'll be cutting vegetables"* *Note: Children cook with staff in cooking classes*	02
8.2	Behaviour substitution	See 3.2	See 3.2	
8.7	Graded task	Diet (reducing portion size)	*"if you're having a massive portion size and then you go down really quickly you'll be just really hungry", so we say like "reduce it like a tablespoon at a time or if you're having a whole pack of biscuits every night just have like two less biscuits or like one less biscuit every day and even that is like a really positive change". So yeah, it's all about really gradual, small steps"*	08
9.1	**Credible source**	Diet (healthy diet)	*"I'm a Nutritionist on the programme, so I deliver the prog… I deliver the sessions for the families that are, that come onto the programme, yeah…. I would kind of cover different topics so things such as portion size or breakfast, a healthy breakfast, yeah lots of other topics"*	03

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

Table 4.2 Twenty -four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interview with quote to illustrate their use (Cont.)

No.[a]	Themes	Target behaviour	Example of BCT quotes from interviews	ID[b]
10.1	Material incentive (behaviour)	Variable[c]	*"we are saying to you we will give you a prize if you engage with the process of showing us how well you've done. And whoever's done the best or has made the most differences or whatever"*	01
10.2	**Material reward (behaviour)**	Variable[c]	"*we give them, if they've done their experiment and they're kind of doing quite well they get like a XX bottle,* so that's quite cute. It's like a little water bottle with like XX on it and like a lot of the kids seem to actually really like it."	08
10.3	Non-specific reward	Diet (reading food labeling in the supermarket) for choosing a better choice	*"we have Junior Nutritionist, so if someone's really made a big effort like the most recent one was at the supermarket and she went round with the sheet by herself, kind of, but, like the family were like close by, but they were all doing it together and she wanted to do it by herself …she got Junior Nutritionist and they were a little lanyard that… we all wear lanyards with our name and it say Family Nutritionist. So she got a little lanyard that said Junior Nutritionist and then they're just our little helpers for the session. So it's just nice and kind of recognising them for their efforts."* Note: A reward was given to a child i.e., the title of Junior nutritionist Additional explanation for supermarket session: "*we take them to a supermarket and we do a quiz and game all around food labelling…."* ID 01	06

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

Table 4.2 Twenty -four themes based on BCTs described in BCTTv1 (Michie et al., 2013) identified from staff interview with quote to illustrate their use (Cont.)

No.[a]	Themes	Target behaviour	Example of BCT quotes from interviews	ID[b]
10.4	**Social reward**	Variable[c]	*"the nutritionists do type into the WhatsApp group, so they'll be like, "Well done",* *For example, "we ask them to send photos in each week for how they've got on. So they might send a photo in saying "This is my portion size this week" ID 01* *Target behaviour was reducing portion size (Diet)*	02
12.1	Restructuring the physical environment	See 3.2	See 3.2	
12.5	Adding object to the environment	Diet or physical activity	*"we sometimes do a prize at the end for graduation, where it would be like a football. We try and find out what they're interested in, so it might be herbs and spices that they can use for, and it might be some cooking utensils, a football, anything that we think that could help them towards their goal. So, if they really like cooking, we'd probably put more cooking things in. If they really liked football, we'd put a few more football things in."*	02

[a] Code number from BCTTv1 (Michie et al., 2013), [b] Participant ID, [c] It depends on the experiment of families, **BCTs in bold** indicated frequently used

4.3.1.1 Goal setting (behaviour) [1.1]

Goal setting (behaviour) can be defined as "set or agree a goal defined in terms of the behaviour to be achieved" (Michie et al., 2013).

During interviews, all ten participants described ***goal setting (behaviour) [1.1]***. An example of a BCT quote is shown below, combined with ***action planning [1.4]***.
During the interview, the participants used different words to explain goal setting for families, i.e., setting an experiment or challenge.

The goal may be *"To have a healthy breakfast four times a week, if they're not having it at all, or they might decide to go for everyday"*

(Participant ID 05)

How the goal setting (behaviour) was reportedly delivered

First, the staff introduced goal setting to families and then gave them a sheet for an individual family. Each week each family sets and reviews their goal in the following week.

1) **Introduced goal setting**

Goal setting (behaviour) was introduced to families by staff in the second week of the programme (an introduction class).

"So in that introduction session we introduce them to this idea of goal setting which we're going to do with them each week."

(ID 01)

2) Give an experiment sheet to individual family

An experiment sheet was an A4 sheet of paper with about 12 questions (**Figure 4.5**). This sheet was used as a tool to guide families in setting and reflecting on their experiments. Staff purposely called it an 'experiment' because they wanted families to understand that if they failed, they could try it again, which was ok.

"We all give out behaviour change like sheets so but it's blank, it's a blank behaviour change sheet and it's what's your challenge, what are you going to achieve, how you're going to achieve it."

(ID 04)

The sheet had two sides. On the first page of the sheet, the primary question was about *Goal setting (behaviour) [1.1]*, followed by a question about planning and support from others. On the second page, the primary question was about *Review behaviour goal(s) [1.5],* followed by questions about reasons for achieving or failing the experiment, reflecting, and plans to overcome any challenges or obstructions. This sheet indicates how different BCTs are linked together, mainly six BCTs (**Figure 4.5**).

3) Set experiment

3A. Time to set experiment

Families set their experiment (or goals) at the end of each nutrition class and spent about 15 minutes completing it before starting the physical activity class.

"*the last quarter of an hour is the bit where we start doing the goal setting with them*"

(ID 01)

“So at the end of the session we often, we often say to them, it… we want you to set yourself a challenge or like a goal for this week”

(ID 03)

The programme lasted at least 12 weeks, *goal setting (behaviour) [1.1]* was used weekly with family individually except at the initial appointment, mid-way review and final review, so it was used approximately 9-10 times throughout the whole programme.

“Initial, midway and final, we don’t do them, but every other single week we do, yeah.”

(ID 02)

3B. Set experiment individually

Even though the session was delivered as a group, the goals were set by individual families depending on what they wanted to change. Staff helped each family by asking questions to plan their experiment.

“that’s individually, it’s not round the whole group, unless somebody wants to share something that they did”

(ID 02)

3C. Type of experiment

Staff asked families to set their experiment around nutrition topics, for example, breakfast and portion size.

“we then do the running experiment and the idea is when they set their goals in this, they set it based around the topics that we've been doing.”

(ID 01)

Staff helped families to identify what prevented them from changing their behaviours. For example, in the following quote, a child wanted to have a healthy breakfast, but the staff talked with the child and ascertained that he woke up late and did not have time to eat breakfast. So, the experiment was going to bed early so that he would have enough time to eat breakfast.

"So it's breaking down each person's individual scenario and then working out how actually does that practically apply. So for example, if someone wants to make a change at breakfast and wants to have a healthier breakfast, the challenge might not be to go and have a healthier breakfast, it might be that they need to go to bed earlier and that might be the challenge"

(ID 04)

During the planning of the experiment, four other BCTs were identified, i.e., *Self-monitoring of behaviour [2.3], Prompts/cues [7.1], Behavioural substitutions [8.2] and Restructuring the physical environment [12.1]*. These BCTs were identified depending on the family's experiment, as each family had different experiments based on their need and preference. The following quote shows seven BCTs were identified.

"a family had aimed to walk to school every day [1.1, 1.4], and *then they hadn't managed to do it because it was pouring down with rain and they realised, or it was freezing cold,* I can't remember which, but *they realised that the clothes that they had weren't, you know, weren't good enough for getting out in the freezing cold, they were like actually I'm going to make sure we've got some gloves and we've got some wellies and we're going to keep them by the door [1.2, 1.5, 3.2, 12.1]. So that kind of little*

change then meant that it was easier for them to insist on 'we're walking to school and we're not taking the car' [8.2]."

Note: [Number] indicated it position in BCTTv1

(ID 09)

4) Follow-up family's experiment

Staff asked the family to take a photo of what they have done with their experiment and then to send their experiment photos via a closed social media group, (WhatsApp, Meta, California USA), where all families attending the family weight management programme could share it. The WhatsApp is a free texting and calling service that is secure and reliable, available on phones worldwide (Koum and Acton, 2023).

"How are we going to know you've done this? And because we use WhatsApp as a communication method for the whole group, everyone joins it and they all talk to each other in it, help each other out. We ask them to send photos in each week of how they've got on."

(ID 01)

At the beginning of the nutrition classes, staff showed experiment photos from the WhatsApp group on the presentation and asked the family to talk about it.

"Then we would start with, going through some photos from the WhatsApp group where they would send through their challenge photos [pause] just so that everyone could see what they were doing"

(ID 03)

5) Reflection on family's experiment

After setting the first experiment (goal), the following week, the staff asked families to reflect on their experiment by using the experiment sheet and asked questions to guide the family.

"So the next week, so on that session we'd do the reflection first and then we would go to their new experiment."

(ID 02)

The BCT, *review behaviour goals* [1.5], was used when the family reflected on their experiment. This was done every week after the first experiment.

"each week we ask them to reflect on it so each week we pick up on it again. We don't just go, "Oh, move onto the next." We always do that reflection"

(ID 01)

6) Set new or same experiment depend on achievement

After reviewing their behaviour goals, the family set new experiments if they had achieved their goals. However, if they not met their goals, staff helped them to explore and find out why. They asked them to set the same experiment but break it down. In this case, the BCT *graded task* [8.7] might be used. The following quote is an example; as a child wanted to reduce snacks, staff advised them to reduce from a few pieces and then increase to many pieces.

"if you're having a whole pack of biscuits every night just have like two less biscuits or like one less biscuit every day and even that is like a really positive change. So yeah, it's all about really gradual, small steps."

(ID 08)

As described above, the *goal setting (behaviour) [1.1]* was used in combination with other five BCTs, i.e., *problem-solving [1.2], action planning [1.4], review behaviour goal(s) [1.5], social support (unspecified) [3.1] and social support (practical) [3.2]* by using the "experiment sheet" as a tool which contains questions to guide families to plan and review their behaviour goals. This showed that not only BCTs were used, but a tool (the experiment sheet) and help from staff asking questions were used to tailor the individual family's needs to change their behaviour toward a healthy lifestyle.

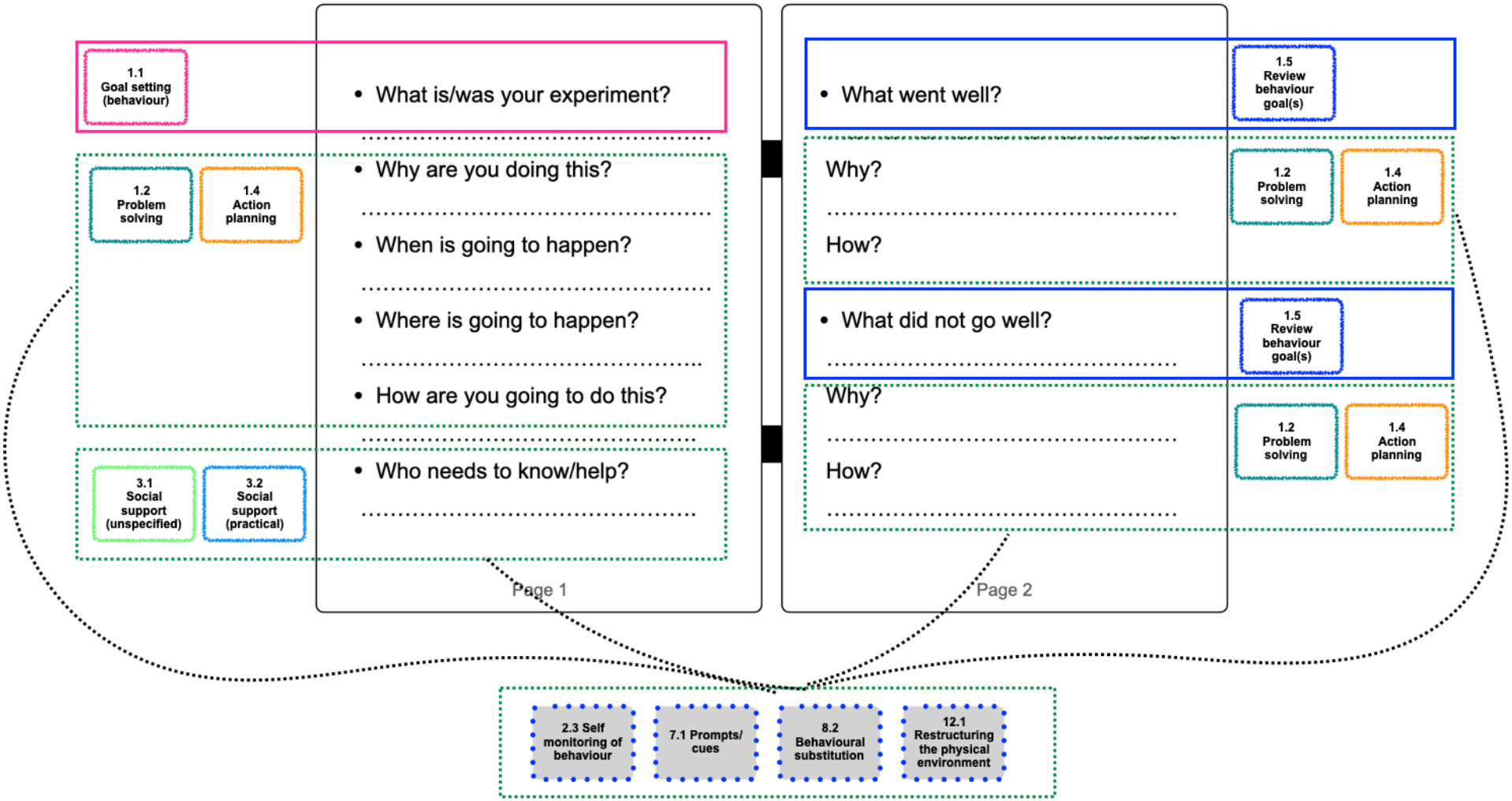


Figure 4.5 An experiment sheet developed from information from interviews (not an original from the programme) linked to BCTs coded using BCTTv1 (Michie et al., 2013)

4.3.1.2 Instruction on how to perform behaviour [4.1]

Instruction on performing behaviour can be defined as "Advise or agree on how to perform the behaviour (includes 'Skills training') (Michie et al., 2013).

All participants described the cooking and/or physical activity classes, for example:

Cooking classes:

"So we show them exactly how to do a cutting technique…Demonstrate, So they will cook healthy pizzas… or couscous… they do cooking skills, so they'll be cutting vegetables…. Reading recipes and then cooking with us…. But what we do is, we give each child a plastic knife, so a cooking knife, a chopping board and then a vegetable of their choice. So, they can chop a mushroom, a spring onion, a pepper, whatever they want to cut"

(ID 02*)*

Physical activity classes:

"the kids like bounce on, so the pogo bouncy thing, and then some balls that they can throw, so there's like different little stations and then the kids kind of go round and have a go at all the different things, like strength-based things"

(ID 08)

How the instruction on how to perform behaviour was reportedly delivered

The family weight management programme included one or two cooking classes for children with staff during the programme and eight to nine classes of physical activity for families. During the cooking classes, a UK-registered nutritionist taught,

demonstrated, instructed and supported children in cooking activities. This indicated that staff not only advised children on cooking, but they also showed the children how to cook, and children were allowed to practice cooking. This showed how different three BCTs, *how to perform the behaviour [4.1], demonstration of behaviour [6.1]* and *behavioural practice/rehearsal [8.1],* were linked together.

1) **Staff instructed children in nutrition classes**

During nutrition classes, UK registered nutritionists instructed and helped children with their tasks, such as cooking and reading food labels.

"we'll kind of be around the room as well helping them out if they get a bit stuck, if they're doing something a little bit wrong, we're just there to guide them in the right direction"

(ID 03)

"the food labelling system, so that's the traffic light system where it's red, amber and green. Some of the kids might, if they're a bit older might've seen it at school but again it's, we've got to get everyone to the same level really. So some of the younger kids might not be aware of that, so we teach them what that means, what the different colours mean, how to see this on packages."

(ID 03)

2) **Staff demonstrated how to cook**

During cooking classes, a UK-registered nutritionist showed children how to cook.

"we show them how to do the passata, so that's in the demonstration as well"

(ID 02)

3) Children practiced cooking and physical activity

During cooking classes, children practice how to cook food. Even though it was a group class, the staff ensured every child was involved. So, everyone had opportunities to cook their food. The group was mixed between younger and older children, so staff paired an older and younger child and the older one helped the younger.

“they will cook healthy pizzas or couscous”

(ID 02)

“they have a group there, group there. You normally put a couple of older children in each group so they can help the younger ones, but you have a staff member in each group.”

(ID 02)

Children not only practised in the cooking classes but there were also other activities in nutrition classes as well such as supermarket class.

“Then we send them round the supermarket with a worksheet and we get them to choose a food that they would normally buy and eat, write down how much sort of fat, sugar and everything is in that, and then we get them on the same bit of paper to write down something that they could change to that’s a healthier alternative”

(ID 03)

As previously described, *instruction on how to perform a behaviour [4.1]* was used in combination with the other two BCTs. This programme included cooking classes and physical activity classes where the other two BCTs were also identified. According to Michie et al. (2013), when a person participates in cooking or exercise classes, researchers should code three BCTs together, i.e., *instruction on how to perform the behaviour [4.1], demonstration of behaviour [6.1]* and *behavioural practice/rehearsal [8.1].*

4.3.1.3 Credible source [9.1]

Credible source can be defined as "Present verbal or visual communication from a credible source in favour of or against the behaviour" (Michie et al., 2013).

During the interviews, Participants described that a registered nutritionist delivered nutrition classes.

"That I'm a Nutritionist on the programme, so I deliver the prog… I deliver the sessions for the families that are, that come onto the programme, yeah.

I, as the nutritionist, would start delivering the session….. Then we'd start the session and I would kind of cover different topics so things such as portion size or breakfast, a healthy breakfast, yeah lots of other topics"

(ID 03)

During the interview, participants described how the programme manager invited a sports coach to join the session, and they used different activities for physical activity classes. The sports coach was not an interviewee.

"basically, a sport coach had come in and done tag rugby and they really enjoyed it"

(ID 02)

"Yeah so typically we've now got really good relationships with local coaches, And they basically come and do team games…. We'll do basketball, we'll do indoor hockey, uh, tag rugby, lots of different games, come and do dance"

(ID 01)

How the credible source was reportedly delivered

In the family weight management programme, mainly two people who delivered the programme, i.e., a UK registered nutritionist and a sports coach. They are experts in their field, so this can be considered a credible source. A *credible source [9.1]* was used throughout the programme eight to nine times.

1) **UK registered nutritionist**

UK-registered nutritionists ran nutrition classes. Participants reported that their experience in delivering the programme ranged from 3 months to 8 years. The nutrition classes included learning/discussing energy balance and food group; healthy/ non-healthy breakfast; portion sizes; snacks; drinks; supermarket; take away meals; cooking and parent classes; habits and routines. A nutritionist explained that they deliver nutrition content:

"my role is, I deliver the session, so deliver the nutritional content and also the sort of behaviour change content"

(ID 09)

A nutritionist usually delivers nutrition content for about 10-15 minutes:

"deliver that for sort of 10-15 minutes"

(ID 03)

Apart from the nutritionists, a coordinator helped set up a place for the delivery of the session.

2) Sports coach

A local sports coach who has expertise in exercise and physical activity ran physical activity classes. The physical activity classes included games and sports, for example, dodgeball, basketball, indoor hockey, tag rugby, and dance.

"basically, a sports coach had come in and done tag rugby"

(ID 02)

As described above, the *credible source [9.1]* was used individually in nutrition classes by a UK-registered nutritionist and physical activity classes by a local sports coach.

4.3.1.4 Material reward (behaviour) [10.2]

Material reward (behaviour) can be defined as "Arrange for the delivery of money, vouchers or other valued objects if and only if there has been effort and /or progress in performing the behaviour (includes positive reinforcement)" (Michie et al., 2013).

Participants described that water bottles with the programme logo were given to families who had made healthy changes or achieved their experiment:

"So, um, at the moment we give them, if they've done their experiment and they're kind of doing quite well they get like a XX bottle, so that's quite cute. It's like a little water bottle with like XX on it and like a lot of the kids seem to actually really like it."

(ID 08)

How the material reward (behaviour) was reportedly delivered

1) **Family sent experiment photo to a closed social media group**

Staff asked the family to send their experiment photos to the closed social media group.

"we use WhatsApp as a communication method for the whole group, everyone joins it and they all talk to each other in it, help each other out. We ask them to send photos in each week of how they've got on"

(ID 01)

2) **Staff reviewed experiment photos**

This BCT, *material reward (behaviour) [10.2]* was used weekly when staff and families discussed and reviewed their experiment photos. Staff reviewed experiment photos from the closed social media group and presented the reward at the beginning of the nutrition classes. Normally, a prize was given once each week, but if they were a big group, more prizes were given.

"we give one prize out each week based on how they've done with their challenges"

(ID 01)

"If there's two peop…, two children that have done really well, we sometimes will give two. It depends how big the group is, if it's a massive group we'll probably do a couple of prize winners"

(ID 02)

3) Staff gave prize to family

Staff chose the photo which showed who had made a healthy change or achieved their experiment or challenge.

"So we, if they send their challenge photo into the WhatsApp group, we normally pick the best one, that we think that have really made like a good effort, we give them a XX Bottle water bottle as a prize"

(ID 02)

4.3.1.5 Social reward [10.4]

Social reward can be defined as "Arrange verbal or non-verbal reward if and only if there has been effort and /or progress in performing the behaviour (include 'positive reinforcement')" (Michie et al., 2013).

The nutritionist shared the experiment photos of families and praised families who made an effort or achieved their goals in the session via a closed social media group. Participants describe that they praised families, for example, when families sent their experiment photo to the closed social media group:

"we'll put in what people have in on the WhatsApp group, we'll kind of talk through it and like "oh like XXX's done this" and we'll like show them on the slideshow and it's quite like a nice way of just, yeah, talking about them in front of everyone and saying it's great"

(ID 08)

The photos were about the experiments of families, which were considered a target behaviour. Sharing pictures and praising the families who put in an effort or achieved their goals, among others, were social rewards.

How the social reward was reportedly delivered

This BCT was used throughout the programme, especially at the beginning of nutrition classes.

1) **Praise on a closed social media group (WhatsApp, Meta, California, USA)**

"the nutritionists do type into the WhatsApp group, so they'll be like, "Well done", obviously, with the day that the picture comes in"

(ID 02)

2) **Praise in classes**

Staff praised children in the classes when they made an effort and also mentioned their names.

"we'll be like "yeah, it's amazing", if we say it in front of people I guess we'll just make sure we use their name and make sure we just really like talk about their achievement, just so they kind of hear it back and like "oh I've actually done something"

(ID 08)

4.3.2 BCTs not used in the programme

Three BCTS were explicitly reported as not used in the programme i.e., *goal setting (outcomes) [1.3], monitoring of emotional consequences [5.4]* and *social comparison [6.2].*

4.3.2.1 Goal setting (outcomes) [1.3]

Goal setting (outcomes) can be defined as "set or agree a goal defined in terms of a positive outcome of wanted behaviour" (Michie et al., 2013).

Six members of staff reported that they tried to avoid using words related to losing weight and to not focus on weight loss; instead, they focused on changing behaviour toward a healthy lifestyle.

"We would never say, "You're doing this to lose weight", *we'll never say that to the children. It's more, I would say that their challenges do go towards that, because they're little things that they're doing. So what we look at is erm…, it's habit change."*

(ID 02)

4.3.2.2 Monitoring of emotional consequences [5.4]

Monitoring of emotional consequences can be defined as "Prompt assessment of feeling after attempts at performing the behaviour" (Michie et al., 2013).

The researcher asked the interviewee about monitoring or recording emotional consequences, and the interviewee explained that while they recorded some of the

participants' behaviours, for example using photos, they did not ask families to record their emotions.

"We don't ask them to write it down, *we can ask them how they found the experiment, so how did they feel doing it. So, if some, if some, if I'm talking about exercise and they got active at the weekends, I'm like, "Oh, how did you find that?", and they might be like, "Oh, it's really fun. I've met my friend, we went for a bike ride", we'd ask them that. But we don't…"*

(ID 02)

4.3.2.3 Social comparison [6.2]

Social comparison can be defined as "Draw attention to others' performance to allow comparison with the person's own performance" (Michie et al., 2013).

Five staff members reported that they did not compare goal setting between families; instead, they encouraged each family to focus on their own goals and to try to improve small steps each time.

"We wouldn't compare, no. It is, it's all about your own targets*, so it's not about what one family's done."*

(ID 02)

4.4 Discussion

This qualitative health research study explored the use of BCTs in one family weight management programme for children aged 5 to 15 years living with overweight and obesity in England through semi-structured interviews with staff who delivered the programme. The current study contributes insight into BCTs used in real life, providing a better understanding of how BCTs were used in real-life settings.

4.4.1 Which BCTs are used in a real-life setting

The current study identified 24 individual BCTs used in a real-life setting. There are few published reports of studies undertaken in real-life settings but these results can be compared with those from published studies of weight management interventions in children and adolescents. According to a systematic review of 18 RCTs and eight control trials, (total: 26 studies and a number of participants ranging 51-3463) of behaviour change interventions targeting dietary, sedentary behaviour and physical activity in healthy children aged 9-12 years from low socioeconomic backgrounds found that a total of 40 BCTs were used across all 26 studies, ranging from zero to 18 BCTs per study (Anselma et al., 2020). Moreover, a systematic review of 10 RCTs (participants ranging 78-2155) of school-based interventions targeting sedentary behaviour and physical activity in healthy adolescents aged 15-19 years found that a total of 36 BCTs were used across all ten studies, ranging from three to 20 BCTs per study (Hynynen et al., 2016). This finding showed that more BCTs were used in a real-life setting than in published studies. Two recent systematic reviews have reported that the number of BCTs used was not significantly related to the intervention's effectiveness in healthy young adults aged 17-35 years (Whatnall et al., 2021) and in women living with overweight and obesity during pregnancy (Flannery et al., 2019). A

comparison of the results from the present study with the results from the systematic review described in **Chapter III** will be made in **Chapter VII**.

4.4.2 How the BCTs were reported used

It is interesting to note that clusters of BCTs, two groups, were often used across the programme i.e., the first group was *goal setting (behaviour)* plus others techniques and the second group was *instruction on how to perform behaviour* plus other techniques.

In the current study, in the first group of BCTs, *goal setting (behaviour)* was reported to be used in combination, at the same time, with at least five other BCTs. These other BCTs included *problem solving, action planning, review behaviour goals, social support (unspecified)* and *social support (practical)*. This finding was also reported in published study of a systematic review of eight RCTs examining family-based nutrition intervention targeting dietary behaviour in children aged 5-18 years living with overweight or obesity which found that using a cluster of BCTs which included *goal setting (behaviour)* and *goal setting (outcomes)* combined with other techniques successfully increased food and vegetable consumption (Perdew, Liu & Naylor, 2021). The difference was that in the published study, both goal setting (behaviour) and goal setting (outcomes) were used. This differs from the present study and is discussed below in the section: **which BCTs not used in real-life setting**.

In the second group of BCTs, *instruction on how to perform behaviour* was reportedly used in combination, at the same time, with the other two BCTs i.e., *demonstration of behaviour* and *behavioral practice/rehearsal*, especially in cooking and exercise

classes. This result seem to be consistent with a systematic of 18 RCTs and eight control trials (total: 26 studies and number of participants ranging 51-3463) of behaviour change interventions targeting dietary, sedentary behaviour and physical activity in healthy children aged 9-12 years from low socioeconomic backgrounds which found this group of BCTs (i.e., *instruction on how to perform behaviour* (19/40), *demonstration of behaviour* (18/40) and *behavioral practice/rehearsal* (21/40)) were identified together and most frequently used (Anselma et.al., 2020). This group of BCTs were also stated as used together if a person attends cooking or exercises classes and is most frequently used for training (Michie et al., 2013). It is possible that training by using this group of BCTs might be suitable for children. A further study with more focus on this group of BCTs in term of effectiveness in children living with overweight or obesity is therefore suggested for future research.

4.4.3 Which BCTs are not used in a real-life setting

From the interviews, staff also explicitly explained that they try to avoid discussion or experiments related to measurable outcomes of behaviour i.e. body weight, weight change, body mass index and body shape, but instead focused more on behaviour change. This was because staff thought it was not suitable for children as some of them had issues at school about their weight, e.g., bullying. In addition, the programme included families with some children who were of normal weight so the programme aimed was focused on changing behaviour toward a healthy lifestyle rather than on outcomes relating to body measurements. This also might be because of staff awareness of a high prevalence of weight stigma, especially in children living with overweight (Puhl & Lessard, 2020), which can lead to behavioural and psychological problems, such as low self-esteem and increased risk of eating disorders (Haqq,

Kebbe, Tan, Manco & Salas, 2021; Palad, Yarlagadda & Stanford, 2019). There has been concern about using words related to weight stigma (Mellor et al., 2022; Puhl, 2020) which is why this thesis refers to 'children living with overweight and obesity' rather than 'overweight and obese children'. Another interesting point is that when the researcher asked staff about comparing the experiments, the staff explicitly explained they were not comparing families to families but instead compared to their own experiment goals. The reason for this was not explored but might have been because comparing children might make them feel low and affect their self-esteem.

4.4.4 Strengths and limitations

The first strength of this study is the reporting of *which* BCTs were used in the intervention and *how* BCTs were delivered in a real-life setting. In contrast, in research settings, reporting usually includes *which* BCTs were used but not *how* specific BCTs were delivered. This is an important detail because if the programme is effective, information about *how* BCTs are used will be required to replicate the programme. The second strength was developing and piloting the topic guide with focus on the research questions before using it with participants and this helped to ensure the interviews would have a good chance of answering the research questions. Lastly, using a semi-structured interview allowed the researcher to have standardized questions to ensure it covers the study's objectives and flexible follow up questions depending on the interviewee's answer to allow them to explore their responses more fully (Denzin, Lincoln & Brinkmann, 2018), which enabled an in-depth exploration of not just which BCTs were used but how these were incorporated into the programme.

The first limitation was that only one family weight management programme was explored and others need to be explored in other public health situations and with different populations to compare the use of BCTs across real-word programme. Secondly, this study explored BCTs from staff who provided the intervention but the 'receipt' of BCTs by the programme participants was not investigated. This would be helpful to examine from the families' perspective and also for triangulation (Patton, 2015). Thirdly, convenience sampling might lead to sampling bias because it was not random sampling. However, all but one of the nutritionists who had ≥12 weeks experience of delivering the programme at the time of interviews were willing to participate. One nutritionist who declined to participate. The response rate of 91% showed that a wide range of possible participants were recruited to achieve a variety of participants' perspectives. Therefore, this might help to minimise sampling bias (Bhandari, 2023). Lastly, the researcher, SS, undertook the interviews and transcription analysis in English which was not her mother tongue and it is possible that some linguistic nuances may have been lost (Espinosa et al., 2022; Smith, Chen and Liu, 2008). SS kept field notes during the interviews and a reflective diary to help minimise researcher bias but this is also a potential limitation.

4.5 Chapter conclusion

This study has identified BCTs used in a ‘real-life’ setting in a family weight management programme for children living with overweight or obesity. Twenty-four individual BCTs were identified. Two groups of BCTs were often used together i.e.:

- *Goal setting (behaviour)* plus at least one of five other techniques;
- *Instruction on how to perform behaviour* plus two other techniques i.e., *demonstration of behaviour* and *behavioural practice/rehearsal*.

Evidence from 'real-world' settings about BCTs used in weight management programmes for children living with overweight or obesity is limited. The present study, which considers a single programme, provided valuable insight of how BCTs were delivered and can be used as evidence which may better reflect real life than other research studies (Blonde, Khunti, Harris, Meizinger & Skolnik, 2018; Kim, Lee & Kim, 2018). Further investigations in other public health interventions will expand this evidence and its application to provide wider support for children living with overweight or obesity.

CHAPTER V

STUDY 3; A QUANTITATIVE DATABASE ANALYSIS OF A FAMILY WEIGHT MANAGEMENT PROGRAMME FOR CHILDREN AGED 5-15 YEARS IN ENGLAND

5.1 Introduction

5.1.1 Background and rationale

In chapter III, a qualitative descriptive study explored behaviour change techniques used in a family weight management programme for children living with overweight or obesity in a real-life setting. This provided only evidence of which BCTs used and how they were delivered. This study found that twenty-four individual BCTs were used in the programme to facilitate families in changing their behaviour. Knowing which BCTs were used does not demonstrate the family weight management programme's effectiveness if their weight status or behaviour have not improved. Therefore, objectively measured outcomes of families who attended the programme are needed to identify the programme's effectiveness in this real-life setting.

Overweight and obesity is a medical condition which is defined by the World Health Organisation (WHO 2020a) as a person who has excessive or abnormal storage of fat. Body fat can be measured in many ways, for example, through dual-energy X-ray absorptiometry and bioelectric impedance analysis (Lemos & Gallagher, 2017). However, those techniques are expensive and some require a trained technician while body mass index (BMI) is a simple criterion that has been used to classify overnutrition based on weight (in kilograms) divided by height (in metres) squared. This criterion is widely used, inexpensive, simple and practical for practitioners and researchers

(Jensen, Camargo & Bergamaschi, 2016). Many studies have reported that BMI is correlated with body fat (Calvo, Galarraga & Gonzalez, 2016; Field et al., 2003).

For adults, BMI between 25.0 – 29.9 kg/m^2 is classified as overweight and BMI from 30.0 kg/m^2 is classified as obese (WHO, 2020a). However, in children, BMI cannot be compared with simple categories because of the impact of growth. As a result, sex-age-specific BMI values, usually expressed as percentiles, are used in children to evaluate their degree of adiposity. This has been used to indicate whether a child is overweight, normal weight or underweight.

There are various cutoff points for BMI percentiles that identify overweight and obesity, such as WHO (WHO, 2020a), Center for Disease Control and Prevention; CDC (CDC, 2010) and the UK (Royal College of Pediatric and Child Health: RCPCH, 2013). As the family weight management programme was carried out in England, the UK cutoff was used in this study (Royal College of Pediatric and Child Health: RCPCH, 2013).

Furthermore, waist circumference is also used as a measure of adiposity that indicates abdominal fat accumulation (Alberti et al., 2009; Alberti, Zimmet and Shaw, 2005). The waist circumference was found to be a better indicator of metabolic risk than body fat percentage in some studies in adults (Ashwell & Gibson, 2016; Farhangiyan, Latifi, Rashidi & Shahbazian, 2019; Shen et al., 2006). The waist circumference has been used as a criterion to define metabolic risk in adults and children (Al-Hamad & Raman, 2017; Alberti et al., 2009; Fredriksen, Skar & Mamen, 2018; Zimmet et al., 2007).

Therefore, sex-age-specific BMI and waist circumference of children from families who attended the programme will be investigated to report the programme's effectiveness in this real-life setting.

5.1.2 Aim and objectives

This study aimed to explore participant-related outcomes of a family weight management programme for children aged 5-15 years living with overweight or obesity delivered as a public health intervention in England.

- To compare change in body mass index (BMI), and BMI z-score before and after the intervention
- To compare change in waist circumference (WC) before and after the intervention

5.2 Methodology

5.2.1 Study design

This pre-post observational study analysed data collected routinely from one family weight management programme in England. (For full description of the programme, including setting, participants recruitment and BCT intervention details please see **Chapter 3 section 3.2.2 Intervention**).

5.2.2 Participants

Children aged 5-15 years living with overweight or obesity who attended the programme with their family.

5.2.3 Data collection

Data were collected during routine practice between February 2007 and June 2019 in a community-based public health intervention delivered in England for children and their families who consented to participate in a family weight management programme.

The data included general information about participants (assessment date at baseline and post-intervention, age, sex, self-identified ethnicity, and self-reported disability status), and anthropometric data (height, weight, BMI and WC) measured by a UK-registered nutritionist at baseline (i.e., at initial appointment (week 1), before the intervention began) and post-intervention (i.e., at final review (week 12 to 16), after intervention finished) (**Figure 5.1**).

Body weight, height and waist circumference (WC)

Body weight, height and WC were measured by a UK-registered nutritionist who delivered the family weight management programme at baseline (15-minutes initial appointment with individual family) and after programmed finished at 12 weeks. However, the precise measurement procedure, i.e., reproducibility of measurements, was not recorded or explored.

General information

Disabilities and ethnicity were self-reported by parents/guardians of children by ticking options offered.

Disabilities options included;

1) No disability
2) Physical disability
3) Mental/learning disability and
4) Others.

Ethnicity options included;

1) British white
2) Black British
3) Asian/British Asian
4) British Italian
5) White other, e.g., Polish;
6) Mixed ethnicity; and
7) Other/prefer not to say.

Data were recorded on paper and transferred to an online system by a member of staff. The data were anonymized (name, date of birth, and address were removed) and password protected by a member of staff before sending to the researcher.

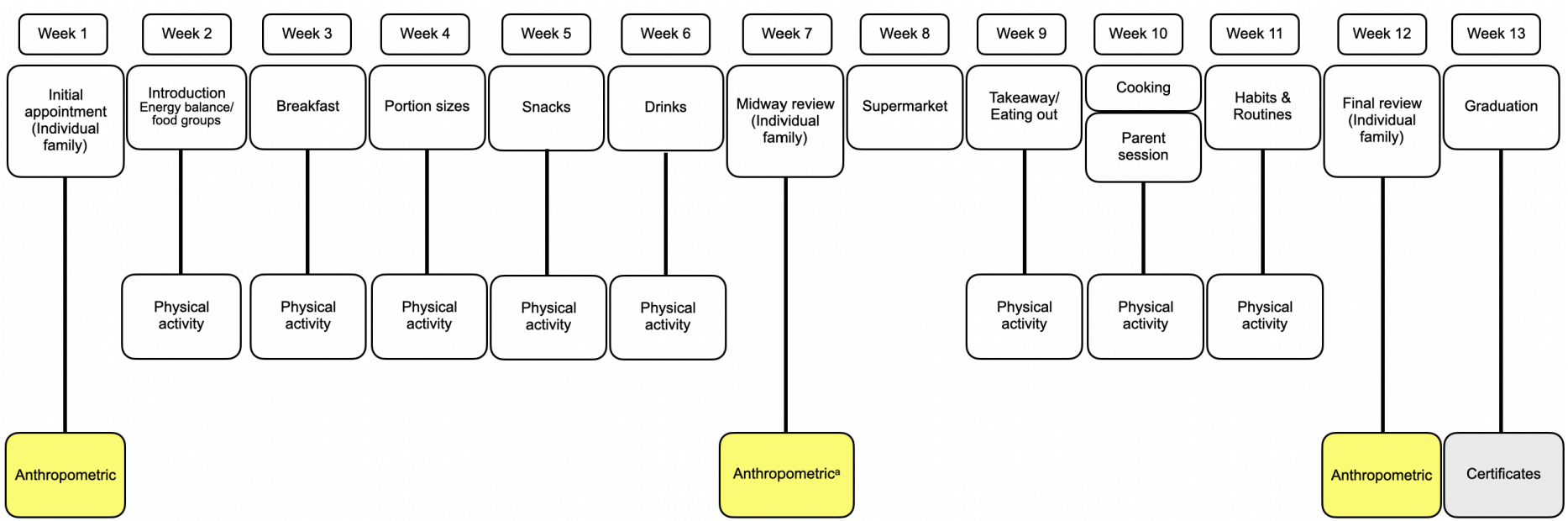


Figure 5.1 Overview of a family weight management programme sessions and assessments according to weeks and topics

[a] Data not recorded on the database system

5.2.4 Data processing

As the data were not collected for a research study according to the Good Clinical Practice standard (GOV.UK, 2024; National Institute for Health and Care Research, 2023), data cleansing was undertaken by the author following a protocol devised for the present evaluation to ensure the quality (**Appendix 5A, protocol for cleansing database**). Briefly, participants were excluded if they had normal weight (sex-age specific BMI between 2nd and 91st percentile); no pre- and post-data; aged were not between 5-15 years; no sex information; height decreased or increased by $\geq$4.5 cm between baseline and post-intervention, height-for-age lower than 0.4th percentile or higher than 99.6th percentile (Royal College of Paediatrics and Child Health, 2013) and average weight change of more than 1 kg per week (Centers for Disease Control and Prevention, 2022).

Anthropometric assessments

Body mass index (BMI) (kg/m^2)

Body weight and height were used to calculate body mass index (BMI) by using the formula; BMI = weight (kg) / [height (m)]^2 (Royal College of Paediatrics and Child Health, 2013). This was double checked by the author compared to BMI with the original file.

Sex-age specific BMI was used to categorise each child as overweight ($\geq$ 91st), obese ($\geq$98th) or severely obese ($\geq$99.6th) (Royal College of Paediatrics and Child Health, 2013). A syntax for the sex-age specific BMI was developed by the author using UK

BMI 2-20 years charts (Royal College of Paediatrics and Child Health, 2013) in SPSS and used on the database to categorise the BMI status of participants.

BMI z-score

BMI z-score was calculated by the author using Lambda-Mu-Sigma (LMS) method formula; $z = [(BMI/M)^{L}-1]/LxS$ (Wright & Cole, 2011) where values of LMS were from the LMS table (Pacharanero, 2021). Three parameters were used to describe a distribution of change, i.e., Box-Cox power to remove skewness (L), Median (M), and Coefficient of variation (S) (Cole, Freeman & Preece, 1998).

Statistical analysis

Statistical analyses were performed using SPSS statistics software version 26 (IBM Corporation, New York).

The normality of continuous data i.e., height, weight, body mass index (BMI), BMI z-score and waist circumference, were evaluated using the Kolmorogov-Smirnov test and data which had a p value ≥ 0.05 were considered to be normally distributed i.e., parametric data, while those with a p value <0.05 considered not normally distributed i.e., non-parametric data (Pallant, 2016). The Kolmorogov-Smirnov test was used because more than 50 participants were included in the study (Mishra et al., 2019) (**Appendix 5B**, Thumbnails of histograms).

Descriptive statistics were used to express numerical and categorical data, i.e., age, sex, ethnicity, and anthropometric data (weight, height, BMI, BMI z-score). Continuous data were expressed using median and range when data were non-parametric. All

continuous data were non-parametric. There were no continuous parametric data. Categorical data were expressed as numbers and percentages. Subgroup analysis was undertaken for groups divided by sex and age.

Comparison between two independent groups (i.e., sex) was analysed using the Mann Whitney U test when data were non-parametric. Comparison between related groups (i.e., BMI at baseline and post-intervention) was undertaken using Wilcoxon signed ranks test i.e., paired non-parametric data. Comparisons between three or more unrelated groups (i.e., age groups, ethnicity groups, disability groups) analysed by the Kruskal Wallis test (Pallant, 2016). Differences between groups or subgroups were considered significant when the P value was <0.05.

5.2.5 Ethical considerations

This study was reviewed and approved by the Health, Science, Engineering and Technology Ethics Committee at the University of Hertfordshire. This was approved on 13/11/2019 with a protocol number LMS/PGR/UH/03866 (**Appendix 5C, Ethics approval**). All participants in the family weight management programme had consented to further analysis of their anonymized data when they joined the family weight management programme.

5.3 Results

5.3.1 Baseline characteristic

There were 1959 children who participated in the family weight management programme between 2007 and 2019. During cleansing of the data 841 (43%) were removed and the reasons documented (**Figure 5.2**). Therefore, data from 1,118 children aged 5-15 years living with overweight or obesity were included in the analysis. Fifty-four per cent were boys, nearly 70% were from white ethnic backgrounds, nearly 47% were categorized as severely obese and 14% were self-declared as disabled (**Table 5.1**).

5.3.2 Change of BMI and BMI z-score

BMI

There was a significant reduction in median (range) BMI from 25.7 (17.6-46.3) to 25.2 (16.5-46.3) kg/m^2, $p<0.001$, in the whole group between the baseline and post-intervention measurement and this were also observed in BMI for the three subgroups by sex-age specific BMI category (**Table 5.2**). When BMI categories before intervention were compared with the BMI categories after the intervention it was found that nearly 15% of participants were recategorized into a lower BMI category and almost 3% were recategorized into a higher BMI category (**Table 5.3**).

BMI z-score

There was a significant reduction in median (range) BMI z-score from 2.60 (1.24-5.30) to 2.52 (0.72 - 5.28), $p<0.001$, in the whole group between baseline and post-intervention measurement (**Table 5.4**). Comparable significant reductions in BMI z-score were also observed in subgroups by sex (both in boys and girls) and in all three age groups (**Table 5.4**).

Self-reported disability

BMI z-score in self-reported disabled children was significantly higher than non-disabled children at baseline and post-intervention. A significant reduction In BMI z-score was observed in all three groups between baseline and post-intervention (**Table 5.5**).

Self-identified ethnicity

There was no significant difference in BMI z-score among sub-groups by ethnicity at baseline and post-intervention. Comparable significant reductions in BMI z-score were observed in Asian, Black, White and unknown groups after the intervention (**Table 5.6**). When participants' data were grouped into three ethnic categories i.e., non-white, white and others (prefer not say and unknown included), there were no significant differences between the BMI z-score of these three subgroups.

5.3.3 Change of waist circumference (WC)

A sub-group analysis of 348 children with WC measured at baseline and post-intervention, compared to international WC percentile cutoff (Xi et al., 2020), 268 (77%) had WC above the 90th percentile at baseline. There was a significant reduction in median WC from 81.0 cm (52.2-105.0) to 81.0 cm (50.0-103.5) ($p<0.001$) between the baseline and post-intervention measurement (**Table 5.7**). WC's medians were similar, but the p-value showed a highly significant difference due to factors such as distribution shape, variability, sample size, and outliers, which could significantly impact datasets, even if they appear similar based on the median.

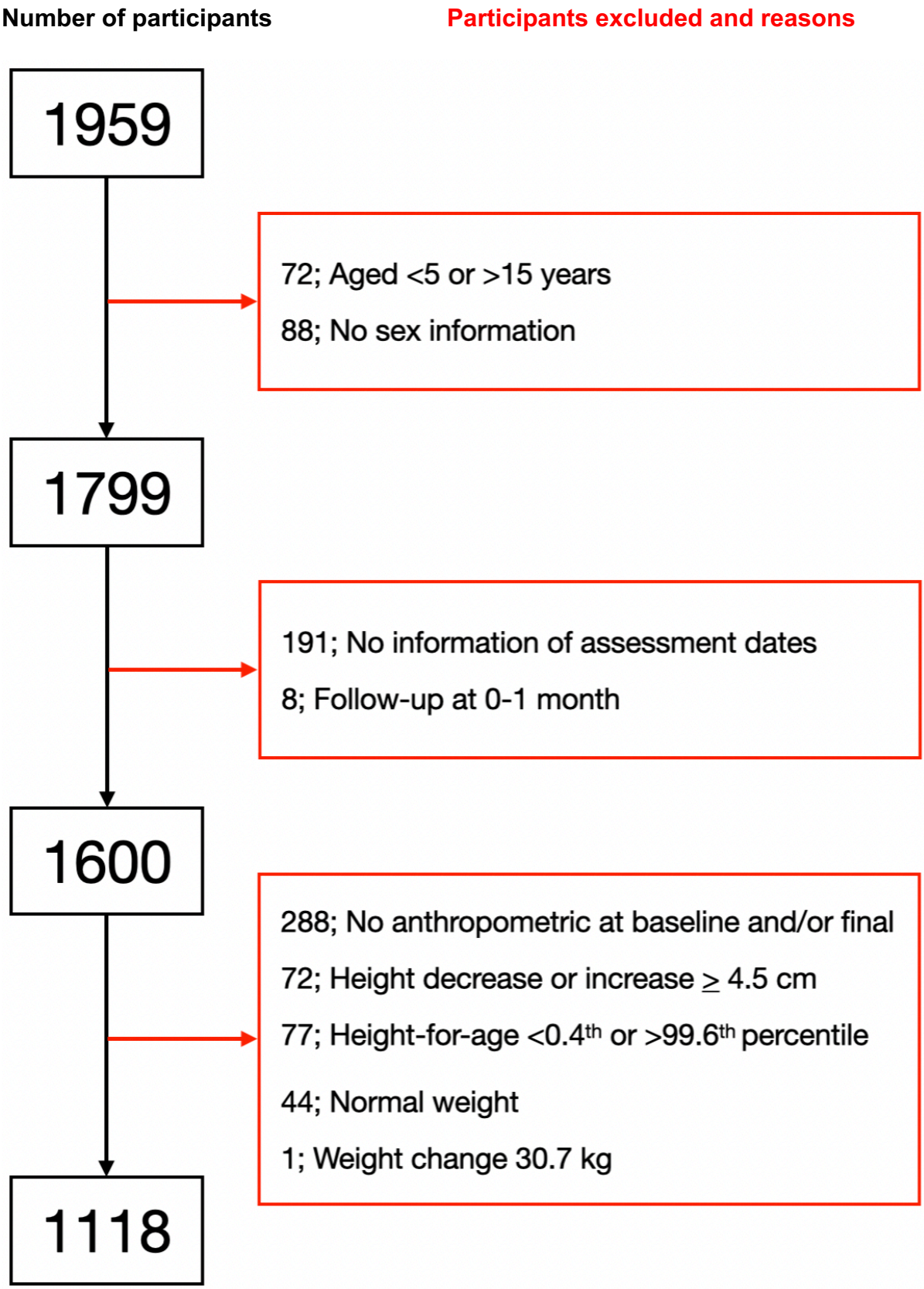


Figure 5.2 Number of participants included for analysis (n=1118) and reason for participants excluded

Table 5.1 Baseline characteristic of the 1118 children who participated in the family weight management programme

	n (% of total)	Median	Range
Age (year)		11.0	5.0-15.0
5-6	102 (9.1)		
7-11	639 (57.2)		
12-15	377 (33.7)		
Sex			
Boys	517 (46.2)		
Girls	601 (53.8)		
Ethnicity[a]			
Asian or Asian British	101 (9.0)		
Black, Black British, Caribbean of African	70 (6.3)		
Mixed or multiple ethnic groups	46 (4.1)		
White	774 (69.2)		
Others	6 (0.5)		
Prefer not to say	22 (2.0)		
Unknown/withheld	99 (8.9)		
Anthropometry			
Body weight (kg)		56.1	20.3-133.7
Height (cm)		147.0	105.0-179.0
BMI (kg/m^2)		25.7	17.6-46.3
Sex and age specific BMI categories[b]			
Overweight	219(19.6)		
Obese	376(33.6)		
Severely obese	523(46.8)		
BMI z-score		2.6	1.2-5.3
Disability[c]			
Non-disabled	755 (67.5)		
Disabled	160 (14.3)		
No information	203 (18.2)		

[a] Census of England and Wales (2021), self-identified
[b] Royal College of Paediatrics and Child Health, 2013
[c] Self-reported

Table 5.2 BMI in 1118 children at baseline and post-intervention

	n	Baseline		Post-intervention		Differences		p value[a]
		Median	Range	Median	Range	Median	Range	
BMI (kg/m^2)	1118	25.7	17.6-46.3	25.2	16.5-46.3	-0.47	-8.04-3.81	<0.001
Sex-age specific BMI category[b]								
Overweight	219	21.9	17.6-26.2	21.2	16.5-26.8	-0.43	-3.10-2.00	<0.001
Obese	376	24.8	19.0-30.0	24.3	18.2-30.3	-0.52	-4.04-1.96	<0.001
Severely obese	523	29.5	20.5-46.3	29.0	19.8-46.3	-0.43	-8.00-3.80	<0.001
Sex								
Boys	517	25.3[c]	17.6-45.3	24.9[c]	16.5-44.5	-0.50	-4.47-3.81	<0.001
Girls	601	26.1[c]	18.1-46.3	25.6[c]	17.0-46.3	-0.41	-8.04-2.04	<0.001
Age group (years)								
5-6	102	20.7[d]	17.6-35.0	20.2[d]	16.5-34.8	-0.44	-2.46-2.05	<0.001
7-11	639	24.8[d]	18.2-41.7	24.4[d]	17.4-39.3	-0.48	-5.80-2.04	<0.001
12-15	377	28.9[d]	21.2-46.3	28.4[d]	19.8-46.3	-0.45	-8.04-3.81	<0.001

[a] Wilcoxon Signed Ranks Test
[b] Royal College of Paediatrics and Child Health, 2013
[c] Significant different between boys and girls at baseline (p= 0.027) and at post-intervention (p=0.014) (Mann-Whitney U Test)
No significant different between boys and girls of differences between two measurements (p=0.094) (Mann-Whitney U Test)
[d] Significant different between age groups at baseline (p<0.001) and post-intervention (p<0.001) (Kruskal-Wallis H Test)
No significant different between age groups of differences between two measurements (p=0.989) (Kruskal-Wallis H Test)

Table 5.3 Number and percentage of 1118 children in sex-age specific BMI categories at baseline and post-intervention

BMI categories at baseline	n	BMI categories at post-intervention			
		Normal weight	Overweight	Obese	Severely obese
Overweight	219	44 (3.9)[a]	160(14.3)	15(1.3)[b]	0(0.0)
Obese	376	0(0.0)	72(6.4)[a]	288(25.8)	16(1.4)[b]
Severely obese	523	0(0.0)	0(0.0)	49(4.4)[a]	474(42.4)
Total	1118	44(3.9)	232(20.8)	352(31.5)	490(43.8)

[a] Recategorized into a lower BMI category
[b] Recategorized into a higher BMI category

Table 5.4 BMI z-score in 1118 children at baseline and post-intervention

	n	Baseline		Post-intervention		Differences		p value[a]
		Median	Range	Median	Range	Median	Range	
Whole group	1118	2.60	1.24-5.30	2.52	0.72-5.28	-0.08	-1.13-0.71	<0.001
Overweight	219	1.74	1.24-2.07	1.57	0.72-2.24	-0.13	-1.13-0.71	<0.001
Obese	376	2.39	1.94-2.75	2.28	1.46-2.84	-0.10	-0.90-0.52	<0.001
Severely obese	523	3.10	2.58-5.30	3.07	2.02-5.28	-0.06	-0.96-0.61	<0.001
Sex								
Boys	517	2.65	1.32-5.30	2.53	0.74-5.28	-0.08	-0.90-0.61	<0.001
Girls	601	2.58[b]	1.24-4.43	2.51	0.72-4.27	-0.08	-1.13-0.71	<0.001
Age groups (years)								
5-6	102	2.58[c]	1.34-5.30	2.43[c]	0.74-5.28	-0.15[c]	-1.13-0.61	<0.001
7-11	639	2.57[c]	1.24-4.77	2.48[c]	07.2-4.66	-0.08[c]	-0.96-0.71	<0.001
12-15	377	2.69[c]	1.32-4.07	2.63[c]	0.94-4.07	-0.07[c]	-0.90-0.32	<0.001

[a] Wilcoxon Signed Ranks Test

[b] Significant different between boys and girls at baseline, p=0.032 (Mann-Whitney U Test)
No significant difference between boys and girls at post-intervention (p=0.080) and differences between two measurements (p=0.163) (Mann-Whitney U Test)

[c] Significant different between age groups at baseline (p=0.019), post-intervention (p=0.021) and differences between two measurements (p<0.001) (Kruskal-Wallis H Test)

Table 5.5 BMI z-score in 1118 children by self-reported disability status at baseline and post-intervention

	n	Baseline		Post-intervention		Differences		p value[a]
		Median	Range	Median	Range	Median	Range	
Non-disabled	755	2.54[b]	1.24-4.80	2.47 [b]	0.72-4.70	-0.09	-0.96-0.71	<0.001
Disabled	160	2.76 [b]	1.39-5.30	2.73 [b]	1.13-5.28	-0.05	-0.52-0.30	<0.001
No information	203	2.73 [b]	1.43-4.01	2.67 [b]	0.93-4.07	-0.07	-1.13-0.61	<0.001

[a] Wilcoxon Signed Ranks Test
[b] Significant different between disability groups at baseline (p<0.001) and post-intervention (p<0.001) (Kruskal-Wallis H Test)
No significant difference of differences between groups (p=0.104) (Kruskal-Wallis H Test)

Table 5.6 BMI z-score in 1118 children by self-reported ethnicity at baseline and post-intervention

Ethnicity[a]	n	Baseline		Post-intervention		Differences		p value[b]
		Median	Range	Median	Range	Median	Range	
Asian or Asian British	101	2.55	1.32-4.80	2.52	0.93-4.70	-0.09	-1.13-0.25	<0.001
Black, Black British, Caribbean of African	70	2.61	1.44-4.42	2.57	1.00-4.24	-0.06	-0.59-0.21	0.001
Mixed or multiple ethnic	46	2.73	1.53-4.07	2.73	1.12-4.15	-0.03	-0.77-0.30	0.045
White	774	2.60	1.24-5.30	2.52	0.72-5.28	-0.08	-0.95-0.71	<0.001
Others	6	2.23	1.78-2.93	2.27	1.75-2.72	-0.09	-0.42-0.42	0.753
Prefer not to say	22	2.51	1.65-3.71	2.54	1.66-3.77	-0.06	-0.51-0.34	0.149
Unknown/withheld	99	2.55	1.34-4.77	2.45	0.74-4.66	-0.08	-0.71-0.40	0.001

[a] Census of England and Wales (2021), self-identified
[b] Wilcoxon Signed Ranks Test
No significant difference in BMI z-score between ethnicity groups at baseline (p=0.494), at post-intervention (p=0.423) and difference between the two measurements (p=0.206) (Kruskal-Wallis H Test)

Table 5.7 Waist circumference in 348 children at baseline and post-intervention

	n	Baseline		Post-intervention		Differences		p value[b]
		Median	Range	Median	Range	Median	Range	
WC (cm)	348	81.0	52.2-105.0	81.0	50.0-103.5	-0.5	-4.0-4.0	<0.001
Sex-age specific BMI category[a]								
Overweight	90	71.8	52.2-94.6	71.1	50.0-92.8	-0.7	-4.0-4.0	<0.001
Obese	141	81.0	56.5-96.5	81.0	57.0-95.0	-0.2	-4.0-4.0	0.180
Severely obese	117	87.3	63.6-105.0	86.5	63.6-103.5	-0.5	-4.0-4.0	0.007
Sex								
Boys	174	82.5 [c]	52.2-105.0	82.4 [c]	50.0-103.5	-0.7	-4.0-4.0	0.001
Girls	174	79.0[c]	56.5-96.0	79.0 [c]	57.0-96.0	-0.2	-4.0-4.0	0.004
Age groups (years)								
5-6	28	63.6[d]	52.2-70.1	62.5 [d]	50.0-72.0	0.0	-4.0-3.3	0.211
7-11	217	79.0 [d]	56.5-98.2	79.0 [d]	53.3-96.9	-0.3	-4.0-4.0	<0.001
12-15	103	88.1 [d]	65.0-105.0	87.0 [d]	64.0-103.5	-0.5	-4.0-4.0	0.020
Sex-age specific WC percentile[e]								
<90th	80(23)	71.0	52.2-80.3	71.0	50.0-84.0	-0.1	-4.0-4.0	0.216
≥90th	268(77)	84.0	62.5-105.0	84.0	61.0-103.5	-0.5	-4.0-4.0	<0.001

[a] Royal College of Paediatrics and Child Health, 2013. [b] Wilcoxon Signed Ranks Test
[c] Significant different between boys and girls at baseline (p=0.002) and post-intervention (p=0.002) (Mann-Whitney U Test)
No significant different between boy and girls of differences between two measurements (p=0.583) (Mann-Whitney U Test)
[d] Significant different between age groups at baseline (p<0.001) and post-intervention (p<0.001) (Kruskal-Wallis H Test)
No significant different between age group of differences between two measurements (p=0.899) (Kruskal-Wallis H Test)
[e] Xi et al., 2020

5.4 Discussion

This study aimed to evaluate anthropometric outcomes of children aged 5-15 years who attended a family weight management programme in England between 2007 and 2019. The key finding was that overall, the median BMI z-score reduced significantly after participation in the intervention.

5.4.1 BMI z-score

A significant reduction in median BMI z-score was observed in the whole group. Although this finding suggests potential benefits, this cannot be confirmed due to the limitations of the observational study design. It does, however, support the testing of the programme using a randomized controlled trial. However, this reduction in the median BMI z-score was comparable to the finding of an RCT that evaluated a family-based intervention for children aged 8-11 years living with overweight or obesity in Malaysia, which found that at 6-month follow-up mean BMI z-score was decreased by 0.10 ± 0.26 ($p=0.002$) (Ahmad et al., 2018). Another RCT that evaluated a different family-based intervention for children aged 8-11 years living with overweight or obesity in the UK, found that at 6 months after the intervention the mean BMI z-score was reduced by -0.30 (-0.36 to -0.23), $p<0.0001$ (Sacher et al., 2010) which was a larger reduction than the current study. The reduction of BMI z-score in the current study suggests that the family weight management programme might benefit their future health outcomes overall because the reduction of BMI z-score relates to a reduction of body fat mass (Birch et al., 2019). A published study which illustrates this is a retrospective analysis of 485 children aged 4-19 years living with obesity who received a healthy lifestyle intervention from a university's pediatric clinic which found that maintaining or decreasing BMI z-score was associated with improving their visceral

fat and cardiovascular fitness (Naik, Allen, Eickhoff & Carrel, 2020). Similarly, an uncontrolled intervention study of 203 children aged 7-17 years living with overweight and obesity who received an intervention delivered from a hospital and public health setting found that either reducing BMI z-score by as little as 0.10 or maintaining a stable BMI z-score (≥0.00 to <0.10) was significantly associated with improved total cholesterol, LDL-cholesterol and total/HDL cholesterol ratio, blood insulin level and insulin resistance, (Kolsgaard et al., 2011). However, further long-term follow-up is necessary to validate these findings.

Self-reported disability

This particular programme is noteworthy because it provides the same intervention to children with and without disabilities, which is different from published studies on overweight and obesity in children that typically exclude those with disabilities to avoid confounding factors that potentially impact outcome measures (Ahmad et al., 2018; Croker et al., 2012; Golley et al., 2007; Hystad, Steinsbekk, Odegard, Wichstrom & Gudbrandsen, 2103; Lochrie et al., 2013). Including children with a disability in a family weight management programme could affect the child's ability to engage with the intervention, their appetite, eating habits, and overall participation. Disabilities are highly variable and some children with limited abilities may face challenges in actively participating, leading to frustration. Their limitations may also make it harder for them to achieve programme goals, impacting overall outcomes (Hogan et al., 1997; Msall et al., 2003; UNICEF, 2023). However, excluding them from a weight management programme in a research context could reduce these potential confounding factors and lead to a more consistent group dynamic and potentially more predictable results. In a practice setting, and to support inclusivity and equity, it is valuable to have data

that include populations that are representative of those needing an intervention and this is likely to include children with a disability. In this current study, the median BMI z-score in the sub-group of children with disabilities was higher than in the children without disabilities at baseline and post-intervention. However, both groups showed a significant reduction in median BMI z-scores after intervention, indicating that the programme was also practical and had a positive effect for children with disabilities who are living with overweight or obesity. However, these disabilities were self-reported and the nature and extent of the disabilities were unknown. This is important because disabilities are quite common in children in the UK. From survey data, prevalence of children living with disabilities reported in the UK was 9% of total of people living with disabilities (a total approximately 15 million) in 2020/21, mainly included social/behavioural, mental health, learning, stamina/breathing/fatigue, mobility and others disabilities (Kirk-Wade, 2022). Children with these disabilities have an increased risk of obesity for example, a cohort study reported that approximately 5-6% of British children living with obesity have intellectual disabilities (Emerson, Robertson, Baines & Hatton, 2016) and obesity is also linked to other disabilities such as learning disabilities and physical disabilities (Public Health England, 2014).

5.4.2 Waist circumference

Most of the children in this programme had a WC measurement above the 90th percentile for their age and sex. WC values higher than the mean for age and sex are more likely to have higher fasting insulin and triglyceride levels (Bassali, Waller, Gower, Allison & Davis, 2010). In this current study, a significant reduction of median WC was observed in the whole group (n=384). This finding was consistent with an RCT in 33 children aged 8-12 years living with overweight or obesity in the UK who

received a family-based intervention which found that a mean WC at post-intervention (six months) was reduced by 0.51±3.23 cm (Croker et al., 2012). This finding suggested that this family weight management programme helps to improve waist circumference overall in children living with overweight and obesity. Having a high WC is associated with higher blood pressure, high insulin level, and high triglyceride in children and adolescents (Bassali et al., 2010; Choy et al., 2011; Tang et al., 2022; Velarde et al., 2013), and a reduction in WC is associated with a reduction in metabolic risks (Rothberg et al., 2017). It is noted that measuring WC can be challenging. The methodology used in the programme and its rigor was not conducted as a research study according to Good Clinical Practice (GOV.UK, 2024; National Institute for Health and Care Research, 2023). The validity and reliability of measurements is, therefore, unknown.

5.4.3 Intention to treat

This study only considered participants' outcome data when it was available in paired format i.e., matched baseline and post-intervention. This does not consider what happens to participants who either withdraw from the intervention or where data is missing. This is important because if only a small proportion of participants complete an intervention and gain benefit from it, this does not recognize that many others may not experience benefit and that the intervention might be too difficult or unacceptable for them. The concept of intention to treat was introduced in RCTs when missing data occurs (Gupta, 2011). In this study, many participants were excluded for missing data at follow-up and also for other reasons, such as typing errors, which led to many being excluded. Therefore, this current study did not analyse data on an intention to treat basis.

Not attending for follow-up may indicate that the programme was unacceptable to participants, but it was not possible to explore this in the present study. If all participants were included in the analysis, it might affect the true effectiveness of the programme. Therefore, in future studies following-up participants who do not complete and ensuring the data collection process is robust e.g., by using double entry records would ensure data are as complete as possible.

5.4.4 Strengths and limitations

The main strength of this study was the analysis of data from a real-life setting. A study reported that the differences between participants in RCT and an observational cohort might lead to the intervention from the RCT study not applying in the real-world setting (Averitt, et al., 2020). As this was a family programme from a real-life setting and the results showed the programme's effectiveness in reducing median BMI z-score, an implication of this is the possibility that it can be used as evidence to support the use of this programme in other real-world settings.

There were several limitations. Firstly, the data from the programme were collected for the purposes of managing the programme rather than designed to be a scientific study, i.e., this study used an observational approach. Findings from observational studies lack certainty due to the risk of bias arising from the absence of randomization and the inability to determine causality (Maki et al., 2014). In addition, findings drawn from a public health intervention, as described in this chapter, which was not designed as a research study and did not follow Good Clinical Pracrice (GOV.UK, 2024), e.g., in standards of record keeping, may be more at risk of error. To evaluate an

intervention, a randomized controlled trial (RCT) is needed where participants can be randomized to receive the intervention or a comparable control (Friedman et al., 2010; Houle, 2015). The observational nature of the evaluation described is, therefore, a major limitation. Secondly, the database, as this was observational data, was incomplete and uncertain quality data, which can compromise their reliability. To minimize this limitation, database cleansing was undertaken using predefined protocols to ensure consistency of removing individual data points to reach the highest level of quality. A high number of participants were excluded after cleansing data for various reasons which have been explained (**Figure 5.2**). The reason for missing data or recording data that is incorrect might be because the staff who recorded were less focused on completing data collection in real life than in research studies and not trained in Good Clinical Practice (GOV.UK, 2024; National Institute for Health and Care Research, 2023) nor are records audited which might be expected in an RCT. These factors can impact the overall quality and applicability of results obtained from this observational data. In addition, time may be limited as it is focused on the delivery of the intervention programme and less on data collection. Therefore, a standard for collecting data in a real-life setting is required, and the attrition rate should be recorded along with the reasons for withdrawing if this can be obtained. This might contribute to more robust evidence in real-life settings and better examine the programme's effectiveness. Thirdly, the anthropometric measurement procedure was not explored. This could be a limitation as systematic errors might occurred during measurements. However, in this study the investigators of the programme were nutritionists who had studied and practiced nutrition assessment. Fourthly, transcription error might have occurred as information was recorded on paper and transferred to online system. Fifthly, this was only a database from one real-life setting, and in a specific country

which limits translation to other settings and different countries. Sixthly, the results of summarising data from a 12-year period may be affected by the methodology, which may have changed over time. Finally, the analysis has not accounted for multiple statistical tests, which could result in an elevated risk of type I errors and inflated rate of false positives. To address this limitation in future analyses, it would be advisable to apply a correction test to adjust for the number of tests conducted in the analysis such as a Bonferroni correction (VanderWeele and Mathur, 2018; Shi et al., 2012).

For future research, it is recommended that the programme is evaluated using an RCT design to establish the effectiveness of the intervention. Furthermore, it is important to note that the programme lasted only 12 weeks, and long-term follow-up is needed to fully understand the intervention's lasting effects. This follow-up will also support families in maintaining healthy habits beyond the initial 12-week programme. To develop a complete picture of understanding of a family weight management programme, apart from looking at their outcomes, it is also essential to examine and try to understand the perspective of participants receiving the intervention not just to look at their measurement data. As participants would be using BCTs to maintain their behaviour toward a healthy lifestyle beyond the duration of the programme, looking into their viewpoint would help develop and tailor a programme to their needs and their long-term health. This led to the study described in the following chapter, which looked at the perspectives of participants who attended the family weight management programme.

5.5 Chapter conclusion

The family weight management programme benefited children living with overweight or obesity overall in terms of improved median BMI z-score level and WC in a public health setting and this specific delivery used a defined set of BCTs to change their behaviour toward a healthy lifestyle. The findings support the further investigation of the programme which uses a defined set of BCTs categorized by BCTTv1 in a specific real-world public health setting to determine its effectiveness using an RCT study design.

CHAPTER VI

STUDY 4; A QUALITATIVE EXPLORATION OF PARTICIPANTS' PERSPECTIVE OF A FAMILY WEIGHT MANAGEMENT PROGRAMME FOR CHILDREN AGED 5-15 YEARS IN ENGLAND

6.1 Introduction

6.1.1 Background and rationale

In **Chapter III**, qualitative semi-structured interviews with staff who delivered a family weight management programme provided evidence on which BCTs were used in the programme and how they were delivered to families in a real-life setting. While in **Chapter IV**, an observational study design and quantitative analysis of the database showed the effectiveness of the same family weight management programme by improving the overall BMI z-score of children. Weight management programmes comprise two human components, i.e., providers (who provide intervention which includes a process of delivering the intervention) and receivers (who receive the intervention) and both of these can influence the effectiveness of interventions.

A comprehensive framework, referred to as the context, input, process and product (CIPP) model, was considered to evaluate the weight management programme. This model was originally designed to improve teaching and learning in school projects and evaluate programmes, products, personnel, organisations, policies and evaluation systems (Stufflebeam & Coryn, 2014). Although the model was not perfectly designed for evaluating weight management programmes, the good part was that it considered every element from all project perspectives, i.e., context, input, process and product.

The model has been used to evaluate effectiveness in many areas, such as education (Hastuti, Zahro, Untari, Rahman & Tahar, 2021; Salam, 2015; Yasin & Rahman, 2011), the effectiveness of team intervention in health research (Charles & McGuire, 2006; Korner et al., 2016; Koner, 2008), and to develop intervention model in health research (Korner et al., 2015). Therefore, in evaluating the effectiveness of the weight management programme, the CIPP model was used to consider all elements of the programme (**Figure 6.1**).

The studies described in previous chapters have investigated only the components relating to the delivery of the intervention (context/input and process from providers) and measurable outcomes (product or output from receivers) but have not considered the product, which includes the perspective of participants. This perspective is important because it would help understand why participants continue on the programme, and if they withdraw, why that might be. Integrating participants' perspectives in weight management programmes might improve participants' satisfaction, leading to good retention and engagement in the programme.

The study described in this chapter focussed on one aspect of the product from an intervention by exploring the perspective of families who participated in a family weight management programme for children aged 5-15 years living with overweight or obesity.

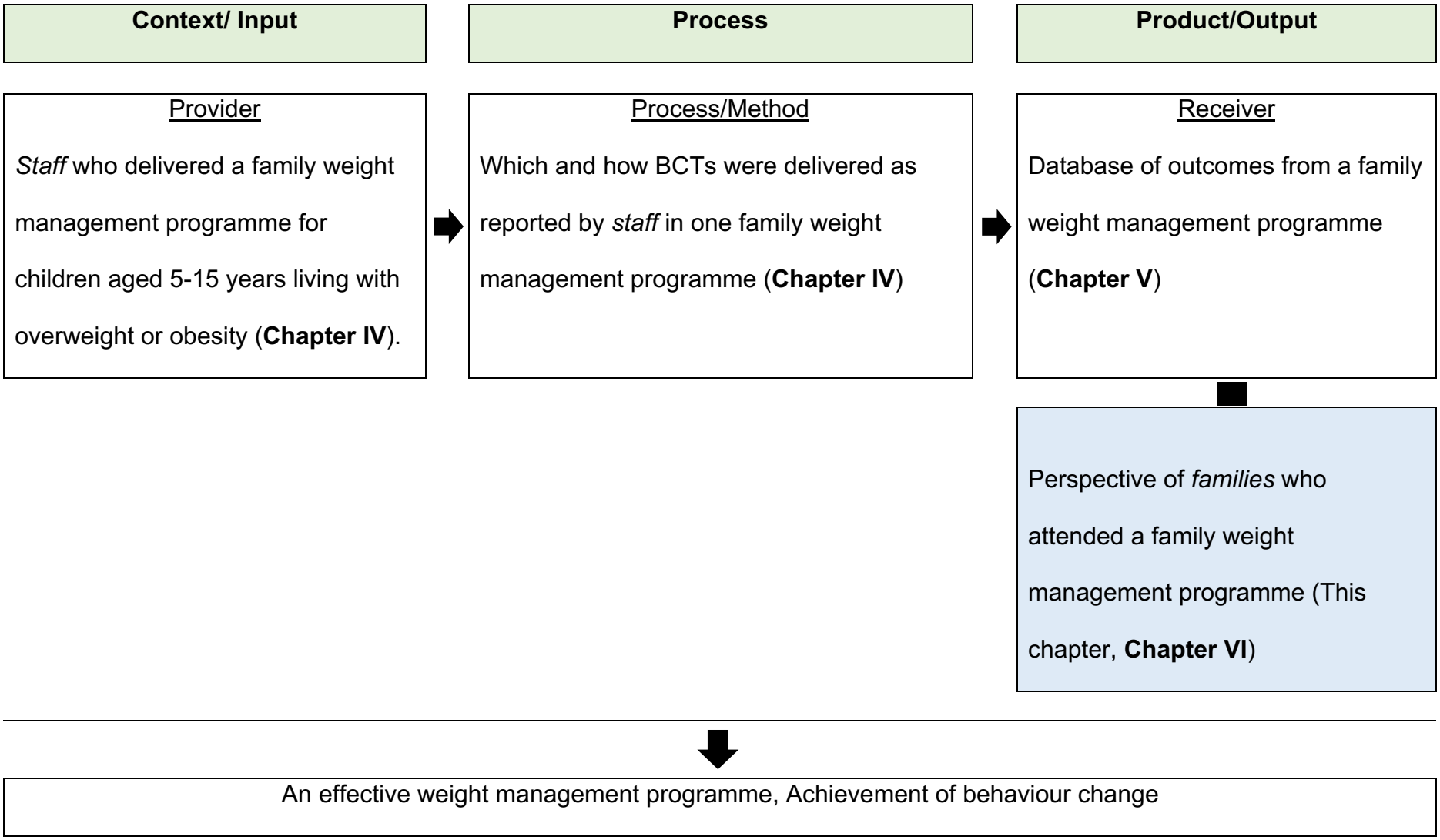


Figure 6.1 The CIPP model developed from Stufflebeam, 1960 (Stufflebeam & Coryn, 2014)

6.1.2 Aim and objectives

This study aimed to explore participants' perspectives on a family weight management programme delivered as a public health intervention in England.

The objectives included:

- To explore which aspects in the programme are helpful in facilitating families to change their behaviour.
- To explore how families benefit from participating in the programme.
- To explore how acceptable and valuable the programme was to families

6.1.3 Research questions

The Emphasis-Purposeful sample-Phenomenon of interest-Context (EPPiC) approach was used to develop the research questions (Moisey et al., 2022) and is shown in **Table 6.1**. This can be summarized as "Which aspects are reported as helpful for changing behaviour by families who attended a family weight management programme for children aged 5-15 years in public health intervention in England in September 2022, and how are they reportedly helpful to change behaviour?". The word "aspects" was used in communication with participants. They were asked about "helpful aspects" and then the "helpful aspects" were analysed and coded for BCTs using BCTTv1 (Michie et al., 2013).

Table 6.1 Research questions following the EPPiC component developed from Moisey et al., 2022

EPPiC component	Research question descriptions
Emphasis	Which aspects are reported as helpful for changing behaviour by families who attended a family weight management programme for children aged 5-15 years
Purposeful sample	Parents/guardians age ≥ 18 years who attended a family weight management programme with their children
Phenomenon of *i*nterest	Helpful aspects to change behaviour; What and how
Context	In a public health intervention in England in September 2022

6.2 Methodology

6.2.1 Study design

A qualitative descriptive approach (Moisey et al., 2022) was used to describe the perspective of families who attended a family weight management programme for children aged 5-15 years living with overweight or obesity.

The Standards for Reporting Qualitative Research (SRQR) (O'Brien et al., 2014) were used to ensure transparency and quality of the report in this study. This SRQR included title and abstract, introduction, methods, context, result/findings, discussion and others (**Appendix 6A, SRQR**).

6.2.2 Research team characteristic

The first researcher (SS) is the PhD candidate. She has successfully completed online training for coding BCTs by using BCTTv1 (Michie et al., 2013; UCL, 2014) and 'How to analyse qualitative data' and "From zero to NVivo 12 qualitative data analysis with NVivo' online from Udemy (Kriukow, 2022a; Kriukow, 2022b).

The second researcher (AM) is a clinical researcher in Nutrition and Dietetics and a UK Registered Dietitian. She has also successfully completed the same online training for coding BCTs by using BCTTv1**.**

The third researcher (RF) is a Senior Lecturer in Nutrition and Dietetics and a UK Registered Dietitian.

6.2.3 Ethical considerations

This study was reviewed and approved by the Health, Science, Engineering and Technology Ethics Committee at the University of Hertfordshire. This was approved on 04/05/2022 with a protocol number LMS/PGR/UH/04853 (**Appendix 6B, Ethical approval**). All participants provided written consent (**Appendix 6C**, Participant information sheet; **Appendix 6D**, Consent form), all names of individuals and organization were anonymized and the ages of children were obscured to prevent families from being identified.

6.2.4 Sampling strategies and recruitment

A convenient sampling approach was used to recruit participants according to their availability. The inclusion criteria were parents or guardians aged ≥18 years who had attended a family weight management programme with their children in England and were willing to participate in the study. The programme is described in detail on **Chapter III, section 3.2.2**. The exclusion criteria were families who attended the family weight management programme for less than 12 weeks. The 12 weeks was used as a criterion because this was the minimum length of the programme. Participants were required to have experienced the whole programme in order to have observed or used all possible BCTs. This was open to all participants who had completed the family weight management programme over the previous two years.

Staff were informed about the study by the researcher. About 40 families who attended the programme between 2020 and 2022 were invited by staff via a closed social media group (WhatsApp, Meta, California, United States of America) or email or face-to-face. They were given an invitation letter briefly about the researcher, her contact details

and information about the interview process (**Appendix 6E, invitation letter**). The letter had a QR code to access the participant information sheet to read and an e-consent form to sign if they were willing to participate. Potential participants had opportunities to ask questions by contacting the programme staff and/or the researcher. Those willing to participate were asked to sign an e-consent form. This e-form was used to give convenience to participants. Recruitment via staff was facilitated to avoid direct contact between potential participants and the researcher before interviews and so to protect their identity and reduce any recruitment bias. After receiving a participant's e-consent, the researcher made an individual interview appointment via phone call and allowed them to ask any further questions they might have.

6.2.5 Data collection

6.2.5.1 Topic guide development

Interview questions were formulated based on the research aim and objectives by the first researcher (SS), reviewed by AM and amended. This included 11 open-ended questions and prompt questions (**Appendix 6F, indicative topic guide**) and the follow up questions that could be asked based on participants' answers. These questions were designed to ensure that the researcher could gain the participants' insight from the interviews.

6.2.5.2 Interview process

Semi-structured interviews were conducted by the first researcher (SS) via Microsoft Teams (Microsoft 365, United Kingdom) or phone according to participants preference. Interviews lasted between 30 to 60 minutes. Data were collected in

September 2022. Interviews were audio recorded using two digital recorders (Sony ICD-PX470, Tokyo) using one as a backup in case of equipment failure; the topic guide described above was used during the interviews (**Appendix 6D).**

6.2.6 Data analysis

The anonymous recordings were identified using study numbers by the researcher and sent via a secure upload to a professional transcription service (The Typing Works, London). After the anonymous transcripts were returned, they were uploaded to Nvivo 12, a computer software programme for qualitative data analysis (QSR international, Denver). The transcripts were checked for accuracy by the researcher by listening to the recordings at the same time as reading the transcripts.

Inductive thematic analysis was used to code the raw dataset (Braun and Clarke, 2012; Braun and Clarke, 2022). Themes were then defined based on the positive aspects of the programme (i.e., an asset-based approach), and sub-themes generated using the coded data. To analyse how the identified elements of the programme related to the pre-defined BCTs, the sub-themes were subsequently mapped to the BCT framework. This systematic process consisting of six key steps is described in further detail below i.e., familiarisation, coding, generation of themes, generation of sub-themes, mapping sub-themes to BCTs, and data visualization.

Step 1 – Familiarisation: this was achieved by listening and re-listening to the recordings and reading and re-reading the transcripts.

Step 2 – Coding: inductive line-by-line- coding (i.e., labeling of the complete text) was used to initiate codes in the NVivo software until both interviews had been entirely coded. Similar codes were then combined by the researcher in the NVivo to refine the codebook.

Step 3 – Generation of themes: themes were generated based on the focus of research questions (i.e., positive aspects and strengths of the programme. This asset-based approach was used to best reflect the programme itself which focused on a positive approach towards making healthy lifestyle changes. This analysis was determined by the codes generated in step 2, however was deductive as it was led by the research questions.

Step 4 – Generation of sub-themes: inductive analysis was used to generate sub-themes by searching for patterns from the codes across both interviews, within the deductively created framework generated in step 3.

Step 5 - Mapping sub-themes to BCTs: each sub-theme was carefully considered by the researcher and mapped to BCTs. This process was deductive and utilised prior knowledge of the activities in the programme sessions (from the family interviews and/or staff interviews) to ensure appropriate mapping.

Step 6: Data visualization: themes, sub-themes and mapped BCTs were presented in a framework.

6.3 Results

Forty families were invited to participate and two families participated in the interviews. The first participant was a mother from a family of four. All her family members attended the programme, i.e., herself (mother), her husband, her daughter and her son (both aged between 6-11 years). She participated in the programme because she wanted her children to learn about nutrition and hoped to enable her children to make healthier decisions about their lives. The second participant was a mother from a family of three. All three family members attended the programme, i.e., herself (mother), her husband, and her son (aged between 6-11 years). She reported participating in the programme because she and her son were overweight.

Two themes were identified from exploring families' perspectives who attended the family weight management programme (**Figure 6.2**). The first theme was *Helpful aspects*, which included six sub-themes, i.e., learning to read food labels, trying recipes, learning about takeaways, learning about portion sizes, sharing tips, and knowing exercise is good. The second theme was *Families' benefit from the programme*, which included two sub-themes, i.e., making better choices and becoming more active. In addition, acceptability and value of the programme were also explored. However, responses were not sufficiently detailed to allow detailed exploration.

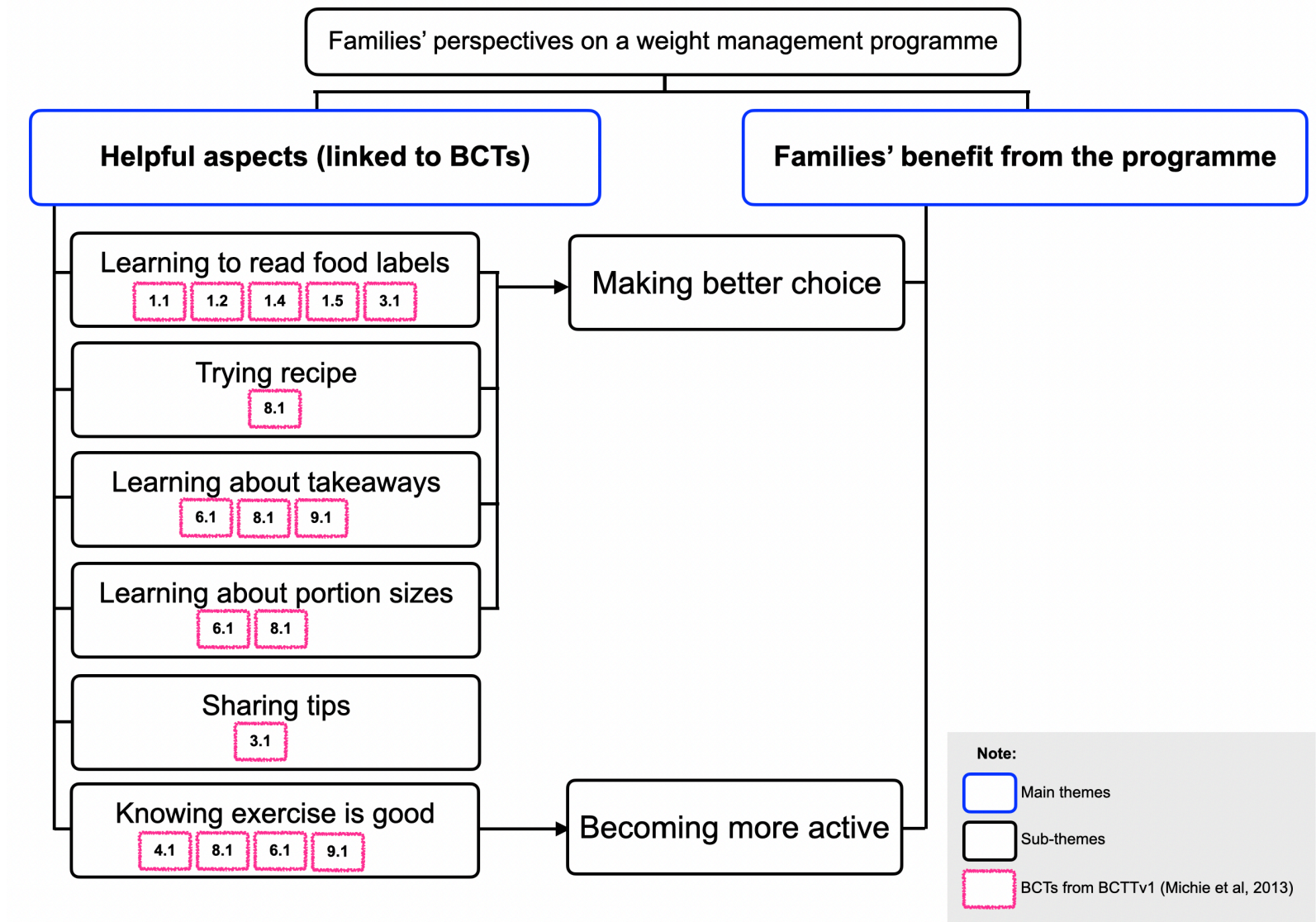


Figure 6.2 The thematic map showing two families' perspectives on a weight management programme

6.3.1 Helpful aspects

6.3.1.1 Learning to read food labels

One mother explained that "reading food labelling" was helpful in helping her children to change their behaviour.

*"I think what helped them the most was **to learn to look at food labelling** and to know that exercise is really good for you. So those are the things that went very well." (FP01).*

Reading food labels was one of her family ‘experiments’ where they agreed to read food labels when shopping (‘experiments’ were challenges or goals set by the families for themselves). She explained that knowing how to read food labels helped her family to reduce the sugar content of their breakfast cereal. However, that was not the only reason that helped them to change; the other was that her son had a problem with his teeth which made him scared of losing them as well as professional advice about reducing sugar and brushing his teeth. These also motivated them to change their behaviour.

There were many experiments they did while attending the programme. Apart from reading food labels, others included agreeing to make pancakes for breakfast and try new snacks. All three experiments went very well but the only one they continued to do was reading food labels. The other two, she said, were hard to maintain. This may be because making pancakes is easy, but it involves preparing and cleaning process which took time.

As these were their experiments and all went very well while attending the programme, an experiment sheet was used in this process. The experiment sheet included many questions to guide the family in setting their experiment, covering many different BCTs. The main BCTs were *goal setting (behaviour) [1.1], problem-solving [1.2], action planning [1.4], social support [3.1], and review behaviour goal(s) [1.5]*. The experiments might also include other BCTs, which depended on the type of experiment as different families had different experiments based on what they wanted to change.

6.3.1.2 Trying recipes

One mother explained that trying recipes was useful for her family.

"We liked having the folder to bring home because then we tried out some of the recipes, so that was useful." (F02)

This indicates that she had practiced making some food from a recipe she was given from the programme in order to increase cooking skills. This can be considered as *behavioural practice/rehearsal [8.1].*

6.3.1.3 Learning about takeaways

One mother explained that learning about the nutritional content of takeaway food was helpful. The session about takeaways was one of the nutrition classes where a nutritionist talked about takeaway food and eating out and showed families examples of takeaway food. Then families did an activity around takeaways by choosing which was more nutritious than others. This can be considered *demonstration of behaviour*

[6.1], *behavioural practice/rehearsal [8.1]* and *credible source [9.1]* because the nutritionist demonstrated food for families to make a better choice toward healthy eating and families practiced by choosing the takeaway foods.

"Yeah, and get whether it's Indian curry or Kentucky Fried Chicken, or Subway, whatever it was, where the three of us think something like chicken would be healthy, but Kentucky Fried Chicken is obviously fried so it's not so healthy, so something like a Chinese came out healthier because you've got the vegetables and, but it's all through practical activities which was really helpful" (F02)

6.3.1.4 Learning about portion sizes

One mother explained that learning about portion size was helpful for her family. The session about portion sizes was one of the nutrition classes where a nutritionist talked about portion size and showed families examples of recommended portion size based on their ages. Then families did an activity around portion size by weighing their food and comparing it with a portion size guideline. This can be considered a *demonstration of behaviour [6.1]* as the nutritionist showed them the portion sizes and *behaviour practice/rehearsal [8.1]* as families weighed their food to see their portion size in order for them to understand how it compared to the recommended portion size.

"we did portion sizes as well, for us and for the children, how much should they be having of, you know, of rice or of raisins or of whatever it was, just seeing it visually that was another good session that stuck in my mind" (F02)

6.3.1.5 Sharing tips

One mother explained that sharing tips in the closed social media group and in the parents' class were helpful for her family. The closed social media group was set up by staff for communicating between staff and all families who attended the programme. All families were able to share their experiments and useful tips to help others or encourage each other to change their behaviour and ask questions they might have. This can be considered as *social support (unspecified) [3.1]* as families had support from staff and other families to enable them to change toward a healthy lifestyle, which was a goal of the programme. They normally shared tips via the closed social media group:

"they set up a WhatsApp group for us as well that the other parents, we could all talk to each other, that worked really well. Yeah, so for example someone would take a photograph of a food packet of something they'd found was good and somebody else would say that this is better, and sort of share tips." (F02)

Apart from the closed social media group, parent also shared their experiences about problems or challenges they had in terms of changing their family's behaviour in parent classes, a session that parents attended while their children attended cooking classes with a nutritionist:

"It was a time to reflect, and to think about what we were doing, and how it wasn't working that things needed to change, and to be able to share that with other parents, because there's a lot of guilt with it, and realising that actually we're not doing a bad

job, it just needs a little bit of change, it's not all wrong, so that was quite nice from a sort of self-esteem boost for me, and just but sharing tips of I don't know, being able to plan your meals before you go and do the food shopping, all those reminders, things that you know you should be doing anyway but you don't always do." (F02)

When the researcher asked the participant whether the parent class was helpful for her family, she replied *"Really good, yeah" (F02).*

6.3.1.6 Knowing exercise is good

One mother explained that knowing about exercise was good to help her family in changing behaviour.

*"I think what helped them the most was to learn to look at food labelling and **to know that exercise is really good for you.** So those are the things that went very well." (F01)*

"The biggest take away [message] my children had was obviously the exercise." (F01)

Knowing that exercise was good was helpful for the family and their children also enjoyed the physical activity classes.

*"One of the other things that the children took away was **how much they enjoyed**, you know, **the activities and exercise** with their dad." (F01)*

The physical activity class, where a sports coach came in and explained and showed families how to do activities, was followed by them doing the activity together. These include at least four BCTs which are *instruction on how to perform behaviour [4.1], demonstration of the behaviour [6.1], behavioural practice/rehearsal [8.1] and credible source [9.1].*

As described above from the six sub-themes, nine different BCTs were identified as helpful to help families change their behaviour. These BCTs included *goal setting (behaviour) [1.1], problem-solving [1.2], action planning [1.4], review behaviour goal(s) [1.5], social support [3.1], instruction on how to perform behaviour [4.1], demonstration of the behaviour [6.1], behavioural practice/rehearsal [8.1] and credible source [9.1].*

6.3.2 Families' benefit from participating in the programme

6.3.2.1 Making better food choices when shopping

One mother explained that they made better food choices when shopping for drinks and breakfast cereals because they had learnt how to read food labels which was the most significant change.

"I think the main thing that's changed is obviously reading the food packaging labels when we do buy something processed, that's the biggest change." (F01)

"so I've been using that to try and encourage healthy choices and when it comes to, sort of, drinks, I've been able to sort of like swap things to diet and so on." (F01)

The other mother also explained that they have changed their choice of food.

“I am more conscious when I go and do the food shopping…. and looking at food labels and just having desert as a treat, whereas we were having desert every night, whereas now it’s a once a week treat, and if we have a desert, it’s something like a yogurt rather than an ice cream, or something, low fat yogurt, yeah." (F02)

6.3.2.2 Becoming more active

Both mothers explained that they have become more physically active. After finishing the programme, one mother specifically looked for activities for her children and found a swimming club that suited her family and was affordable.

“Getting some exercise and doing something with themselves, that has been quite a big, sort of, you know, exercise is healthy for you and so they actually look for opportunities to go out and about now. They’ve spent the entire summer holidays going on their bikes, which has been amazing actually.” (F01)

"So we’ve started swimming every Saturday as a family together." (F01)

"We’ve spent more time either going for walks, going on the bike, going swimming, more time together as a family, more time being active.” (F02)

6.4 Discussion

This qualitative research explored the perspective of families who attended one family weight management programme in England through semi-structured interviews in which BCTs were reported as being helpful to change their family's behaviour, and how those were helpful.

6.4.1 Which BCTs are helpful in changing their family behaviour?

The participants did not directly report the BCTs as being helpful in changing behaviour. Instead, the authors identified the BCTs in the interview transcripts and linked them to the reported behaviour change. To explore this association further, it would have been valuable for the interviewer to ask more probing questions about which specific elements helped change family behaviour. This limitation is discussed in "**6.5 the strengths and limitations of the study**" section. Knowing which BCTs are considered helpful by the participants might help intervention designers and researcher to tailor specific BCTs to participants' preferences, as suggested by NICE (2022) which stated that interventions should be tailored to the preference and needs of families and children.

From nutrition classes, participants reported that learning to read food labels, takeaway foods, and portion sizes through practical activities were helpful. This finding showed that staff had given families knowledge that could increase their psychological capability and that practising through activities could increase physical ability and physical opportunities (Jatau et al., 2019; Michie, Atkins and West, 2014). These

capabilities and opportunities could lead to increased motivation, leading to a change in their behaviour, as explained in the COM-B model (Michie et al., 2014). A cross-sectional survey in 1,037 adults aged 18-35 years of eating and physical activity behaviour found that capability and opportunity were significantly positively associated with behaviour through a mediating effect of motivation, e.g., social support (opportunity) is an indicator to motivate a person to be active (Willmott, Pang & Thiele, 2021).

From mapping *Helpful aspects* to BCTs, nine out of twenty-four BCTs which were reported by staff (chapter III) were also found helpful for families and these included two groups of BCTs which are most often used together, i.e. *goal setting (behaviour) [1.1]+* and *instruction on how to perform behaviour [4.1]+* and one single BCT which are most frequently used in the programme i.e., *credible source [9.1].* The possible explanation for this might be because these BCTs were used often in the programme. These the two groups of BCTs and the one single BCTs were used nine times in the programme (**Chapter IV, section 4.3.1**).

6.4.2 How did families benefit from participating in the programme?

Both families found that they made better choices when shopping and became more physically active as a consequence of participating in the programme. A possible explanation for this result might be that the programme was activity- or game-based. For example, nutrition classes demonstrated a variety of food and allowed families to practice, such as in the supermarket class, where staff and families visited a supermarket where families could visualise and practice making healthier choices than their usual food intake. This finding was also reported in a qualitative study which

interviewed 18 adults living with overweight or obesity who received a one-to-one weight loss intervention focusing on behaviour change as part an RCT study and found that visual materials, e.g., portion size, were helpful to adults who received the interventions (Holdsworth, Thorogood, Sorhaindo & Nanchahal, 2017). Another was a study in students comparing active learning classes and lectures, which found that students learn more when studying in an active class than when sitting listening in a lecture (Deslauriers, McCarty, Miller, Callaghan & Kestin, 2019). Dale's cone of experience states that if people learn by doing it, this increases the effectiveness of the learning (stated in Lee & Reeves, 2007).

Families provided positive feedback on their reception of the programme, expressing high appreciation for it. They exhibited confidence in the programme and were willing to endorse it to others. Specifically, they highlighted the following three aspects as sources of satisfaction.

Firstly, the nutritionists were qualified and knowledgeable. This finding showed that staff specialising in the area were important to the two families. This finding was consistent with a qualitative study in 16 adults with experience in attending weight management from general practice in rural areas which found that delivery by a qualified and competent person was a significant desire for them in weight management programme (Norman, Burrows, Chepulis, Keenan & Lawrenson, 2023).

Secondly, nutritionists were supportive, friendly and welcoming. This finding was also reported in a systematic review of thirty-three qualitative studies in adults living with severe obesity which found that adults appreciated positive, friendly staff (Skea,

Martins, Robertson, De Bruin & Avenell, 2019). Another study which interviewed 18 adults living with overweight or obesity who received one-to-one weight loss intervention focusing on behaviour change found that supportive and empathic staff was the most important factor required for the adults to engage with the intervention (Holdsworth et al., 2017).

Thirdly, the way of delivering the programme was non-judgmental and fun. This finding is consistent with a systematic review of thirty-three qualitative studies in adults living with severe obesity. They found that adults value a non-judgmental approach in the weight management programme (Skea et al., 2019).

In order to conduct a more in-depth exploration, a more comprehensive sample for detailed analysis is required.

6.4.3 Strengths and limitations

The strength of this study included exploring the perspective of two families who used BCTs in a 'real-life' setting following their participation in a family weight management programme. This study is contributing to triangulation with other studies in this thesis. Methodological triangulation is the combining of different research methods investigation the same focus of interest, i.e., qualitative and quantitative (Cohen, Manion & Morrison, 2017; Patton, 2015). Collecting data from different groups of people i.e., staff delivering an intervention and participating families who receive the intervention could also be considered as data triangulation (Carter, Lukosius, DiCenso, Blythe & Neville, 2014; Noble & Heale, 2019). It also means using multiple data sources i.e., describing of the weight management programme from the staff

interviews, the BCTs used in the programme and trying to ascertain what was the strength of the programme. Triangulation is an effective strategy to increase the validity of an investigation (Patton, 2015). Moreover, this thesis employed a mixed method approach to expand the scope of the research (Rocco, Bliss, Gallagher & Prado, 2003), using qualitative research to explore which and how BCTs were used in the programme and those that were helpful and beneficial to participating families and using quantitative research to examine the programme's effectiveness by looking at participants' anthropometric outcomes.

This study has limitations. Firstly, it includes a very small number of participants. Secondly, it would have been useful to have included additional follow-up questions to probe about the role of BCTs. Thirdly, the researcher (SS) was not a native English speaker. Finally, there is a possibility in recruitment bias. The details of each limitation are explained below:

Firstly, the difficulty in recruiting participants in the interviews resulting in only two mothers consenting to take part. There are many reasons that may have contributed to this, including the time of recruiting, which was during the school summer closure and many families were on holiday. The two participants agreed to participate after a face-to-face invitation from the programme staff during a 6-month follow-up session of the programme. This response was better than invitations sent via messages and might be because communicating face-to-face was easier and prospective participants could ask questions and gain trust (Auster & Janda, 2009; Gilliss et al., 2001; Wambua, Vang, Audi, Linzer & Eton, 2022). A face-to-face invitation might be a suitable way to recruit participants in this context (Auster & Janda, 2009). As a result

of the very small number of participants, data from this study did not reach saturation which is used to describe study findings when no new themes are identified from additional interview. Guest, Bunce and Johnson (2006), observed that saturation was reached after twelve interviews but there is no defined number of interviews that are required with observable saturation varying between investigations and a systematic review of empirical tests reported that saturation was reached within nine to seventeen interviews (Hennink & Kaiser, 2022). This shows that using sample size as a criterion for data saturation is quite varied. Indeed, some researchers believe that there is always uncertainty that saturation is reached because sampling in qualitative research is not designed to be representative of a given population (Braun & Clarke, 2021). Therefore, the findings from this study cannot be extrapolated to a wider population of families participating in weight management programmes for children.

Secondly, direct follow-up questions about the BCTs in the interviews could have helped gain a better understanding of which and how BCTs were helpful for the families to change their behaviour. For example, when one participant mentioned food labels (as this was one of their experiments), the author could had asked whether the tool they used, which was an "experiment sheet", was helpful to encourage/help them change their behaviour. It is quite hard to explore this as different families have different experiments, but the author could have asked about *Goal setting behaviour [1.1]* and *Review behaviour goal [1.5].* If there had been more participants, it would have been possible to identify this gap and develop the topic guide during the data collection period so that later interviews included additional questions. Iterative development of a topic guide throughout the study would help to address this issue in future studies (stated in Busetto, Wick & Gumbinger, 2020; Galleta & Cross, 2013).

Examples of possible follow up questions could be: could you please tell me about the experiment sheet?, do you think by writing down your experiment and planning how to do it helpful or unhelpful in changing your family behaviour? These follow-up questions need to be adequately explored in the interviews. It is not sufficient to go into depth on the analysis side, and the future work should try to include more families.

Thirdly**,** it is also possible that some linguistic nuances may have been lost as a result of the researcher conducting interviews and analyzing transcriptions in English, which was not her native language (Espinosa et al., 2022; Smith, Chen & Liu, 2008). In addition, previous experience and preconceived idea of the researcher are also potential limitations. During the interviews, the researcher kept field notes and a reflective diary in an effort to identify and minimize researcher bias (Braun & Clarke, 2022; Phillipi & Lauderdale, 2018; Treharne & Riggs, 2015), however, this is also one of the potential limitations.

Fourthly, it is also possible for recruitment bias because participants seemed optimistic about support from staff and non-judgmental approaches. Only those who were optimistic about the programme completed the programme and were eligible to participate, so there is likely to be a bias in recruitment (Bhandari, 2023). The two families were recruited from participants attending a 6-month follow-up, which showed that they engaged well with the programme, as staff reported that only a few families usually come to a 6-month follow-up session.

6.4.4 Implication of the findings

This research found that practical learning in nutrition classes was helpful for parents trying to change their family's behaviour. Interventions which included knowledgeable, supportive, friendly, welcoming staff and used non-judgmental approaches were acceptable and valuable for the families. These findings suggested that intervention for children living with overweight or obesity should include practical learning, and the providers should have aspects as explained above. These aspects might be used to help keep participants continuing in the programme and increase the effectiveness of future programme.

6.5 Chapter conclusion

This study explored the perspective of two families who attended one family weight management programme. Overall, their responses show that the programme was acceptable and valuable to them in practical ways that they were able to use with their families. These included increasing awareness of healthier foods while shopping, cooking and serving appropriate food portions and becoming more physically active in a supportive and non-judgmental setting. However, due to the small number of participants and lack of data saturation, it was not possible to extrapolate to a conclusion about which BCTs or how they were used were helpful for families.

CHAPTER VII

THESIS DISCUSSION

In this chapter, the findings from all four studies will be drawn together. Firstly, to summarise the thesis overview and reiterate the aim of the overall thesis, then to bring together the main findings and discuss the relationships between the four studies, to discuss the implication of the overall thesis, and finally to suggest future research.

7.1 Thesis overview

This thesis started with a systematic review of BCTs used in children aged 5-15 years living with overweight and obesity which provides evidence of BCTs used and interventions' effectiveness in research settings. This was to establish the existing published evidence in this area. The most commonly used BCTs were identified from the four included studies. However, all four studies were identified as having some concerns or a high risk of bias. In addition, no information was extracted on how specific BCTs were used. Due to the limitations of the evidence identified in the research studies included in the systematic review, qualitative interviews with ten staff who delivered a family weight management programme in a real-life setting were conducted to address the gaps and extend the knowledge. These interviews provided evidence of BCTs used in one real-life setting and how BCTs were delivered (discussed below in section **7.2.2**). Then, data collected routinely by staff working on the family weight management programme were processed and analysed to investigate the programme's effectiveness. Finally, two families' perspectives of participating in the weight management programme were explored.

A mixed method approach was used to meet the thesis' aim of identifying the use of BCTs and interventions' effectiveness for children aged 5-15 years living with overweight or obesity in published studies and one real-life setting using the Behaviour Change Techniques Taxonomy version 1 (BCTTv1).

7.2 Main findings

7.2.1 Most frequently used and most effective BCTs in research settings

The systematic review found that 28 BCTs were identified across four RCTs, ranging from 12 to 19 BCTs per study (**See 3.3.3, Table 3.2**). The most commonly used in the four studies were *goal setting (behaviour) [1.1], problem-solving [1.2], self-monitoring of behaviour [2.3], social support (unspecified) [3.1],* and *demonstration of behaviour [6.1]* (**Table 3.2).** This finding showed which BCTs were used in a specific population of children 5-15 years living with overweight or obesity. The strength of this study is that it was undertaken using a stringent systematic process. However, the findings are limited as only four RCTs met the inclusion criteria, all four studies were identified as being some concerns and a high risk of bias (Sterne et al., 2019) and the quality of evidence was very low (Schunemann et al., 2013).

7.2.2 BCTs used in one real life setting and how they were delivered

In the qualitative interviews with ten individual members of staff who delivered a family-based weight management programme from one public health intervention, a total of 24 different BCTs were identified, and twelve BCTs were reportedly used in most sessions. (**See 4.3.1**). Of the twelve BCTs, two groups of BCTs were often used together (**Figure 4.2**). The first group included *goal setting (behaviour) [1.1]* plus with

others, i.e., *problem-solving [1.2], action planning [1.4], review behaviour goal(s) [1.5], social support (unspecified) [3.1]* and *social support (practical) [3.2]*. The second group included *instruction on how to perform behaviour [4.1]* plus with others, i.e., *demonstration of behaviour [6.1] and behavioural practice/rehearsal [8.1]*. Other three BCTs were used individually, i.e., *credible source [9.1], social reward [10.4]* and *material reward [10.2]*.

This is an important finding that showed in details *how* the BCTs were delivered in the programme, i.e., the context, combinations of BCTs and repetition. There is little published evidence about combining of BCTs in practice or research but this is logical for delivering an intervention based on behaviour change. These BCTs were delivered face-to-face by UK-registered nutritionists and sports coaches to children aged 5-15 years and their families in community-based public health. This finding is helpful because it provides practitioners, intervention designers, and researchers with evidence that can be used in designing, implementing and replicating interventions. The application of this finding requires adequate reporting of BCTs, i.e., which and how BCTs were delivered, delivered to whom (i.e., children aged 5-15 years living with overweight or obesity and their families) and by whom (UK-registered nutritionists and sports coaches), in which means (face-to-face) (Armitage et al., 2020; Noris et al., 2020, Michie et al., 2017). Using a qualitative approach allowed the information to be collected from participants whilst methodology descriptions of interventions in published RCTs is usually limited to a list of BCTs or brief description of activities from which BCTs can be identified.

7.2.3 Comparison BCTs in research settings with BCTs in one real-life setting

The number of BCTs used in the “real-life” setting, 24, was higher than the number of BCTs typically used in the "research" setting, 12-19 per study. One possible explanation might be because the qualitative interview gave more insight into the programme, giving a clear picture of the programme information and allowing the researcher to ask probing follow up questions that allowed identification of more BCTs. However, a systematic review of RCT and control trials of behaviour change interventions targeting dietary, sedentary behaviour and physical activity in healthy children aged 9 -12 years which used the BCTTv1 found that the number of BCTs were not related to intervention's effectiveness (Anselma, Chinapaw, Kornet-van der Aa and Altenberg, 2020). This was also reported in systematic reviews in adults (Ashton et al., 2020; Flannery et al., 2019; Whatnall et al., 2021).

Similarity in BCTs used in RCTs and real-life setting

In this thesis, the five most commonly used BCTs in the research setting were also identified in the real-life setting. The total number of BCTs similarities between the research and real-life settings was 18. This result shows some overlap between BCTs used in research and real-life settings. Most of the BCTs were from BCTTv1 group 1, goal and planning, which included five out of a maximum of nine BCTs (Michie et al., 2013). The reason for this may be that setting goals and planning how the goals will be met may be considered ‘easier’ or more tangible than other BCTs and more positive, i.e., looking towards achievement than BCTs involving monitoring which may feel potentially threatening in some situations.

Differences in BCTs used in RCTs and real-life setting

Although there was some overlap between the BCTs used in the two settings, ten BCTs were used only in RCTs, and six were used only in the real-life setting. It is interesting to note that five out of the ten BCTs used in research setting were more focused on outcomes and these BCTs were not identified in the real-life setting. Indeed, participants in the qualitative interviews stated explicitly that measurable outcomes, e.g., body mass index and weight, were not a focus of their programme. The possible explanation for this might be that is easier to measure outcomes i.e., weight and height (to calculate BMI), than to measure behaviour which might have to rely on subjective measurement e.g., self-reporting, diaries or direct observation. Objectively measured outcomes are also more valid and reliable (NIHR, n.d.; Mobbs, 2021). This difference in focus is important because measurements of the outcomes of behaviour are often used to assess the effectiveness of an intervention but if these are used less in real life, then assessing the effectiveness of interventions in practice may require other metrics which should also be reliable and robust.

7.2.4 Effectiveness of family weight management programme interventions

The systematic review of RCTs reported in this thesis (**See 3.3.4**) found that the interventions led to significant improvements in BMI z-score and waist circumference among children living with overweight or obesity. Furthermore, an analysis of a "real-life" setting of a weight management programme for children living with overweight or obesity (**See 5.3.2**) also showed a significant improvement in participants' overall BMI z-score after the intervention finished. The systematic review and the "real-life" database analysis demonstrated that the interventions were associated with improved

overall BMI z-score in children living with overweight or obesity. However, the data extracted from the included studies did not allow the effectiveness of individual BCTs to be evaluated, and further investigation is needed to determine the most effective combination of BCTs.

Apart from using BCTs in the interventions, four other factors might contribute to the programme's effectiveness in this study.

First, the rapport between staff and families. Based on a scoping review, "rapport" was defined in the context of a relationship, a concept, and a set of indicators (English, Gott & Robinson, 2022). In the real-life weight management programme, "rapport" is a relationship that the programme staff try to develop to understand and sympathise with the families' issues and to make them feel comfortable when attending group classes. During an initial appointment where each individual family met with a nutritionist, the nutritionist used this opportunity to learn about the family, find out what they wanted to change and to build rapport with them. This is because building the relationship between provider and receiver would help to increase their trust (Price, 2017). A qualitative study which interviewed 18 adults living with overweight or obesity who received one-to-one weight loss intervention focusing on behaviour change found that one of the most significant aspects of the programme was the relationship participants formed with the providers (Holdsworth, Thorogood, Sorhaindo and Nanchahal, 2017). Another study which re-analysed a systematic review considered the ten most and ten least effective weight management interventions reported that the opportunity to establish the providers' supportive relationship was one of the

aspects of effective weight management interventions (Torres, Sutcliffe, Burchett, Rees, Richardson & Thomas, 2017).

Second, the rapport between participating families. During the Introduction week, staff helped families connect with each other. This is because having relationships with others might motivate them to support and encourage each other, share ideas and solutions, enjoy the programme and help them to make positive changes to their health behaviours. Developing peer-supportive relationships is one of the aspects of effective weight management programmes (Torres et al., 2017).

Third, the programme used a combination of group and individual approaches. The intervention was delivered to participants as a group, but the goal setting (behaviour) was tailored to each individual family with individual families setting their goals with help and encouragement from the programme staff. In terms of group intervention, there is evidence from a systematic review and meta-analysis of RCTs in 2576 adults living with overweight or obesity that group interventions are more effective than individual interventions (Abbott, Smith, Tighe & Lycett, 2020). Comparable findings were reported in a systematic review of ten RCTs in 3124 adults living with overweight or obesity which found that overall groups were more effective than individual interventions (Street & Avenell, 2022). In terms of tailoring the goal to individual families, this might be effective because the goals that were set were directed to behaviours that participants wanted to change, not what staff wanted them to change. An RCT study which illustrated this was a study in 459 young adults living with overweight and obesity which found that participants in a group with a tailored intervention lost more weight than those in a general group which received an intervention which was not tailored in a control group (Napolitano et al., 2021). In terms

of support from the programme staff, the families received support from the staff to help them set and plan their goals. There is evidence from a systematic review of eleven qualitative analyses of weight management programmes for children reported that facilitating social support for family was one of the aspects of effective interventions (Burchett, Sutcliffe, Torres, Rees & Thomas, 2017). The support from staff also motivated participants to change behaviour as based on the theory of planned behaviour, in order to form strong intentions which will drive a person to engage more in a particular behaviour when support is given by significant others, a person is more likely to engage in behaviour (Madden, Ellen and Ajzen, 1992).

Fourth, although the programme was delivered to the whole group, individual families were followed up at midway and final reviews where they could share their issues privately with staff. This individual follow-up is important because some people might not be comfortable and would feel shy about sharing their issues publicly, especially around sensitive issues like obesity. There is concern about weight stigma and the negative effects on mental health especially in children living with overweight or obesity (Puhl & Lessard, 2020).

7.3 Implications for practice and future research

There were two main implications from the studies described in this thesis.

Firstly, this thesis reported in detail *how* BCTs were delivered in one family weight management programme in England, and specifically how two sets of the most frequently used BCTs (the frequency of session where the BCTs were used) were often used together. These results have the potential to help practitioners, researchers and intervention designers to develop and deliver effective interventions in different

locations and settings to test the effectiveness of BCTs. Future research should consider other elements of how BCTs were delivered. These might include frequency of delivery (repetition in the same or different ways), using different approaches to deliver the same BCTs (e.g., text message, mobile applications, face-to-face, individual, group), grading delivery (i.e., starting with BCTs perceived as easier to follow before introducing others that are more challenging) and using consistent approaches to reinforce. It might be useful to also use standardized documentation to describe each technique such as how many goals are set, what are the goals and how long it takes to change.

Secondly**,** the interventions containing a combination of various BCTs in both the research settings and in one ‘real-life’ setting were associated with improved overall BMI z-score of children aged 5-15 years living with overweight and obesity. These findings suggest that combinations of BCTs should be used in interventions in children living with overweight or obesity. Further research is required to identify which individual BCTs are the most and least effective.

Even though this thesis had identified BCTs used in a 'real-life' setting, which were associated with overall improving BMI z-score and considered satisfactory to the two families interviewed, it is only from one public health intervention and was undertaken using an observational design. There are few published studies about the effectiveness of individual BCTs or a combination of BCTs in ‘research’ and ‘real-life’ settings in children living with overweight or obesity and the number and quality of the studies limits the certainty of the evidence available. Therefore, further studies in similar and in other settings (e.g., communities, schools, hospitals, clinics) and locations (e.g., different countries, rural, urban) and with families from different socio-

economic and cultural backgrounds are needed to test acceptability and effectiveness and to better understand BCTs used in children living with overweight or obesity. In addition, investigating differences between individual families is needed to explore whether the same patterns of BCTs are useful for all or whether some individuals respond better to particular BCTs but not to others.

7.4 Thesis conclusion

The five most frequently used BCTs were *goal setting (behaviour), problem-solving, self-monitoring of behaviour, social support (unspecified) and demonstration of the behaviour* in 'research' settings. While in a 'real-life' setting, two groups of BCTs, *goal setting (behaviour)* and *instructions on how to perform a behaviour*, were often used together. The five most commonly used BCTs in the 'research' settings were also used in the two groups of BCTs in the 'real-life' setting. There were similarities and differences between BCTs used in the 'research' and 'real-life' settings. However, the 'real-life' setting investigated in the studies described in this thesis focused more on BCT relating to the behaviour itself and less on those relating to the outcomes of the behaviour than those BCTs used more frequently in 'research' settings. Interventions containing various BCTs in combination helped improve overall BMI z-score in both the 'research' and 'real-life' settings. However, more research is needed to confirm which combination of BCTs is most effective in helping children living with overweight or obesity to change their behaviour toward a healthy lifestyle.

7.5 PhD dissemination

Oral presentation

Satoh, S., Fallaize, R. & Madden, A.M. (2022). Differences in behaviour change techniques used in the 'real-world' and in randomized control trial interventions for children aged 5-15 years living with overweight and obese. *BDA Research Symposium Abstract Booklet*, pp.51.

Satoh, S., Fallaize, R. & Madden, A. (2021). A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years. *BDA Research Symposium Abstract Booklet*, pp.48.

Satoh, S., Madden, A.M. & Fallaize, R. (2021). A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years. *LMS Research Conference Book of Abstract*, pp.45.

Poster presentation

Satoh, S., Fallaize, R. & Madden, A.M. (2022). Differences in behaviour change techniques used in the 'real-world' and in randomized control trial interventions for overweight and obese children aged 5-15 years. *LMS Research Conference Book of Abstract*, pp.68.

REFERENCES

Abraham, C., & Michie, S. (2008). A taxonomy of behavior change techniques used in interventions. Health psychology. 27(3), 379–387. https://doi.org/10.1037/0278-6133.27.3.379

Abbott, S., Smith, E., Tighe, B., & Lycett, D. (2021). Group versus one-to-one multi-component lifestyle interventions for weight management: a systematic review and meta-analysis of randomised controlled trials. Journal of Human Nutrition and Dietetics, 34(3), 485–493. https://doi.org/10.1111/jhn.12853

Afzaal, M., Saeed, F., Shah, Y. A., Hussain, M., Rabail, R., Socol, C. T., Hassoun, A., Pateiro, M., Lorenzo, J. M., Rusu, A. V., & Aadil, R. M. (2022). Human gut microbiota in health and disease: Unveiling the relationship. Frontiers in microbiology, 13, 999001. https://doi.org/10.3389/fmicb.2022.999001

Aggarwal, N., Kitano, S., Puah, G. R. Y., Kittelmann, S., Hwang, I. Y., & Chang, M. W. (2023). Microbiome and Human Health: Current Understanding, Engineering, and Enabling Technologies. Chemical reviews, 123(1), 31–72. https://doi.org/10.1021/acs.chemrev.2c00431

Ahmad, N., Shariff, Z.M., Mukhtar, F., & Lye, M.S. (2018). Family-based intervention using face-to-face sessions and social media to improve Malay primary school children's adiposity: a randomized controlled field trial of the Malaysian REDUCE programme. Nutrition Journal, 17(74), 1-13. https://doi.org/10.1186/s12937-018-0379-1

Ahmad, N., Shariff, Z.M., Mukhtar, F., & Lye, M.S. (2016). Harnessing social media in family-based intervention for childhood obesity: Study protocol for randomized controlled field trial of reduce programme. International of Public Health and Clinical Sciences, 3(5), 95-109.

Alberti, K.G., Eckel, R.H., Grundy, S.M., Zimmet, P.Z., Cleeman, J.I., Donato, K.A., et al., (2009). Harmonizing the metabolic syndrome: a joint interim statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. Circulation, 120(16), 1640–1645. https://doi.org/10.1161/CIRCULATIONAHA.109.192644

Al-Hamad, D., & Raman, V. (2017). Metabolic syndrome in children and adolescents. Translational Pediatrics, 6(4), 397–407. https://doi.org/10.21037/tp.2017.10.02

Ambrosini, G. L., Emmett, P. M., Northstone, K., Howe, L. D., Tilling, K., & Jebb, S. A. (2012). Identification of a dietary pattern prospectively associated with increased adiposity during childhood and adolescence. International journal of obesity (2005), 36(10), 1299–1305. https://doi.org/10.1038/ijo.2012.127

American Psychologist Association. (2020). Summary of the clinical practice guideline for multicomponent behavioral treatment of obesity and overweight in children and adolescents. American Psychologist, 75(2), 178–188. https://doi.org/10.1037/amp0000530

Anselma, M., Chinapaw, M. J. M., Kornet-van der Aa, D. A., & Altenburg, T. M. (2020). Effectiveness and promising behavior change techniques of interventions targeting energy balance related behaviors in children from lower socioeconomic environments: A systematic review. PloS One, 15(9), e0237969. https://doi.org/10.1371/journal.pone.0237969

Aprilia, N., Tantomo, D., Pawito., and Murti, B. (2018). The effects of water intake, fruits and vegetables consumption and socio-cultural on obesity among adolescents. Journal of Health Promotion and Behavior. 3(4), 279-289.

Armitage, C.J., Conner, M., Prestwich, A., de Bruin, M., Johnston, M., Sniehotta, F., et al., (2020). Investigating which behaviour change techniques work for whom in which contexts delivered by what means: Proposal for an international collaboratory of Centres for Understanding Behaviour Change (CUBiC). British Journal of Health Psychology, 26(1), 1–14. https://doi.org/10.1111/bjhp.12479

Ashton, L. M., Sharkey, T., Whatnall, M. C., Haslam, R. L., Bezzina, A., Aguiar, E. J., et al., (2020). Which behaviour change techniques within interventions to prevent weight gain and/or initiate weight loss improve adiposity outcomes in young adults? A systematic review and meta-analysis of Randomized Controlled Trials. Obesity Reviews, 21(6), 1-19. https://doi.org/10.1111/obr.13009

Ashwell, M., & Gibson, S. (2016). Waist-to-height ratio as an indicator of 'early health risk': simpler and more predictive than using a 'matrix' based on BMI and waist circumference. BMJ open, 6(e010159). https://doi.org/10.1136/bmjopen-2015-010159

Auster, J., & Janda, M. (2009). Recruiting older adults to health research studies: A systematic review. Australasian Journal on Ageing, 28(3), 149–151. https://doi.org/10.1111/j.1741-6612.2009.00362.x

Averitt, A. J., Weng, C., Ryan, P., & Perotte, A. (2020). Translating evidence into practice: eligibility criteria fail to eliminate clinically significant differences between real-world and study populations. NPJ Digital Medicine, 3(67), 1-10. https://doi.org/10.1038/s41746-020-0277-8

Bassali, R., Waller, J.L., Gower, B., Allison, J., & Davis, C.L. (2010). Utility of waist circumference percentile for risk evaluation in obese children. International Journal of Pediatric Obesity, 5(1), 97–101. https://doi.org/10.3109/17477160903111722

Bell, W., Colaiezzi, B. A., Prata, C. S., & Coates, J. C. (2017). Scaling up Dietary Data for Decision-Making in Low-Income Countries: New Technological Frontiers. Advances in nutrition (Bethesda, Md.), 8(6), 916–932. https://doi.org/10.3945/an.116.014308

Bhandari, P. (2023). Sampling bias and how to avoid it: Types & examples. Scribbr. Retrieved April 19, 2023, from https://www.scribbr.com/research-bias/sampling-bias/

Birch, L., Perry, R., Hunt, L. P., Matson, R., Chong, A., Beynon, R., et al., (2019). What change in body mass index is associated with improvement in percentage body fat in childhood obesity? A meta-regression. BMJ open, 9(8), e028231. https://doi.org/10.1136/bmjopen-2018-028231

Blonde, L., Khunti, K., Harris, S. B., Meizinger, C., & Skolnik, N.S. (2018). Interpretation and Impact of Real-World Clinical Data for the Practicing Clinician. Advances in Therapy, 35(11), 1763–1774. https://doi.org/10.1007/s12325-018-0805-y

Boushey, C. J., Spoden, M., Zhu, F. M., Delp, E. J., & Kerr, D. A. (2017). New mobile methods for dietary assessment: review of image-assisted and image-based dietary assessment methods. The Proceedings of the Nutrition Society, 76(3), 283–294. https://doi.org/10.1017/S0029665116002913

Boyland, E. J., Nolan, S., Kelly, B., Tudur-Smith, C., Jones, A., Halford, J. C., & Robinson, E. (2016). Advertising as a cue to consume: a systematic review and meta-analysis of the effects of acute exposure to unhealthy food and nonalcoholic beverage advertising on intake in children and adults. The American journal of clinical nutrition, 103(2), 519–533. https://doi.org/10.3945/ajcn.115.120022

Braun, V. & Clarke, V. (2022). Thematic analysis: A practical guide. London: SAGE Publication Ltd.

Braun, V., & Clarke, V. (2012). Thematic analysis. In H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf, & K. J. Sher (Eds.), APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological (pp. 57–71). American Psychological Association. https://doi.org/10.1037/13620-004

Braun, V. & Clarke, V. (2021). To saturate or not to saturate? Questioning data saturation as a useful concept for thematic analysis and sample-size rationales, Qualitative Research in Sport, Exercise and Health, 13(2), 201-216. https://doi.org/10.1080/2159676X.2019.1704846

Brown, J. & Wade, E.K. (2021). Coronavirus: A history of “Lockdown laws’ in England. Common Library Research Briefing. Retrieved March 31, 2023, from https://commonslibrary.parliament.uk/research-briefings/cbp-9068/

Brown, T., Moore, T. H., Hooper, L., Gao, Y., Zayegh, A., Ijaz, S., Elwenspoek, M., Foxen, S. C., Magee, L., O'Malley, C., Waters, E., & Summerbell, C. D. (2019). Interventions for preventing obesity in children. The Cochrane database of systematic reviews, 7(7), CD001871. https://doi.org/10.1002/14651858.CD001871.pub4

Burchett, H.E.D., Sutcliffe, K., Torres, G.J.M., Rees, R., & Thomas, J. (2017). Lifestyle weight management programmes for children: A systematic review using qualitative comparative analysis to identify critical pathways to effectiveness. Preventive Medicine, 106, 1–12. https://doi.org/10.1016/j.ypmed.2017.08.025

Busetto, L., Wick, W., & Gumbinger, C. (2020). How to use and assess qualitative research methods. Neurological Research and Practice, 2(1). https://doi.org/10.1186/s42466-020-00059-z

Butland, B., Jebb, S., Kopelman, P., McPherson, K., Thomas, S., Mardell, J. et al., (2007). Foresight tackling obesities: Future choices – project report 2nd Edition. London: Department of Innovation, Universities and Skills.

Cappuccio, F. P., Taggart, F. M., Kandala, N. B., Currie, A., Peile, E., Stranges, S., & Miller, M. A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. Sleep, 31(5), 619–626. https://doi.org/10.1093/sleep/31.5.619

Calvo, N.M., Galarraga, L.M., & Gonzalez, M.A.M. (2016). Association between Body Mass Index, Waist-to-Height Ratio and Adiposity in Children: A Systematic Review and Meta-Analysis. Nutrients, 8(8), 512. https://doi.org/10.3390/nu8080512

Carraça, E., Encantado, J., Battista, F., Beaulieu, K., Blundell, J., Busetto, L., et al., (2021). Effective behavior change techniques to promote physical activity in adults with overweight or obesity: A systematic review and meta-analysis. Obesity Reviews, 22(Suppl 4), e13258. https://doi.org/10.1111/obr.13258

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public health reports (Washington, D.C.: 1974), 100(2), 126–131.

Centers for Disease Control and Prevention (2009). Recommended community strategies and measurements to prevent obesity in the United States. Retrieved March, 31, 2024, from https://www.cdc.gov/mmwr/pdf/rr/rr5807.pdf

Center for Disease Control and Prevention, National Center for Health and Statistic (2010). CDC growth charts. Retrieved September, 11, 2019 from https://www.cdc.gov/growthcharts/cdc_charts.htm

Centers for Disease Control and Prevention (2011). Strategies to prevent obesity and other chronic diseases: The CDC guide to strategies to increase physical activity in the community. Retrieved March, 31, 2024, from https://www.cdc.gov/obesity/downloads/PA_2011_WEB.pdf

Centers for Disease Control and Prevention (2017). Growth charts - clinical growth charts. Retrieved March, 25, 2023, from https://www.cdc.gov/growthcharts/clinical_charts.htm

Carter, N., Lukosius, D.B., DiCenso, A., Blythe, J., & Neville, A. J. (2014). The use of triangulation in qualitative research. Oncology Nursing Forum, 41(5), 545–547. https://doi.org/10.1188/14.ONF.545-547

Chakraborty, D., Bailey, B. A., Seidler, A. L., Yoong, S., Hunter, K. E., Hodder, R. K., et al., (2022). Exploring the application of behaviour change technique taxonomies in childhood obesity prevention interventions: A systematic scoping review. Preventive Medicine Reports, 29, 1-8. https://doi.org/10.1016/j.pmedr.2022.101928

Chodankar D. (2021). Introduction to real-world evidence studies. Perspectives in Clinical Research, 12(3), 171–174. https://doi.org/10.4103/picr.picr_62_21

Choy, C.S., Chan, W.Y., Chen, T.L., Shih, C.C., Wu, L.C., & Liao, C.C. (2011). Waist circumference and risk of elevated blood pressure in children: A cross-sectional study. BMC Public Health, 11(613), 1-7. https://doi.org/10.1186/1471-2458-11-613

Chu, N. F., Rimm, E. B., Wang, D. J., Liou, H. S., & Shieh, S. M. (1998). Clustering of cardiovascular disease risk factors among obese schoolchildren: the Taipei Children Heart Study. The American journal of clinical nutrition, 67(6), 1141–1146. https://doi.org/10.1093/ajcn/67.6.1141

Clark, T., Foster, L., Sloan, L. & Bryman, A. (2021). Bryman's Social Research Methods (6th ed.).

Cohen, L., Manion, L., & Morrison, K. (2017). Research Methods in Education (8th ed.). Taylor & Francis Group [eBook]. http://ezproxy.herts.ac.uk/login?url=https://dx.doi.org/10.4324/9781315456539

Cole T.J., Freeman J.V., & Preece M.A. 1998. British 1990 growth reference centiles for weight, height, body mass index and head circumference fitted by maximum penalized likelihood. Stat Med 17(4):407-29

Cole, T. J., & Lobstein, T. (2012). Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatric Obesity, 7(4), 284–294. https://doi.org/10.1111/j.2047-6310.2012.00064.x

Connell, L.E., Carey, R.N., de Bruin, M., Rothman, A.J., Johnston, M., Kelly, M.P., et al., (2019). Links Between Behavior Change Techniques and Mechanisms of Action: An Expert Consensus Study. Annals of Behavioral Medicine, 53(8), 708–720. https://doi.org/10.1093/abm/kay082

Croker, H., Viner, R. M., Nicholls, D., Haroun, D., Chadwick, P., Edwards, C., et al., (2012). Family-based behavioural treatment of childhood obesity in a UK National Health Service setting: randomized controlled trial. International Journal of Obesity, 36(1), 16–26. https://doi.org/10.1038/ijo.2011.182

Daniel, N., Lécuyer, E. & Chassaing, B. (2021). Host/microbiota interactions in health and diseases—Time for mucosal microbiology!.Mucosal Immunol 14, 1006–1016. https://doi.org/10.1038/s41385-021-00383-w

Da Silva, C. C., Monteil, M. A., & Davis, E. M. (2020). Overweight and Obesity in Children Are Associated with an Abundance of Firmicutes and Reduction of Bifidobacterium in Their Gastrointestinal Microbiota. Childhood obesity (Print), 16(3), 204–210. https://doi.org/10.1089/chi.2019.0280

Davis, R., Campbell, R., Hildon, Z., Hobbs, L., & Michie, S. (2015). Theories of behaviour and behaviour change across the social and behavioural sciences: a scoping review. Health Psychology Review, 9(3), 323–344. https://doi.org/10.1080/17437199.2014.941722

Deeks JJ, Higgins JPT & Altman DG (editors). Chapter 10: Analysing data and undertaking meta-analyses. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.3 (updated February 2022). Cochrane, 2022. Available from www.training.cochrane.org/handbook

Deng, X., He, M., He, D., Zhu, Y., Zhang, Z., & Niu, W. (2021). Sleep duration and obesity in children and adolescents: evidence from an updated and dose-response meta-analysis. Sleep medicine, 78, 169–181. https://doi.org/10.1016/j.sleep.2020.12.027

Denzin, N. K., Lincoln, Y. S., & Brinkmann, S. (2018). Chapter 26 The interview. In The sage handbook of qualitative research (5th ed., pp. 576–599). essay, SAGE.

Deslauriers, L., McCarty, L.S., Miller, K., Callaghan, K. & Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. PNAS, 116(39), 19251-19257. https://doi.org/10.1073/pnas.1821936116

Diddana (2021). Prevalence of overweight/obesity and its association with socioeconomic status in Ethiopia: Systeamtic review and meta-analysis. Journal of Obesity and Weight-loss Medication, 1(7), 1-10. DOI: 10.23937/2572-4010.1510042

Dombrowski, S.U., Sniehotta, F.F., Avenell, A., Johnson, M.,MacLennan, G. & Araujo-Soares, V. (2012). Identifying active ingredients in complex behavioural interventions for obese adults with obesity-related co-morbidities or additional risk factors for co-morbidities: a systematic review. Health Psychology Review, 6(1), 7-32. https://doi.org/10.1080/17437199.2010.513298

Ejtahed, H. S., Soroush, A. R., Angoorani, P., Larijani, B., & Hasani-Ranjbar, S. (2016). Gut Microbiota as a Target in the Pathogenesis of Metabolic Disorders: A New Approach to Novel Therapeutic Agents. Hormone and metabolic research, 48(6), 349–358. https://doi.org/10.1055/s-0042-107792

Ejtahed, H. S., Angoorani, P., Soroush, A. R., Hasani-Ranjbar, S., Siadat, S. D., & Larijani, B. (2020). Gut microbiota-derived metabolites in obesity: a systematic review. Bioscience of microbiota, food and health, 39(3), 65–76. https://doi.org/10.12938/bmfh.2019-026

English, W., Gott, M., & Robinson, J. (2022). The meaning of rapport for patients, families, and healthcare professionals: A scoping review. Patient Education and Counseling, 105(1), 2–14. https://doi.org/10.1016/j.pec.2021.06.003

Emerson, E., Robertson, J., Baines, S. & Hatton, C. (2016). Obesity in British children with and without intellectual disability: cohort study. BMC Public Health, 16(644), 1-10. https://doi.org/10.1186/s12889-016-3309-1

Epton, T., Currie, S., & Armitage, C.J. (2017). Unique effects of setting goals on behavior change: Systematic review and meta-analysis. Journal of Consulting and Clinical Psychology, 85(12), 1182–1198. https://doi.org/10.1037/ccp0000260

Espinosa, P.R., Pichayayothin, N. B., Suavansri, P., French, J. J., Areekit, P., Nilchantuk, C., et al. (2022). Found in translation: Reflections and lessons for qualitative research collaborations across language and Culture. International Journal of Qualitative Methods, 21, 1-12. https://doi.org/10.1177/16094069221101280

Etchison, W. C., Bloodgood, E. A., Minton, C. P., Thompson, N. J., Collins, M. A., Hunter, S. C., & Dai, H. (2011). Body mass index and percentage of body fat as indicators for obesity in an adolescent athletic population. Sports health, 3(3), 249–252. https://doi.org/10.1177/1941738111404655

Farhangiyan, Z., Latifi, S. M., Rashidi, H., & Shahbazian, H. (2019). The most appropriate cut-off point of anthropometric indices in predicting the incidence of metabolic syndrome and its components. Diabetes & Metabolic Syndrome, 13(4), 2739–2745. https://doi.org/10.1016/j.dsx.2019.07.009

Felső, R., Lohner, S., Hollódy, K., Erhardt, É., & Molnár, D. (2017). Relationship between sleep duration and childhood obesity: Systematic review including the potential underlying mechanisms. Nutrition, metabolism, and cardiovascular diseases: NMCD, 27(9), 751–761. https://doi.org/10.1016/j.numecd.2017.07.008

Field, A. E., Laird, N., Steinberg, E., Fallon, E., Janneh, M.S., & Yanovski, J.A. (2003). Which metric of relative weight best captures body fatness in children?. Obesity research, 11(11), 1345–1352. https://doi.org/10.1038/oby.2003.182

Flannery, C., Fredrix, M., Olander, E.K., McAuliffe, F.M., Byrne, M., & Kearney, P.M. (2019). Effectiveness of physical activity interventions for overweight and obesity during pregnancy: a systematic review of the content of behaviour change interventions. International Journal of Behavioral Nutrition and Physical Activity, 16(97), 1-20. https://doi.org/10.1186/s12966-019-0859-5

Fredriksen, P.M., Skår, A., & Mamen, A. (2018). Waist circumference in 6-12-year-old children: The Health Oriented Pedagogical Project (HOPP). Scandinavian Journal of Public Health, 46(21_suppl), 12–20. https://doi.org/10.1177/1403494818767790

Friedman, L. M., DeMets, D. L., & Furberg, C. D. (2010). Fundamentals of Clinical Trials (4th ed.). Springer.

Galleta, A. & Cross, W.E. (2013). Mastering the semi-structured interview and beyond: From research design to analysis and publication. New York University Press.

Gemming, L., Utter, J., & Ni Mhurchu, C. (2015). Image-assisted dietary assessment: a systematic review of the evidence. Journal of the Academy of Nutrition and Dietetics, 115(1), 64–77. https://doi.org/10.1016/j.jand.2014.09.015

Gibson, R.S. (2024). Principle of nutritional assessment. 3rd ed. Retrieved October 10, 2024, from https://nutritionalassessment.org

Gilliss, C. L., Lee, K. A., Gutierrez, Y., Taylor, D., Beyene, Y., Neuhaus, J., et al., (2001). Recruitment and retention of healthy minority women into community-based longitudinal research. Journal of Women's Health & Gender-Based Medicine, 10(1), 77–85. https://doi.org/10.1089/152460901750067142

Golley, R.K., Magarey, A.M., Baur, L.A., Steinbeck, K.S., & Daniels, L.A. (2007). Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: a randomized, controlled trial. Pediatrics, 119(3), 517–525. https://doi.org/10.1542/peds.2006-1746

Golley, R.K., Perry, R.A., Magarey, A. & Daniels, L. (2007). Family-focused weight management program for five-to nin-year-olds incorporating parenting skills training with healthy lifestyle information to support behaviour modification. Nutrition & Dietitics, 64, 144-150. https://doi.org/10.1111/j.1747-0080.2007.00106.x

GOV.UK (2024). Good clinical practice for clinical trial. Retrieved October, 10, 2024, from https://www.gov.uk/guidance/good-clinical-practice-for-clinical-trials

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? Field Methods, 18(1), 59–82. https://doi.org/10.1177/1525822x05279903

Gupta S. K. (2011). Intention-to-treat concept: A review. Perspectives in Clinical Research, 2(3), 109–112. https://doi.org/10.4103/2229-3485.83221

Haqq, A.M., Kebbe, M., Tan, Q., Manco, M., & Salas, X.R. (2021). Complexity and stigma of pediatric obesity. Childhood Obesity, 17(4), 229–240. https://doi.org/10.1089/chi.2021.0003

Harvey, J., Krukowski, R., Priest, J., & West, D. (2019). Log Often, Lose More: Electronic Dietary Self-Monitoring for Weight Loss. Obesity (Silver Spring), 27(3), 380–384. https://doi.org/10.1002/oby.22382

Hariton, E., & Locascio, J. J. (2018). Randomised controlled trials - the gold standard for effectivenessresearch: Study design: randomised controlled trials. BJOG: an international journal of obstetrics and gynaecology, 125(13), 1716. https://doi.org/10.1111/1471-0528.15199

Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. Social Science & Medicine, 292(114523), 1-10. https://doi.org/10.1016/j.socscimed.2021.114523

Herouvi, D., Soldatou, A., Paschou, S. A., Kalpia, C., Karanasios, S., & Karavanaki, K. (2023). Bariatric surgery in the management of childhood and adolescence obesity. Endocrine, 79(3), 411–419. https://doi.org/10.1007/s12020-022-03210-9

Higgins, J., Thomas, J., Chandler, J., Cumpston, M., Li, T., Page, M. & Welch, V. (2022). Cochrane handbook for systematic review of interventions. Retrieved, March, 31, 2023 from https://training.cochrane.org/handbook/current

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., et al., (2014). Better reporting of interventions: template for intervention description and replication (TIDieR) checklist and guide. British Medical Journal, 348(g1687), 1-12. https://doi.org/10.1136/bmj.g1687

Hoffmann, T. C., Oxman, A. D., Ioannidis, J. P., Moher, D., Lasserson, T. J., Tovey, D.I., et al., (2017). Enhancing the usability of systematic reviews by improving the consideration and description of interventions. British Medical Journal, 357(j2998), 1-8. https://www.jstor.org/stable/26950207

Hogan, D. P., Msall, M. E., Rogers, M. L., & Avery, R. C. (1997). Improved disability population estimates of functional limitation among American children aged 5-17. Maternal and child health journal, 1(4), 203–216. https://doi.org/10.1023/a:1022354126797

Holdsworth, E., Thorogood, N., Sorhaindo, A., & Nanchahal, K. (2017). A qualitative study of participant engagement with a weight loss intervention. Health Promotion Practice, 18(2), 245–252. https://doi.org/10.1177/1524839916659847

Holmes, C. J., & Racette, S. B. (2021). The Utility of Body Composition Assessment in Nutrition and Clinical Practice: An Overview of Current Methodology. Nutrients, 13(8), 2493. https://doi.org/10.3390/nu13082493

Holst-Schumacher I, Nuñez-Rivas H, Monge-Rojas R, Barrantes-Santamaría M. Components of the Metabolic Syndrome among a Sample of Overweight and Obese Costa Rican Schoolchildren. Food and Nutrition Bulletin. 2009;30(2):161-170. https://doi.org/10.1177/156482650903000208

Hou, K., Wu, Z.-X., Chen, X.-Y., Wang, J.-Q., Zhang, D., Xiao, C., Zhu, D., Koya, J. B., Wei, L., Li, J., & Chen, Z.-S. (2022). Microbiota in health and diseases. Signal Transduction and Targeted Therapy, 7(1). https://doi.org/10.1038/s41392-022-00974-4

Houle S. (2015). An introduction to the fundamentals of randomized controlled trials in pharmacy research. The Canadian journal of hospital pharmacy, 68(1), 28–32. https://doi.org/10.4212/cjhp.v68i1.1422

Houtman, T. A., Eckermann, H. A., Smidt, H., & de Weerth, C. (2022). Gut microbiota and BMI throughout childhood: the role of firmicutes, bacteroidetes, and short-chain fatty acid producers. Scientific reports, 12(1), 3140. https://doi.org/10.1038/s41598-022-07176-6

Human Microbiome Project Consortium (2012). Structure, function and diversity of the healthy human microbiome. Nature, 486(7402), 207–214. https://doi.org/10.1038/nature11234

Hynynen, S-T., van Stralen, M.M., Sniehotta, F.F., Araújo-Soares, V., Hardeman, W., Chinapaw, M.J. M., et al., (2016). A systematic review of school-based interventions targeting physical activity and sedentary behaviour among older adolescents. International Review of Sport and Exercise Psychology, 9(1), 22–44. https://doi.org/10.1080/1750984X.2015.1081706

Hystad, H. T., Steinsbekk, S., Ødegård, R., Wichstrøm, L., &; Gudbrandsen, O. A. (2013). A randomised study on the effectiveness of therapist-led v. self-help parental intervention for treating childhood obesity. British Journal of Nutrition, 110(6), 1143–1150. https://doi.org/10.1017/s0007114513000056

l'Allemand, D., Wiegand, S., Reinehr, T., Müller, J., Wabitsch, M., Widhalm, K., & Holl, R. (2008). Cardiovascular risk in 26,008 European overweight children as established by a multicenter database. Obesity (Silver Spring, Md.), 16(7), 1672–1679. https://doi.org/10.1038/oby.2008.259

IBM Corporation. (2019). IBM SPSS statistic version 26. IBM Corporation, New York.

Indiani, C. M. D. S. P., Rizzardi, K. F., Castelo, P. M., Ferraz, L. F. C., Darrieux, M., & Parisotto, T. M. (2018). Childhood Obesity and Firmicutes/Bacteroidetes Ratio in the Gut Microbiota: A Systematic Review. Childhood obesity (Print), 14(8), 501–509. https://doi.org/10.1089/chi.2018.0040

JaKa, M.M., Haapala, J.L., Trapl, E.S., Kunin-Batson, A.S., Olson-Bullis, B.A., Heerman, W. J., et al., (2016). Reporting of treatment fidelity in behavioural paediatric obesity intervention trials: a systematic review. Obesity Reviews, 17(12), 1287–1300. https://doi.org/10.1111/obr.12464

JaKa, M.M., Wood, C., Veblen-Mortenson, S., Moore, S. M., Matheson, D., Stevens, J., et al., (2020). Applying the behavior change technique taxonomy to four multicomponent childhood obesity interventions. Western Journal of Nursing Research, 43(5), 468–477. https://doi.org/10.1177/0193945920954782

Janicke, D.M., Sallinen, B.J., Perri, M.G., Lutes, L.D., Huerta, M., Silverstein, J.H., et al., (2008). Comparison of parent-only vs family-based interventions for overweight children in underserved rural settings: outcomes from project STORY. Archives of Pediatrics & Adolescent Medicine, 162(12), 1119–1125. https://doi.org/10.1001/archpedi.162.12.1119

Janicke, D.M., Sallinen, B. J., Perri, M. G., Lutes, L. D., Silverstein, J. H., Huerta, M. G., et al., (2008). Sensible treatment of obesity in rural youth (STORY): design and methods. Contemporary Clinical Trials, 29(2), 270–280. https://doi.org/10.1016/j.cct.2007.05.005

Jatau, A.I., Peterson, G.M., Bereznicki, L., Dwan, C., Black, J.A., Bezabhe, W.M., et al., (2019). Applying the Capability, Opportunity, and Motivation Behaviour Model (COM-B) to guide the development of interventions to improve early detection of atrial fibrillation. Clinical Medicine Insights. Cardiology, 13, 1-8. https://doi.org/10.1177/1179546819885134

Jensen, N.S., Camargo, T.F., & Bergamaschi, D.P. (2016). Comparison of methods to measure body fat in 7-to-10-year-old children: a systematic review. Public health, 133, 3–13. https://doi.org/10.1016/j.puhe.2015.11.025

Jia P. (2021). Obesogenic environment and childhood obesity. Obesity reviews: an official journal of the International Association for the Study of Obesity, 22 Suppl 1, e13158. https://doi.org/10.1111/obr.13158

Karri, S., Aline, J., Reijo, S., Yoshie, Y., Yoon-Mi, H., Wendy, C., et. al. (2017). Differences in genetic and environmental variation in adult BMI by sex, age, time period, and region: an individual-based pooled analysis of 40 twin cohorts. The American Journal of Clinical Nutrition, 106(2), 457-466. https://doi.org/10.3945/ajcn.117.153643

Kim, H. S., Lee, S., & Kim, J. H. (2018). Real-world Evidence versus Randomized Controlled Trial: Clinical Research Based on Electronic Medical Records. Journal of Korean Medical Science, 33(34), e213. https://doi.org/10.3346/jkms.2018.33.e213

Kim, T., & Knesebeck, O. (2018). Income and obesity: what is the direction of the relationship? A systematic review and meta-analysis. BMJ Open, 8. https://doi.org/10.1136/bmjopen-2017-019862.

King, N. (2012) 'Doing template analysis', in G.Symon and C.Cassell (eds.)

King, N., & Brooks, J.M. (2017). Template Analysis for Business and Management Students. London: Sage.

Kinross, J.M., Darzi, A.W. & Nicholson, J.K. (2011). Gut microbiome-host interactions in health and disease. Genome Med 3, 14. https://doi.org/10.1186/gm228

Kirk-Wade, E. (2022). UK disability statistics: Prevalence and life experiences. UK parliament. Retrieved March, 31, 2023, from https://commonslibrary.parliament.uk/research-briefings/cbp-9602/

Kollias, A., Skliros, E., Stergiou, G., Leotsakos, N., Saridi, M. & Garifallos, D. (2011). Obesity and associated cardiovascular risk factors among schoolchildren in Greece: a cross-sectional study and review of the literature. Journal of Pediatric Endocrinology and Metabolism, 24(11-12), 929-938. https://doi.org/10.1515/JPEM.2011.309

Kolsgaard, M. L., Joner, G., Brunborg, C., Anderssen, S. A., Tonstad, S., & Andersen, L. F. (2011). Reduction in BMI z-score and improvement in cardiometabolic risk factors in obese children and adolescents. The Oslo Adiposity Intervention Study - a hospital/public health nurse combined treatment. BMC Pediatrics, 11(47), 1-8. https://doi.org/10.1186/1471-2431-11-47

Kozakowska, A.K., Kozłowska, M., & Jagielski, P. (2020). Assessment of diet quality, nutrient intake, and dietary behaviours in obese children compared to healthy children. Pediatric endocrinology, diabetes, and metabolism, 26(1), 27–38. https://doi.org/10.5114/pedm.2020.93250

Kriukow, J. (2022a). From zero to Nvivo 12 – qualitative data analysis with Nvivo. Retrieved February, 2, 2022, from https://www.udemy.com/course/from-zero-to-nvivo-12/learn/lecture/15654466?start=0#content

Kriukow, J. (2022b). How to analyse qualitative data. Retrieved February, 2, 2022, from https://www.udemy.com/course/how-to-analyse-qualitative-data/learn/lecture/12615834#overview

Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: A systematic review of behaviour theories. Health Psychology Review, 10(3), 277–296. https://doi.org/10.1080/17437199.2016.1151372

Lally, P., van Jaarsveld, C.H., Potts, H.W., & Wardle, J. (2010). How are habits formed: Modelling Habit Formation in the real world. European Journal of Social Psychology, 40(6), 998–1009. https://doi.org/10.1002/ejsp.674

Lee, J. S., Jin, M. H., & Lee, H. J. (2022). Global relationship between parent and child obesity: a systematic review and meta-analysis. Clinical and experimental pediatrics, 65(1), 35–46. https://doi.org/10.3345/cep.2020.01620

Lee, S.J., & Reeves, T.C. (2007). Edgar Dale: A significant contributor to the field of educational technology. Educational Technology, 47(6), 56.

Lemos, T., & Gallagher, D. (2017). Current body composition measurement techniques. Current Opinion in Endocrinology, Diabetes, and Obesity, 24(5), 310–314. https://doi.org/10.1097/MED.0000000000000360

Ley, R. E., Turnbaugh, P. J., Klein, S., & Gordon, J. I. (2006). Microbial ecology: human gut microbes associated with obesity. Nature, 444(7122), 1022–1023. https://doi.org/10.1038/4441022a

Lin, J., Jiang, Y., Wang, G., Meng, M., Zhu, Q., Mei, H., Liu, S., & Jiang, F. (2020). Associations of short sleep duration with appetite-regulating hormones and adipokines: A systematic review and meta-analysis. Obesity reviews: an official journal of the International Association for the Study of Obesity, 21(11), e13051. https://doi.org/10.1111/obr.13051

Li T, Higgins JPT, Deeks JJ (editors). Chapter 5: Collecting data. In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020). Cochrane, 2020. Available from www.training.cochrane.org/handbook

Lindberg, L. (2020). Obesity in childhood: psychosocial consequences and premature mortality. Doctoral dissertation, Karolinska Institute, Sweden.

Lochrie, A. S., Wysocki, T., Hossain, J., Milkes, A., Antal, H., Buckloh, L., et al., (2013). The effects of a family-based intervention (FBI) for overweight/obese children on health and psychological functioning. Clinical Practice in Pediatric Psychology, 1(2), 159–170. https://doi.org/10.1037/cpp0000020

Madden, T.J., Ellen, P.S., & Ajzen, I. (1992). A comparison of the theory of planned behavior and the theory of reasoned action. Personality and Social Psychology Bulletin, 18(1), 3–9. https://doi.org/10.1177/0146167292181001

Maffeis, C., Olivieri, F., Valerio, G., Verduci, E., Licenziati, M. R., Calcaterra, V., et al., (2023). The treatment of obesity in children and adolescents: consensus position statement of the Italian society of pediatric endocrinology and diabetology, Italian Society of Pediatrics and Italian Society of Pediatric Surgery. Italian journal of pediatrics, 49(1), 69. https://doi.org/10.1186/s13052-023-01458-z

Mahan, L. K., & Raymond, L. J. (2017). Krause's Food & the Nutrition Care Process (14th ed.). Elsevier [eBook].

Maki, K. C., Slavin, J. L., Rains, T. M., & Kris-Etherton, P. M. (2014). Limitations of observational evidence: implications for evidence-based dietary recommendations. Advances in nutrition (Bethesda, Md.), 5(1), 7–15. https://doi.org/10.3945/an.113.004929

Marchesi, J. R., & Ravel, J. (2015). The vocabulary of microbiome research: a proposal. Microbiome, 3, 31. https://doi.org/10.1186/s40168-015-0094-5

Martin, J., Chater, A., & Lorencatto, F. (2013). Effective behaviour change techniques in the prevention and management of childhood obesity. International journal of obesity, 37(10), 1287–1294. https://doi.org/10.1038/ijo.2013.107

Mazur, A., Zachurzok, A., Baran, J., Dereń, K., Łuszczki, E., Weres, A., et al., (2022). Childhood Obesity: Position Statement of Polish Society of Pediatrics, Polish Society for Pediatric Obesity, Polish Society of Pediatric Endocrinology and Diabetes, the College of Family Physicians in Poland and Polish Association for Study on Obesity. Nutrients, 14(18), 3806. https://doi.org/10.3390/nu14183806

Mazza, S., Bastuji, H., & Rey, A. E. (2020). Objective and Subjective Assessments of Sleep in Children: Comparison of Actigraphy, Sleep Diary Completed by Children and Parents' Estimation. Frontiers in psychiatry, 11, 495. https://doi.org/10.3389/fpsyt.2020.00495

Mei, K., Huang, H., Xia, F., Hong, A., Chen, X., Zhang, C., et al. (2021). State-of-the-art of measures of the obesogenic environment for children. Obesity reviews: an official journal of the International Association for the Study of Obesity, 22 (Suppl 1), e13093. https://doi.org/10.1111/obr.13093

McHugh M. L. (2012). Interrater reliability: the kappa statistic. Biochemia medica, 22(3), 276–282.

Mead, E., Brown, T., Rees, K., Azevedo, L. B., Whittaker, V., Jones, D., et al., (2017). Diet, physical activity and behavioural interventions for the treatment of overweight or obese children from the age of 6 to 11 years. The Cochrane database of systematic reviews, 6(6), CD012651. https://doi.org/10.1002/14651858.CD012651

Mellor, D.D., Brown, A., Asher, K.E. & Ball, L. (2022), Our language has not always been right and this is how we are looking to change: Stigma and inequality in nutrition research reporting. Journal of Human Nutrition and Diet, 35: 754-756. https://doi.org/10.1111/jhn.13059

Michie, S., Abraham, C., Whittington, C., McAteer, J., & Gupta, S. (2009). Effective techniques in healthy eating and physical activity interventions: a meta-regression. Health psychology, 28(6), 690–701. https://doi.org/10.1037/a0016136

Michie, S., Ashford, S., Sniehotta, F. F., Dombrowski, S. U., Bishop, A., & French, D. P. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: the CALO-RE taxonomy. Psychology & health, 26(11), 1479–1498. https://doi.org/10.1080/08870446.2010.540664

Michie, S., Atkins, L., & West, R. (2014). The behaviour change wheel a guide to designing intervention. Great Britain: Silverback publishing.

Michie, S. & Johnson, M. (2013). Behaviour change techniques. Encyclopedia of Behavioral Medicine. New York; Springer Science Business Media.

Michie, S., Richardson, M., Johnston, M., Abraham, C., Francis, J., Hardeman, W., et al. (2013). The behavior change technique taxonomy (v1) of 93 hierarchically clustered techniques: building an international consensus for the reporting of behavior change interventions. Annals of Behavioral Medicine, 46(1), 81–95. https://doi.org/10.1007/s12160-013-9486-6

Michie, S., West, R., Finnerty, A. N., Norris, E., Wright, A. J., Marques, M. M., et al. (2021). Representation of behaviour change interventions and their evaluation: Development of the upper level of the Behaviour Change Intervention Ontology. Wellcome Open Research, 5, 123. https://doi.org/10.12688/wellcomeopenres.15902.1

Michie, S., Carey, R.N., Johnston, M., Rothman, A. J., de Bruin, M., Kelly, M. P., et al., (2018). From theory-Inspired to theory-based interventions: A protocol for developing and testing a methodology for linking behaviour change techniques to theoretical mechanisms of action. Annals of Behavioral Medicine, 52(6), 501–512. https://doi.org/10.1007/s12160-016-9816-6

Miller, M. A., Kruisbrink, M., Wallace, J., Ji, C., & Cappuccio, F. P. (2018). Sleep duration and incidence of obesity in infants, children, and adolescents: a systematic review and meta-analysis of prospective studies. Sleep, 41(4),1-19. https://doi.org/10.1093/sleep/zsy018

Miltenberger, G.R. (2016). Behaviour modification principles and procedures. (6th ed.). USA: Nelson Education Ltd.

Mishra, P., Pandey, C.M., Singh, U., Gupta, A., Sahu, C., & Keshri, A. (2019). Descriptive statistics and normality tests for statistical data. Annals of Cardiac Anaesthesia, 22(1), 67. https://doi.org/10.4103/aca.aca_157_18

Mobbs R.J. (2021). From the subjective to the objective era of outcomes analysis: how the tools we use to measure outcomes must change to be reflective of the pathologies we treat in spinal surgery. Journal of Spine Surgery, 7(3), 456–457. https://doi.org/10.21037/jss-2021-2

Moisey, L.L., Campbell, K.A., Whitmore, C., & Jack, S.M. (2022). Advancing qualitative health research approaches in applied nutrition research. Journal of Human Nutrition and Dietetics 35(2), 376–387. https://doi.org/10.1111/jhn.12989

Morrissey, B., Taveras, E., Allender, S., & Strugnell, C. (2020). Sleep and obesity among children: A systematic review of multiple sleep dimensions. Pediatric obesity, 15(4), e12619. https://doi.org/10.1111/ijpo.12619

MRC Epidemiology Unit. (2024). Measurement toolkit - duplicate diets. Retrieved October, 4, 2024, from https://www.measurement-toolkit.org/diet/objective-methods/duplicate-diets

Msall, M. E., Avery, R. C., Tremont, M. R., Lima, J. C., Rogers, M. L., & Hogan, D. P. (2003). Functional disability and school activity limitations in 41,300 school-age children: relationship to medical impairments. Pediatrics, 111(3), 548–553. https://doi.org/10.1542/peds.111.3.548

NCD Risk Factor Collaboration (2017). Worldwide trends in body-mass index, underweight, overweight, and obesity from 1975 to 2016: a pooled analysis of 2416 population-based measurement studies in 128·9 million children, adolescents, and adults. Lancet, 390, 2627 - 2642. https://doi.org/10.1016/S0140-6736(17)32129-3.

NCD Risk Factor Collaboration (2020). Height and body-mass index trajectories of school-aged children and adolescents from 1985 to 2019 in 200 countries and territories: a pooled analysis of 2181 population-based studies with 65 million participants. Lancet (London, England), 396(10261), 1511–1524. https://doi.org/10.1016/S0140-6736(20)31859-6

NCD Risk Factor Collaboration (2024). Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. Lancet (London, England), 403(10431), 1027–1050. https://doi.org/10.1016/S0140-6736(23)02750-2

Neu, J. (2021). Chapter 15 The early microbiome and subsequent obesity. In The Microbiome in Prenatal and Neonatal Life (pp. 137–143). Academic Press. Retrieved from https://doi.org/10.1016/C2018-0-04531-4.

NHS Digital (2019). Statistic on obesity, physical activity and diet – England 2019. Retrieved November, 13, 2020, from https://digital.nhs.uk/data-and-information/publications/statistical/statistics-on-obesity-physical-activity-and-diet/statistics-on-obesity-physical-activity-and-diet-england-2019/part-4-childhood-obesity

NHS digital (2020). Health Survey for England 2019 overweight and obesity in adults and children. Retrieved November, 14, 2023, from https://digital.nhs.uk/data-and-information/publications/statistical/health-survey-for-england/2019/main-findings#:~:text=27%25%20of%20men%20and%2029,75%20and%20over%20(26%25).

NHS digital (2023). National Child Measurement Programme, England 2022/23 School year. Retrieved November, 14, 2023, from https://digital.nhs.uk/data-and-information/publications/statistical/national-child-measurement-programme/2022-23-school-year

Naik, Y., Allen, D.B., Eickhoff, J., & Carrel, A.L. (2020). Stabilization of BMI z-score is associated with a decrease in visceral fat in children with obesity. Hormone and Metabolic Research, 52(7), 527–531. https://doi.org/10.1055/a-1159-4506

Napolitano, M.A., Whiteley, J.A., Mavredes, M., Tjaden, A.H., Simmens, S., Hayman, L. L., et al., (2021). Effect of tailoring on weight loss among young adults receiving digital interventions: an 18-month randomized controlled trial. Translational Behavioral Medicine, 11(4), 970–980. https://doi.org/10.1093/tbm/ibab017

National Institute for Health and Care Excellence (2013). Weight management: lifestyle services for overweight or obese children and young people. Retrieved March, 31, 2023, from https://www.nice.org.uk/guidance/ph47

National Institute for Health and Care Excellence (2014a). Behaviour change: individual approaches. Retrieved November, 13, 2020, from https://www.nice.org.uk/guidance/ph49/chapter/6-Glossary#individual-level-behaviour-change-interventions

National Institute for Health and Care Excellence (2014b). Weight management: lifestyle services for overweight or obese adults. Retrieved March, 31, 2023, from https://www.nice.org.uk/guidance/ph53

National Institute for Health and Care Excellence (2022). Obesity: identification, assessment and management. Retrieved March, 31, 2023, from https://www.nice.org.uk/guidance/cg189

National Institute for Health and Care Research: NIHR (2023). Good clinical practice. Retrieved March, 31, 2023, from https://www.nihr.ac.uk/health-and-care-professionals/learning-and-support/good-clinical-practice.htm

National Institute for Health and Care Excellence (2023). Obesity: identification, assessment and management. Retrieved March, 31, 2024, from https://www.nice.org.uk/guidance/cg189/resources/obesity-identification-assessment-and-management-pdf-35109821097925

National Institute for Health and Care Excellence (2016). Obesity: clinical assessment and management. Retrieved March, 31, 2024, from https://www.nice.org.uk/guidance/qs127/resources/obesity-clinical-assessment-and-management-pdf-75545363615173

National Institute for Health and Care Excellence (2015). Obesity in children and young people: prevention and lifestyle weight management programmes. Retrieved March, 31, 2024, from https://www.nice.org.uk/guidance/qs94/resources/obesity-in-children-and-young-people-prevention-and-lifestyle-weight-management-programmes-pdf-2098969040581

National Institute for Health and Care Excellence (2013). Weight management: lifestyle services for overweight or obese children and young people. Retrieved March, 31, 2024, from https://www.nice.org.uk/guidance/ph47/resources/weight-management-lifestyle-services-for-overweight-or-obese-children-and-young-people-pdf-1996362978757

National Institute of Environmental Health Sciences. (2024). Microbiome. Retrieved May, 20, 2024, from https://www.niehs.nih.gov/health/topics/science/microbiome#:~:text=Introduction,to%20human%20health%20and%20wellness.

NIHR. (n.d.). Anthropometry. DAPA Measurement Toolkit. Retrieved April 29, 2023, from https://www.measurement-toolkit.org/anthropometry/anthro-splash

Noble, H. & Heale, R. (2019). Triangulation in research, with examples. Evid Based Nurs, 22(3), 67-68.

Norris E, Marques M.M, Finnerty A.N., Wright, A.J., West, R., Hastings, J. et al. (2020). Development of an intervention setting ontology for behaviour change: Specifying where interventions take place [version 1; peer review: 2 approved]. Wellcome Open Research, 5(124). https://doi.org/10.12688/wellcomeopenres.15904.1

Norman, K., Burrows, L., Chepulis, L., Keenan, R., & Lawrenson, R. (2023). Understanding weight management experiences from patient perspectives: Qualitative exploration in general practice. BMC Primary Care, 24(1). https://doi.org/10.1186/s12875-023-01998-7

Nyman, S. R., Adamczewska, N., & Howlett, N. (2018). Systematic review of behaviour change techniques to promote participation in physical activity among people with dementia. British Journal of Health Psychology, 23(1), 148–170. https://doi.org/10.1111/bjhp.12279

O'Brien, B. C., Harris, I. B., Beckman, T. J., Reed, D. A., & Cook, D. A. (2014). Standards for reporting qualitative research. Academic Medicine, 89(9), 1245–1251. https://doi.org/10.1097/acm.0000000000000388

Office for Health Improvement and Disparities (2023). Obesity profile. Retrieved November, 14, 2023, from https://fingertips.phe.org.uk/profile/national-child-measurement-programme/data#page/13/gid/8000011/pat/159/par/K02000001/ati/15/are/E92000001/iid/92465/age/201/sex/4/cat/-1/ctp/-1/yrr/1/cid/4/tbm/1/page-options/tre-do-0

O'Hara, V. M., Curran, J. L., & Browne, N. T. (2020). The co-occurrence of pediatric obesity and ADHD: An understanding of shared pathophysiology and implications for collaborative management. Current Obesity Reports, 9(4), 451–461. https://doi.org/10.1007/s13679-020-00410-0

Olivier, M.M., Erjavec, M., Horne, P.J., Viktor, S., & Pearson, R. (2019). Measuring lunchtime consumption in school cafeterias: a validation study of the use of digital photography. Public Health Nutrition, 22, 1745 – 1754. DOI:10.1017/S136898001900048X

Ouzzani, M., Hammady, H., Fedorowicz, Z., & Elmagarmid, A. (2016). Rayyan-a web and mobile app for Systematic Reviews. Systematic Reviews, 5(210), 1-10. https://doi.org/10.1186/s13643-016-0384-4

Park, J.S., Choi, H.N., Kim, J.Y., Ma, S.H., & Yim, J.E. (2022). Assessment of dietary quality and nutrient intake of obese children in Changwon area. J Nutr Health, 55(6), 630-641. https://doi.org/10.4163/jnh.2022.55.6.630

Pacharanero, M.B. (2021). Growth-references/UK-who RCPCH/growth-references. GitHub. Retrieved January 16, 2023, from https://github.com/rcpch/growth-references/tree/main/uk-who

Paciorek, C. J., Stevens, G. A., Finucane, M. M., Ezzati, M., & Nutrition Impact Model Study Group (Child Growth) (2013). Children's height and weight in rural and urban populations in low-income and middle-income countries: a systematic analysis of population-representative data. The Lancet. Global health, 1(5), e300–e309. https://doi.org/10.1016/S2214-109X(13)70109-8

Page, M.J., Moher, D., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., et al. (2021). Prisma 2020 explanation and elaboration: Updated guidance and exemplars for reporting systematic reviews. BMJ 372, 1-36. https://doi.org/10.1136/bmj.n160

Palad, C.J., Yarlagadda, S., & Stanford, F.C. (2019). Weight stigma and its impact on paediatric care. Current Opinion in Endocrinology, Diabetes, and Obesity, 26(1), 19–24. https://doi.org/10.1097/MED.0000000000000453

Palad, C. J., Yarlagadda, S., & Stanford, F. C. (2019). Weight stigma and its impact on paediatric care. Current opinion in endocrinology, diabetes, and obesity, 26(1), 19–24. https://doi.org/10.1097/MED.0000000000000453

Pallant, J. (2016). SPSS survival manual; A step by step guide to data analysis using IBM SPSS. (6th ed.). New York: McGraw-Hill Education.

Patton, M. Q. (2015). Qualitative research & evaluation methods: integrating theory and practice (Fourth). SAGE Publications, Inc [eBook].

Perdew, M., Liu, S., & Naylor, P.J. (2021). Family-based nutrition interventions for obesity prevention among school-aged children: a systematic review. Translational Behavioral Medicine, 11(3), 709–723. https://doi.org/10.1093/tbm/ibaa082

Phillippi, J., & Lauderdale, J. (2018). A guide to field notes for qualitative research: context and conversation. Qualitative Health Research, 28(3), 381–388. https://doi.org/10.1177/1049732317697102

Price B. (2017). Developing patient rapport, trust and therapeutic relationships. Nursing Standard, 31(50), 52–63. https://doi.org/10.7748/ns.2017.e10909

Pont, S. J., Puhl, R., Cook, S. R., & Slusser, W., (2017). Stigma experienced by children and adolescents with obesity. Pediatrics, 140(6), e20173034. https://doi.org/10.1542/peds.2017-3034

Public Health England. (2014). Obesity and disability Children and young people. Retrieved March, 31, 2023, from https://webarchive.nationalarchives.gov.uk/ukgwa/20170110165944/https://www.noo.org.uk/NOO_pub/briefing_papers

Puhl, R.M. (2020). What words should we use to talk about weight? A systematic review of quantitative and qualitative studies examining preferences for weight-related terminology. Obesity Reviews, 21(e.13008),1-28. https://doi.org/10.1111/obr.13008

Puhl, R.M., & Lessard, L.M. (2020). Weight Stigma in Youth: Prevalence, Consequences, and Considerations for Clinical Practice. Current Obesity Report, 9, 402–411. https://doi.org/10.1007/s13679-020-00408-8

Pourhoseingholi, M. A., Baghestani, A. R., & Vahedi, M. (2012). How to control confounding effects by statistical analysis. Gastroenterology and hepatology from bed to bench, 5(2), 79–83.

Qualitative Organizational Research: Core Methods and Current Challenges. London: Sage.

Ravussin, E., & Bogardus, C. (2000). Energy balance and weight regulation: genetics versus environment. The British journal of nutrition, 83(S1), S17–S20. https://doi.org/10.1017/s0007114500000908

Reinehr, T., Andler, W., Denzer, C., Siegried, W., Mayer, H., & Wabitsch, M. (2005). Cardiovascular risk factors in overweight German children and adolescents: relation to gender, age and degree of overweight. Nutrition, metabolism, and cardiovascular diseases: NMCD, 15(3), 181–187. https://doi.org/10.1016/j.numecd.2004.06.003

Renjith, V., Yesodharan, R., Noronha, J. A., Ladd, E., & George, A. (2021). Qualitative Methods in Health Care Research. International Journal of Preventive Medicine, 12(20), 1-7. https://doi.org/10.4103/ijpvm.IJPVM_321_19

Riva, A., Borgo, F., Lassandro, C., Verduci, E., Morace, G., Borghi, E., & Berry, D. (2017). Pediatric obesity is associated with an altered gut microbiota and discordant shifts in Firmicutes populations. Environmental microbiology, 19(1), 95–105. https://doi.org/10.1111/1462-2920.13463

Rocco, T.S., Bliss, L.A., Gallagher, S. & Prado, A.P. (2003). Taking the next step: Mixed methods research in organizational systems. Information Technology, Learning, and Performance Journal, 21(1), 19-29.

Romieu, I., Dossus, L., Barquera, S., Blottiere, H.M., Franks, P.W., Gunter, M., et al. (2017). Energy balance and obesity: what are the main drivers? Cancer Causes & Control 28(3), 247–258 (2017). https://doi.org/10.1007/s10552-017-0869-z

Rothberg, A. E., McEwen, L. N., Kraftson, A. T., Ajluni, N., Fowler, C. E., Nay, C. K., et al. (2017). Impact of weight loss on waist circumference and the components of the metabolic syndrome. BMJ Open Diabetes Research and Care, 5(1). https://doi.org/10.1136/bmjdrc-2016-000341

Royal College of Pediatrics and Child Health (RCPCH) (2013). Body mass index (BMI) chart. Retrieved September, 8,2019 from https://www.rcpch.ac.uk/resources/body-mass-index-bmi-chart

Sacher, P.M., Kolotourou, M., Chadwick, P.M., Cole, T.J., Lawson, M.S., Lucas, A., et al., (2010). Randomized controlled trial of the MEND program: a family-based community intervention for childhood obesity. Obesity (Silver Spring), 18 (Suppl 1), S62–S68. https://doi.org/10.1038/oby.2009.433

Samdal, G. B., Eide, G. E., Barth, T., Williams, G., & Meland, E. (2017). Effective behaviour change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. International Journal of Behavioral Nutrition and Physical Activity, 14(42), 1-14. https://doi.org/10.1186/s12966-017-0494-y

Sanchez Arenas, J.J. & Ruiz Martinez, A.O. (2015). Relationship between self-esteem and body image in children with obesity. Mexican Journal of Eating Disorders. 6; 38-44. https://doi.org/10.1016/j.rmta.2015.05.006

Satoh, S., Madden, A. & Fallaize, R. (2019). Behaviour change intervention for managing overweight and obese children and adolescents aged 5-19 years: a systematic review protocol. PROSPERO. CRD42019141417. Retrieved November, 13, 2020, from https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=141417

Schunemann, H., Brozek, J., Guyatt, G. & Oxman, A. (2013). GRADEpro GDT. Retrieved March, 31, 2023 from https://gdt.gradepro.org/app/

Scopus (n.d.). Abraham, Charles. Retrieved February, 16, 2023 from https://www.scopus.com/record/display.uri?eid=2-s2.0-47749113622&origin=resultslist&sort=plf-t

Scopus (n.d.). Michie, Susan. Retrieved February, 16, 2023 from https://www.scopus.com/record/display.uri?eid=2-s2.0-79959212067&origin=resultslist&sort=plf-f

Sepulveda, A. R., Blanco, M., Nova, E., Marcos, A., Martínez, S. G., Carrobles, J. A., & Graell, M. (2019). Identifying the relationship between biological, psychosocial and family markers associated with childhood obesity: Case-control "ANOBAS" study. Psychoneuroendocrinology, 110, 104428. https://doi.org/10.1016/j.psyneuen.2019.104428

Sharif, K., Watad, A., Bragazzi, N. L., Lichtbroun, M., Amital, H., & Shoenfeld, Y. (2018). Physical activity and autoimmune diseases: Get moving and manage the disease. Autoimmunity reviews, 17(1), 53–72. https://doi.org/10.1016/j.autrev.2017.11.010

Shen, W., Punyanitya, M., Chen, J., Gallagher, D., Albu, J., Pi-Sunyer, X., et al., (2006). Waist circumference correlates with metabolic syndrome indicators better than percentage fat. Obesity (Silver Spring), 14(4), 727–736. https://doi.org/10.1038/oby.2006.83

Sherman, R.E., Anderson, S.A., Dal Pan, G.J., Gray, G.W., Gross, T., Hunter, N. L., et al., (2016). Real-World Evidence - What Is It and What Can It Tell Us?. The New England Journal of Medicine, 375(23), 2293–2297. https://doi.org/10.1056/NEJMsb1609216

Short, S. E. & Mollborn, S. (2016). Social Determinants and Health Behaviors: Conceptual Frames and Empirical Advances. Current Opinion in Psychology, 5, 78–84. https://doi.org/10.1016/j.copsyc.2015.05.002

Shreiner, A. B., Kao, J. Y., & Young, V. B. (2015). The gut microbiome in health and in disease. Current opinion in gastroenterology, 31(1), 69–75. https://doi.org/10.1097/MOG.0000000000000139

Sijtsma, A., Schierbeek, H., Goris, A. H., Joosten, K. F., van Kessel, I., Corpeleijn, E., & Sauer, P. J. (2013). Validation of the TracmorD triaxial accelerometer to assess physical activity in preschool children. Obesity (Silver Spring, Md.), 21(9), 1877–1883. https://doi.org/10.1002/oby.20401

Sims, J., Milton, K., Foster, C. & Scarborough, P. (2022). A profile of children's physical activity data from the 2012 and 2015 health survey for England. BMC Public Health, 22, 1785. https://doi.org/10.1186/s12889-022-14150-4

Singhal, V., Sella, A. C., & Malhotra, S. (2021). Pharmacotherapy in pediatric obesity: current evidence and landscape. Current opinion in endocrinology, diabetes, and obesity, 28(1), 55–63. https://doi.org/10.1097/MED.0000000000000587

Skea, Z.C., Martins, M.A., Robertson, C., De Bruin, M., & Avenell, A. (2019). Acceptability and feasibility of weight management programmes for adults with severe obesity: a qualitative systematic review. BMJ open, 9(9), e029473. https://doi.org/10.1136/bmjopen-2019-029473

Smith, H. J., Chen, J., & Liu, X. (2008). Language and rigour in qualitative research: Problems and principles in analyzing data collected in Mandarin. BMC Medical Research Methodology, 8(1). https://doi.org/10.1186/1471-2288-8-44

Smith, J. D., Fu, E., & Kobayashi, M. A. (2020). Prevention and management of childhood obesity and its psychological and health comorbidities. Annual Review of Clinical Psychology, 16(1), 351–378. https://doi.org/10.1146/annurev-clinpsy-100219-060201

Sterne, J. A. C., Savović, J., Page, M. J., Elbers, R. G., Blencowe, N. S., Boutron, I., et al. (2019). RoB 2: A revised tool for assessing risk of bias in randomised trials. British Medical Journal, 366(l4898), 1-8. https://doi.org/10.1136/bmj.l4898

Stommel, M., & Schoenborn, C. (2010). Variations in BMI and prevalence of health risk in diverse racial and ethnic populations. Obesity, 18, 1821-1826. https://doi.org/10.1038/oby.2009.472

Street, S., & Avenell, A. (2022). Are individual or group interventions more effective for long-term weight loss in adults with obesity? A systematic review. Clinical Obesity, 12(5), e12539. https://doi.org/10.1111/cob.12539

Styne, D. M., Arslanian, S. A., Connor, E. L., Farooqi, I. S., Murad, M. H., Silverstein, J. H., et al. (2017). Pediatric obesity—assessment, treatment, and prevention: An endocrine society clinical practice guideline. The Journal of Clinical Endocrinology & Metabolism, 102(3), 709–757. https://doi.org/10.1210/jc.2016-2573

Tang, X., Liu, Y., Hu, J., Zhai, L., Jia, L., Ding, N., et al. (2022). Association of waist circumference with blood pressure and familial dietary habits in preschool children: a cross-sectional study in northeastern China. Italian Journal of Pediatrics, 48(1), 53. https://doi.org/10.1186/s13052-022-01236-3

Taveras, E. M., Rifas-Shiman, S. L., Bub, K. L., Gillman, M. W., & Oken, E. (2017). Prospective Study of Insufficient Sleep and Neurobehavioral Functioning Among School-Age Children. Academic pediatrics, 17(6), 625–632. https://doi.org/10.1016/j.acap.2017.02.001

Tomayko, E. J., Prince, R. J., Cronin, K. A., & Adams, A. K. (2016). The Healthy Children, Strong Families intervention promotes improvements in nutrition, activity and body weight in American Indian families with young children. Public health nutrition, 19(15), 2850–2859. https://doi.org/10.1017/S1368980016001014

Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care, 19(6), 349–357. https://doi.org/10.1093/intqhc/mzm042

Torres, G. J. M., Sutcliffe, K., Burchett, H. E., Rees, R., Richardson, M., & Thomas, J. (2017). Weight Management programmes: Re-analysis of a systematic review to identify pathways to effectiveness. Health Expectations, 21(3), 574–584. https://doi.org/10.1111/hex.12667

Treharne, G.J. & Riggs, D.W. (2015). Ensuring quality in qualitative research (pp. 57-73).

Tremblay, M.S., Aubert, S., Barnes, J.D., Saunders, T.J., Carson, V., Latimer-Cheung, A.E., et al. (2017). Sedentary Behavior Research Network (SBRN) – Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act 14, 75 (2017). https://doi.org/10.1186/s12966-017-0525-8

Topçu, S., Orhon, F. Ş., Tayfun, M., Uçaktürk, S. A., & Demirel, F. (2016). Anxiety, depression and self-esteem levels in obese children: a case-control study. Journal of pediatric endocrinology & metabolism: JPEM, 29(3), 357–361. https://doi.org/10.1515/jpem-2015-0254

United Nation Children's Fund (UNICEF). (2022). UNICEF disability inclusion policy and strategy 2022-2030. New York. UNICEF

University College London (2014). BCT Taxonomy v1 Online Training. Retrieved March, 31, 2023 from http://www.bct-taxonomy.com

Valerio, G., Maffeis, C., Saggese, G., Ambruzzi, M. A., Balsamo, A., Bellone, S., et al., (2018). Diagnosis, treatment and prevention of pediatric obesity: Consensus position statement of the Italian Society for Pediatric Endocrinology and Diabetology and the Italian Society of Pediatrics. Italian Journal of Pediatrics, 44(1). https://doi.org/10.1186/s13052-018-0525-6

VanderWeele, T. J., & Mathur, M. B. (2019). Some desirable properties of The Bonferroni correction: is the Bonferroni correction really so bad?. American journal of epidemiology, 188(3), 617–618. https://doi.org/10.1093/aje/kwy250

Varman, S. D., Cliff, D. P., Jones, R. A., Hammersley, M. L., Zhang, Z., Charlton, K., & Kelly, B. (2021). Experiential Learning Interventions and Healthy Eating Outcomes in Children: A Systematic Literature Review. International journal of environmental research and public health, 18(20), 10824. https://doi.org/10.3390/ijerph182010824

Vazquez-Moreno M, Perez-Herrera A, Locia-Morales D, Dizzel S, Meyre D, Stearns JC, & Cruz M. (2021) Association of gut microbiome with fasting triglycerides, fasting insulin and obesity status in Mexican children. Pediatric Obesity, 16(5). https://doi.org/10.1111/ijpo.12748

Velarde, E.R., Garibay, E.M.V., Román, Y.A.A., Reyes, S.F., Toral, E.C., & Sanromán, R.T. (2013). Waist circumference and its association with cardiovascular risk factors in obese children and adolescents. Bol Med Hosp Infant Mex, 70(5), 357-361.

Vieira, D.A.S., Castro, M.A., Fisberg, M. & Fisberg R.M. (2017). Nutritional quality of dietary patterns of children: are there differences inside and outside school?. J Pediatr, 93(1), 47-57. http://dx.doi.org/10.1016/j.jped.2016.03.008

Villinger, K., Wahl, D.R., Boeing, H., Schupp, H.T., & Renner, B. (2019). The effectiveness of app-based mobile interventions on nutrition behaviours and nutrition-related health outcomes: A systematic review and meta-analysis. Obesity Reviews, 20, 1465–1484. https://doi.org/10.1111/obr.12903

Walker, J. L., Ardouin, S., & Burrows, T. (2018). The validity of dietary assessment methods to accurately measure energy intake in children and adolescents who are overweight or obese: a systematic review. European journal of clinical nutrition, 72(2), 185–197. https://doi.org/10.1038/s41430-017-0029-2

Wambua, M., Vang, M., Audi, C., Linzer, M., & Eton, D. T. (2022). Lessons learned: Recruiting research participants from an underrepresented patient population at a Safety Net Hospital. Journal of General Internal Medicine, 37(4), 922–927. https://doi.org/10.1007/s11606-021-07258-7

Wang, J., Zhuang, P., Lin, B. et al. (2024). Gut microbiota profiling in obese children from Southeastern China. BMC Pediatr 24, 193. https://doi.org/10.1186/s12887-024-04668-4

Weihrauch-Blüher, S., Schwarz, P., & Klusmann, J. H. (2019). Childhood obesity: increased risk for cardiometabolic disease and cancer in adulthood. Metabolism: Clinical and Experimental, 92, 147–152. https://doi.org/10.1016/j.metabol.2018.12.001

Whatnall, M.C., Sharkey, T., Hutchesson, M.J., Haslam, R.L., Bezzina, A., Collins, C.E., et al., (2021). Effectiveness of interventions and behaviour change techniques for improving physical activity in young adults: A systematic review and meta-analysis. Journal of Sports Sciences, 39(15), 1754–1771. https://doi.org/10.1080/02640414.2021.1898107

Wilkie, H. J., Standage, M., Gillison, F. B., Cumming, S. P., & Katzmarzyk, P. T. (2018). Correlates of intensity-specific physical activity in children aged 9-11 years: a multilevel analysis of UK data from the International Study of Childhood Obesity, Lifestyle and the Environment. BMJ open, 8(2), e018373. https://doi.org/10.1136/bmjopen-2017-018373

Willmott, T.J., Pang, B. & Thiele, S.R. (2021). Capability, opportunity, and motivation: an across contexts empirical examination of the COM-B model. BMC Public Health 21(1014), 1-17 https://doi.org/10.1186/s12889-021-11019-w

World Health Organisation (2020a). Obesity. Retrieved October, 21, 2020, from https://www.who.int/news-room/facts-in-pictures/detail/6-facts-on-obesity

World Health Organisation (2020b). Noncommunicable diseases country profiles 2018. Retrieved October, 21, 2020, from https://www.who.int/nmh/publications/ncd-profiles-2018/en/

World Health Organisation (2024). Obesity and overweight. Retrieved September, 23, 2024, from https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

World Health Organisation. (2022a). International Classification of Diseases, Eleventh Revision (ICD-11) for mortality and morbidity statistics. Retrieved January, 6, 2023, from https://icd.who.int/browse11/l-m/en

World Health Organisation (2022b). WHO European regional obesity report 2022. Retrieved December, 12, 2023, from https://www.who.int/europe/publications/i/item/9789289057738#:~:text=Overweight%20and%20obesity%20affect%20almost,pressure%2C%20dietary%20risks%20and%20tobacco.

World Health Organisation (2023). Health service delivery framework for prevention and management of obesity. Retrieved March, 31, 2024, from https://www.who.int/publications/i/item/9789240073234

World Health Organization. (2024). Growth reference 5-19 years - BMI-for-age (5-19 years). Retrieved March, 25, 2024, from https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age.

Wright, C.M. & Cole, T.J. (2011). UK-WHO chart source data.

Yan, H., Karmur, B. S., & Kulkarni, A. V. (2020). Comparing Effects of Treatment: Controlling for Confounding. Neurosurgery, 86(3), 325–331. https://doi.org/10.1093/neuros/nyz509

Zheng, X., Wang, H., & Wu, H. (2023). Association between diet quality scores and risk of overweight and obesity in children and adolescents. BMC pediatrics, 23(1), 169. https://doi.org/10.1186/s12887-023-03966-7

Zimmet, P., Alberti, K.G., Kaufman, F., Tajima, N., Silink, M., Arslanian, S., et al., (2007). The metabolic syndrome in children and adolescents - an IDF consensus report. Pediatric Diabetes, 8(5), 299–306. https://doi.org/10.1111/j.1399-5448.2007.00271.x

APPENDICES

Appendix 3A

Otherwise healthy criteria

CRITERIA FOR OTHERWISE HEALTHY

Articles will be INCLUDED if participants are described by authors as obese or overweight and 'otherwise healthy' (See example 1). Articles will be EXCLUDED if there is no information about the participants' physical or mental health or medication (See example 2 and 3). Articles will be EXCLUDED if the participants have any of the conditions in A* **AND** B* **AND** C* (See example 4).		
A* ***Physical health conditions or chronic or acute disease illness***	B* ***Mental health conditions or psychiatric disorders***	C* ***Medication***
-Dyslipidemia, -Hypertension, -Pre-diabetes, -Diabetes, -Thyroid disease, -Other endocrine disorders -Cardiovascular disease, -Cancer, -Metabolic syndrome, - Prada Willi syndrome, - Single gene defects - Genetic disorders -Other physical health conditions that might affect body weight, appetite, physical activity or behaviour.	-Schizophrenia, -Autism, -Psychosis, -Mental retardation, -Eating disorder, -Mania, -Dementia, -Attention deficit hyper activity disorder (ADHD), -Developmental/intellectual or learning disabilities, need special education -Behavioural problems -Substance abuse disorder -Other mental health conditions that might affect body weight, appetite, physical activity or behaviour. -Common conditions like depression or anxiety will not be considered as exclusion criteria unless they are described as 'serious'	-Taking any prescribed medication -Taking any 'over the counter' or self-purchased medication that might affect body weight, appetite, physical activity or behaviour.

However, If the reviewer cannot decide the article will be discussed between two reviewers to make a decision. If the two reviewers do not agree, a third reviewer will review the article and the decision will be based on a majority's decision.

Example	Phrase from articles	Decision
Example 1:	Eligible participants were overweight or obese but otherwise healthy, who could attend group session with parent/carer.	INCLUDED IN SYSTEMATIC REVIEW
Example 2:	Participants included adolescents attending a XXX school in England.	EXCLUDED FROM SYSTEMATIC REVIEW
	Explanation: No information about the participant's physical or mental health or medication	
Example 3:	Any subject undergoing psychotherapy, drug therapy, or who was involved in a weight-reduction programme was excluded. *Explanation*: No information about the participant's physical health	EXCLUDED FROM SYSTEMATIC REVIEW
Example 4:	Parents who reported children having co-morbidities, chronic diseases, physical disabilities, learning disabilities, on medication for chronic illness or participated in other research were excluded. Explanation: They excluded the participants who were having co-morbidities, chronic diseases, physical disabilities (A*), learning disabilities (B*) and on medication (C*)	INCLUDED IN SYSTEMATIC REVIEW

Appendix 3B

Examples of explaining BCTs

Example of Behaviour Change Technique (BCT)
BCT = 1.1 Goal setting (behaviour) ● Children agreed to reduce fat content in their diet ● Adolescents agreed to take a fifteen minute walk
BCT = 1.2 Problem solving ● Children wrote down the main barrier to dietary change they had encountered and how they planned to overcome each in the coming week ● Adolescents discussed possible barrier to dietary change and how to overcome that barrier
BCT = 2.3 Self-monitoring of behaviour ● Children were asked to record food diary, noting what they ate and for how much or how many
BCT = 6.1 Demonstration of the behaviour ● Children were shown the correct way to stretch while a health professional emphasised the importance of stretching
BCT = 6.2 Social comparison ● Adolescents were asked to share publicly how much they exercised
BCT = 8.1 Behaviour practice/rehearsal ● Adolescents practiced jogging at different speeds
BCT = 9.1 Credible source ● Children watched a short message delivered by a successful athlete outlining the importance of physical activity ● Children were shown the correct way to stretch while a health professional emphasised the importance of stretching
BCT = 10.2 Material reward (behaviour) ● Children received 1 pound for every additional hour that they spent studying

Appendix 3C

Search strategies

Database		Search strategies	Time span
PubMed	#1	Search "behaviour change" OR "behavior change" OR"behaviour change technique" OR "behaviour change techniques" OR "behavior change technique" OR "behavior change techniques" OR "behavioural change technique" OR "behavioural change techniques" OR "behavioral change technique" OR "behavioral change techniques" OR "behaviour change intervention" OR "behaviour change interventions" OR "behavior change intervention" OR "behavior change interventions" OR "behavioural change intervention" OR "behavioural change interventions" OR "behaviour modification" OR "behaviour modifications" OR "behavior modification" OR "behavior modifications" OR "behavioural modification" OR "behavioural modifications" OR "behavioral modification" OR "behavioral modifications" OR "behaviour therapy" OR "behavior therapy" OR "behavioural therapy" Sort by: Best Match	13.11.2019
	#2	Search goals OR planning OR "goal setting" OR "problem solving" OR "action planning" OR "behavioral contract" OR "behavioural contract" OR "commitment" Sort by: Best Match	
	#3	Search feedback OR monitoring OR "social support" OR "shaping knowledge" OR "Natural consequences" OR "social comparison" OR "habit formation" OR reward OR threat OR "self reward" Sort by: Best Match	
	#4	Search obese OR obesity OR overweight OR "weight management" OR "weight loss" OR "weight control" OR "weight reduction" Sort by: Best Match	

Database		Search strategies	Time span
	#5	Search "behaviour change" OR "behavior change" Sort by: Best Match	
	#6	#1 AND #4	
	#7	#2 AND #4	
	#8	(#4 AND #6) AND #5	
	#9	#7 OR #8	
Cochrane	#1	("behaviour change"):ti,ab,kw	13.11.2019
	#2	("behaviour change technique"):ti,ab,kw	
	#3	("behaviour change intervention"):ti,ab,kw	
	#4	("behaviour therapy"):ti,ab,kw	
	#5	("behaviour modification"):ti,ab,kw	
	#6	#1 OR #2 OR #3 OR #4 OR #5	
	#7	(goals OR planning OR "goal setting" OR "problem solving" OR "action planning" OR "behavioral contract" OR "commitment"):ti,ab,kw	
	#8	(feedback OR monitoring OR "social support" OR "shaping knowledge" OR "natural consequences" OR "social comparison" OR "habit formation" OR reward OR threat OR "self reward"):ti,ab,kw	
	#9	#7 OR #8	
	#10	(obese OR obesity OR overweight OR "weight management" OR "weight loss" OR "weight control" OR "weight reduction"):ti,ab,kw	
	#11	#6 AND #10	
	#12	#9 AND #10	
	#13	#11 OR #12	

Database		Search strategies	Time span
Scopus	#1	TITLE-ABS-KEY ("behavio* change technique" OR "behavio* change intervention" OR "behavio* modification" OR "behavio* therapy")	14/11/2019
	#2	TITLE-ABS-KEY (goals OR planning OR "goal setting" OR "problem solving" OR "action planning" OR "behavio* contract" OR "commitment")	
	#3	TITLE-ABS-KEY (feedback OR monitoring OR "social support" OR "shaping knowledge" OR "natural consequences" OR "social comparison" OR "habit formation" OR reward OR threat OR "self reward")	
	#4	TITLE-ABS-KEY ("behavio* change")	
	#5	TITLE-ABS-KEY (obes* OR overweight OR "weight management" OR "weight loss" OR "weight control" OR "weight reduction")	
	#6	#1 AND #5	
	#7	(#2 AND #4) AND #5	
	#8	(#3 AND #4) AND #5	
PsycArticles	1	Any Field: "behavio* change technique" OR Any Field: "behavio* change intervention" OR Any Field: "behavio* modification" OR Any Field: "behavio* therapy"	14.11.2019
	2	Any Field: goals OR Any Field: planning OR Any Field: "goal setting" OR Any Field: "problem solving" OR Any Field: "action planning" OR Any Field: "behavio* contract" OR Any Field: "commitment"	
	3	Any Field: feedback OR Any Field: monitoring OR Any Field: "social support" OR Any Field: "shaping knowledge" OR Any Field: "natural consequences" OR Any Field: "social	

Database		Search strategies	Time span
		comparison" OR Any Field: "habit formation" OR Any Field: reward OR Any Field: threat OR Any Field: "self reward"	
	4	Any Field: "behavio* change"	
	5	Any Field: obes* OR Any Field: overweight OR Any Field: "weight management" OR Any Field: "weight loss" OR Any Field: "weight control" OR Any Field: "weight reduction"	
	6	1 AND 5	
	7	2 AND 4 AND 5	
	8	3 AND 4 AND 5	
	9	6 OR 7 OR 8	
CINAHL Plus	S1	"behavio* change technique" OR "behavio* change intervention" OR "behavio* modification" OR "behavio* therapy"	14.11.2019
	S2	goals OR planning OR "goal setting" OR "problem solving" OR "action planning" OR "behavio* contract" OR "commitment"	
	S3	feedback OR monitoring OR "social support" OR "shaping knowledge" OR "natural consequences" OR "social comparison" OR "habit formation" OR reward OR threat OR "self reward"	
	S4	"behavio* change"	
	S5	obes* OR overweight OR "weight management" OR "weight loss" OR "weight control" OR "weight reduction"	
	S6	S1 AND S5	
	S7	S2 AND S4 AND S5	
	S8	S3 AND S4 AND S5	
	S9	S6 OR S7 OR S8	

Database	Search strategies	Time span
THAIJO	"behaviour change" AND obesity	23 – 25.10.2019
	"behaviour change" AND obese	
	"behaviour change" AND overweight	
	"behaviour change" AND "weight management"	
	"behavior change" AND obesity	
	"behavior change" AND obese	
	"behavior change" AND overweight	
	"behavior change" AND "weight management"	
	"goal setting" AND obesity	
	"goal setting" AND obese	
	"goal setting" AND overweight	
	"goal setting" AND "weight management"	
	"problem solving" AND obesity	

Appendix 3D

Protocol for a random 10% screening titles and abstracts

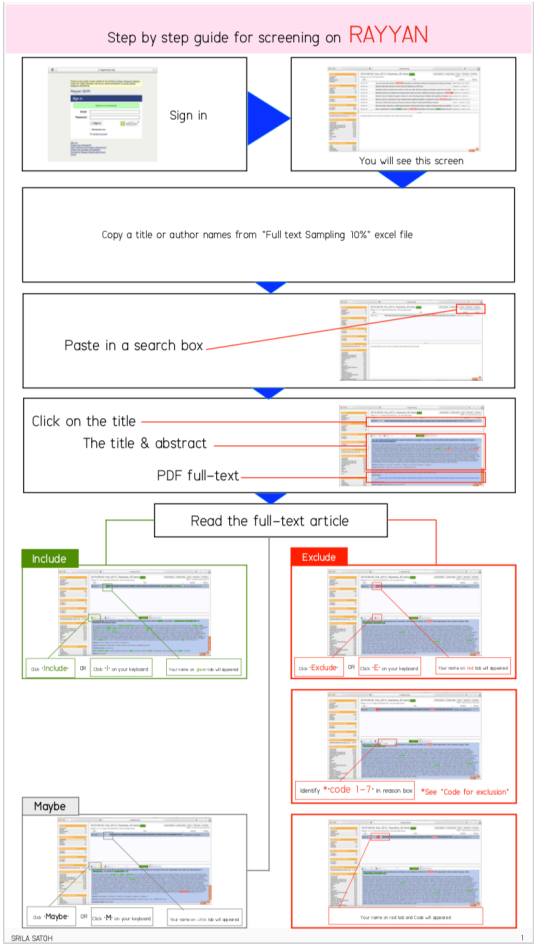
A protocol for selecting 10% screening by second researcher from supervisory team;

1. There are 26,680 articles from six databases after deleted duplicate. This will upload to RAYYAN – online web application (Ouzzani, Hammady, Fedorowicz and Elmagarmid, 2016).
2. This will select 10% of the articles by using simple random sampling which is 2,690 articles. This randomization will use computer generated random number internet-based system.
3. Export the articles from RAYYAN in CSV format file.
4. Export CSV format file to Excel format file.
5. Assign a number to the articles from 1 to 26,680
6. Find random number by using computer generated random number internet-based system (Urbaniak and Plous, 2020).
7. Select the articles by follow the number from computer generated random number internet-based system.
8. Search the articles on Rayyan by using titles or authors.
9. Screen the articles from titles and abstracts.
10. Identify a reason and/or label for excluding or including the articles following a protocol.

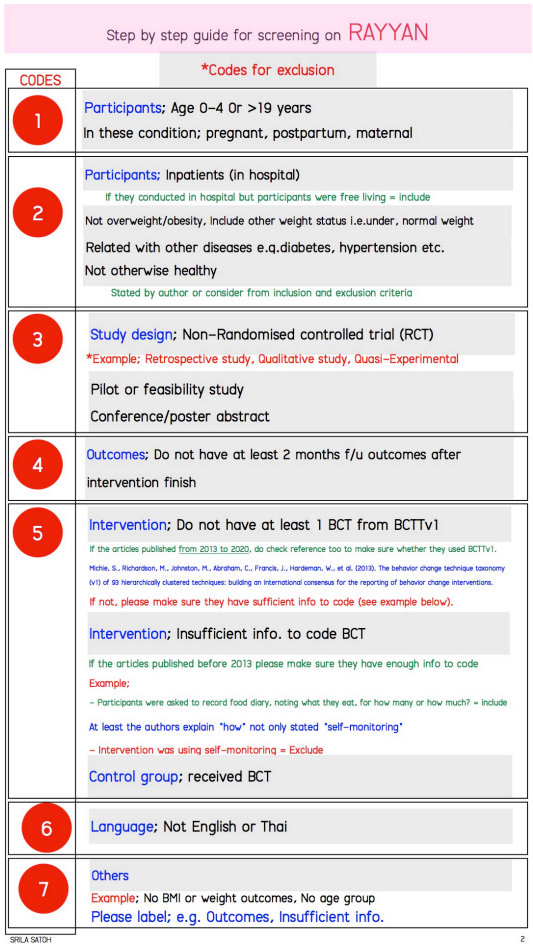
Appendix 3E

Documents for training the research team

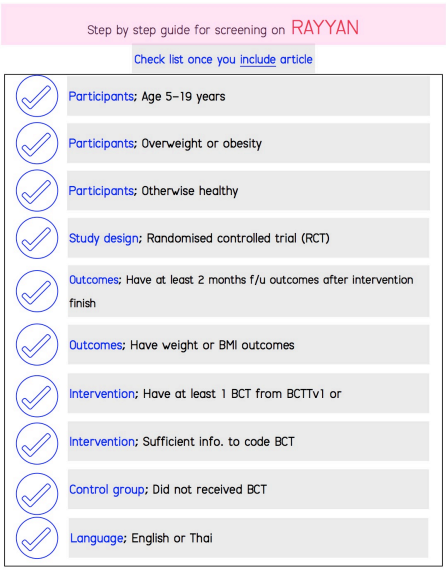
Step by step guide for screening on Rayyan



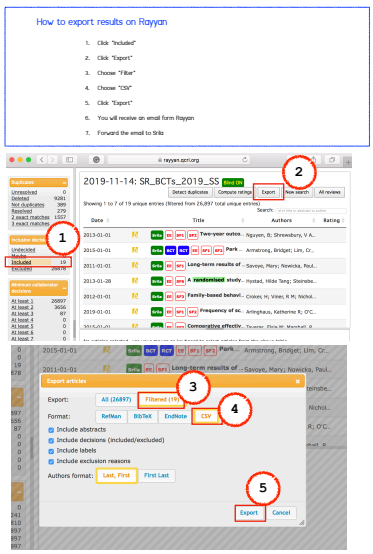
Codes for exclusion



Inclusion checklist



How to export on Rayyan



Appendix 3E (Cont.)

Documents for training of participants

Brief protocol

Introduction to RAYYAN online platform

A SYSTEMATIC REVIEW OF

BEHAVIOUR CHANGE INTERVENTIONS

FOR MANAGING OVERWEIGHT AND OBESE

CHILDREN AND ADOLESCENTS AGED 5-19 YEARS

Satoh, S., Madden, A. & Fallaize, R.

https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=141417

SRILA SATOH 2020.09.15 8

Introduction to RAYYAN online platform

A SYSTEMATIC REVIEW OF **BEHAVIOUR CHANGE INTERVENTIONS** FOR **MANAGING OVERWEIGHT** AND **OBESE CHILDREN** AND **ADOLESCENTS AGED 5-19 YEARS**

Research Questions

Which behaviour change techniques are most frequently used to manage overweight and obesity in children and adolescents aged 5-19 years?

Which are the most effective behaviour change techniques in managing overweight and obesity in children and adolescents aged 5-19 years?

SRILA SATOH 2020.09.15 9

Introduction to RAYYAN online platform

A SYSTEMATIC REVIEW OF **BEHAVIOUR CHANGE INTERVENTIONS** FOR **MANAGING OVERWEIGHT** AND **OBESE CHILDREN** AND **ADOLESCENTS AGED 5-19 YEARS**

Inclusion criteria

- Children & adolescents aged 5-19 years old,
- Overweight or obese, otherwise healthy
- Randomised control trial, at least 1 BCT
- Measure outcomes for at least 2 months after intervention finish

SRILA SATOH 2020.09.15 10

Otherwise healthy criteria

-See Appendix 3A

Example of explaining BCTs

-See Appendix 3B

BCTTv1

-See BCTTv1 and Michie et al., 2013

Prospero protocol (full version).

-See PROSPERO

Appendix 3F

Data extraction table form

Note: This was developed from the Cochrane data collection form for RCT intervention review (Li, Higgins and Deeks, 2020)
A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years

Note:

1.General information	1.1 Date of extraction (dd/mm/yyyy)	
	1.2 Name of person extracting data	
	1.3 Study ID (First author, year of publication)	
	1.4 Title	
	1.5 Journal	
	1.6 Source of funding, country	
	1.7 Notes	

	Study characteristic	**Eligibility criteria**	**Location in text** *(page/figure/table)*
2. Study eligibility	2.1 Type of study		
	2.2 Participants		
	2.3 Intervention		
	2.4 Comparison		
	2.5 Outcomes		
	2.6 Notes		

Appendix 3F

Data extraction table form (cont.)

		Description as stated in report	Location in text *(page/figure/table)*
3. Method	3.1 Aim of study		
	3.2 Type of study design		
	3.3 Ethical approval		
	3.4 Recruitment & sampling method		
	3.5 Study start date		
	3.6 Study end date		
	3.7 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
4. Participants	4.1 Total number of participants/sample size/gender		
	4.2 Age		
	4.3 Setting		
	4.4 Inclusion criteria		
	4.5 Exclusion criteria		
	4.6 Notes		

Appendix 3F

Data extraction table form (Cont.)

		Description as stated in report	Location in text *(page/figure/table)*	Decision *(Yes/No/Unclear)*
5. Intervention and control conditions	5.1 Name of intervention			
	5.2 Rationale, theory, goal			
	5.3 Materials/media used			
	5.4 Procedure			
	5.5 Providers			
	5.6 Mode of delivery			
	5.7 Locations			
	5.8 Duration & intensity			
	5.9 Tailoring (if)			
	5.10 Modifications			
	5.11 How well (planned)			
	5.12 How well (actual)			
	5.13 Control group			
	5.14 Notes			

		Description as stated in report	Location in text *(page/figure/table)*
6. Behaviour change techniques (BCTs)	6.1 Intervention group	BCT quote: BCT label: Note:	
	6.2 Number of BCTs in intervention group		
	6.2 Control group		
	6.3 Categorized by		
	6.4 Notes		

Appendix 3F

Data extraction table form (Cont.)

		Description as stated in report	Location in text *(page/figure/table)*
7. Results and finding	7.1 Primary outcomes (BMI, BMI z-score, weight, waist circumference (WC), percentage of body fat (%BF), or other method of body composition analysis determined using methods validated in children with overweight or obesity)		
	7.2 Secondary outcomes (Behaviour change i.e. dietary intake and physical activity that have been objectively assessed using validated instruments, mental health, quality of life, and self-esteem determined using objective methods validated in children).		
	7.3 Other outcomes (if available)		
	7.4 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
8. Limitation and	8.1 Strength		
	8.2 Limitation		
	8.3 Strategies to overcome limitation		
	8.4 Notes		

Appendix 3F

Data extraction table form (Cont.)

	Domain	Signaling questions	Description as stated in report	Location in text *(page/figure/table)*	Extractors' note *(Y/PY/PN/N/NI/NA)**	Extractors' judgement *(low/some concerns/high)*
9. Risk of Bias (RoB)	9.1 Randomization process	9.1.1 Was the allocation sequence random?				
		9.1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?				
		9.1.3 Did baseline differences between intervention groups suggest a problem with the randomization process? Note: Is this mean between intervention and control group?				
		RoB judgment 9.1				
	9.2 Intended intervention	9.2.1 Were participants aware of their assigned intervention during the trial?				
		9.2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?				
		Answer either ***effect of assignment to intervention*** (9.2.3-9.2.7) or ***effect of adhering to intervention*** (9.2.8-9.2.11)				
		Effect of assignment to intervention 9.2.3 If Y/PY/NI to 9.2.1 or 9.2.2: Were there deviations from the intended intervention that arose because of the trial context?				
		9.2.4 If Y/PY to 9.2.3: Were these deviations likely to have affected the outcome?				
		9.2.5 If Y/PY/NI to 9.2.4:				

		Were these deviations from intended intervention balanced between groups?				
		9.2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?				
		9.2.7 If N/PN/NI to 9.2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?				
		Effect of adhering to intervention 9.2.8 [If applicable:] If Y/PY/NI to 9.2.1 or 9.2.2: Were important non-protocol interventions balanced across intervention groups?				
		9.2.9 [If applicable:] Were there failure in implementing the intervention that could have affected the outcome?				
		9.2.10 [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcome?				
		9.2.11 If N/PN/NI to 9.2.8 or Y/PY/NI to 9.2.9 or 9.2.10: Was an appropriate analysis used to estimate the effect of adhering to intervention?				
		RoB judgment 9.2				
	9.3 Missing outcome data	9.3.1 Were outcome data available for all, or nearly all, participants randomization?				
		9.3.2 If N/PN/NI to 9.3.1: Is there evidence that the result was not biased by missing outcome data?				
		9.3.3 if N/PN to 9.3.2: Could missingness in the outcome depend on its true value?				

		9.3.4 If Y/PY/NI to 9.3.3: Is it likely that missingness in the outcome depended on its true value?				
		RoB judgment 9.3				
	9.4 Measurement of the outcome	9.4.1 Was the method of measuring the outcome inappropriate?				
		9.4.2 Could measurement or ascertainment of the outcome have differed between intervention groups? Note: Is it mean between intervention and control group or between intervention and intervention group in case they had more than 1 intervention groups? = Answer: intervention and control group				
		9.4.3 If N/PN/NI to 9.4.1 and 9.4.2: Were outcome assessors aware of the intervention received by study participants?				
		9.4.4 If Y/PY/NI to 9.4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?				
		9.4.5 If Y/PY/NI to 9.4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?				
		RoB judgment 9.4				
	9.5 Selection of the report result	9.5.1 Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis				
		Is the numerical result being assessed likely to have been selected, on the basis of the results, from.. (9.5.2 and 9.5.3)				

		9.5.2 Multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain? (check from a trial protocol or statistical analysis plan)				
		9.5.3 Multiple eligible analyses of the data? (check from a trial protocol or statistical analysis plan)				
		RoB judgment 9.5				
	9.4 Overall judgment (9.1-9.5)					
	9.5 Notes					

*Y=Yes, PY=Probably yes, PN=Probably no, N=No, NI=No information, NA=Not applicable

Appendix 3G

Protocol for coding BCTs

The following process was used to code BCTs used in the included intervention studies:

1. Four articles (Ahmad, Shariff, Mukhtar, and Lye, 2018; Croker et al., 2012; Golley, Magarey, Baur, Steinbeck and Daniels, 2007; Janicke et al., 2008) have been identified for data extraction in the systematic review and will be coded.
2. Two reviewers (SS&AMM) will code BCTs independently from the description of the intervention in the included articles (Ahmad, Shariff, Mukhtar, and Lye, 2018; Croker et al., 2012; Golley, Magarey, Baur, Steinbeck and Daniels, 2007; Janicke et al., 2008) and additional supporting articles i.e., published study protocols, supplementary papers (Ahmad, Lye, Shariff and Mukhtar, 2016; Golley, Perry, Magarey and Daniels, 2007; Janicke et al., 2008).
3. BCT coding will be based on the 93 behaviour change techniques described in BCTTv1 (Michie et al, 2013).
4. Both reviewers have successfully completed online training in using BCTTv1 to specify the content of complex behaviour change interventions from the UCL Centre for Behaviour Change (Michie et al, 2013)
5. Each reviewer will code a BCT as present in the included intervention studies if the text in either the published paper or supporting documents includes sufficient description to allow the judgement to be made that the BCT is “present in all probability”. They will also highlight the relevant text relating to each identified BCT to enable the decision to be confirmed.
6. Each reviewer will record their decisions on a BCT coding form specifically prepared for the purpose.
7. After completing independent coding, the first reviewer (SS) will use the completed BCT coding forms to compare BCTs codes identified by herself and the second reviewer (AMM).
8. Differences in the BCT codes identified by the first and second reviewer will be discussed with each other.
9. If the two reviewers do not agree after discussion, a third reviewer (RF) will review the BCT coding forms and further discussion if needed, then will make a final decision.

Appendix 3H

Data extraction

3H1: Ahmad et al., 2018

3H2: Croker et al., 2012

3H3: Golley et al., 2007

3H4: Janicke et al., 2008

3H1: Ahmad et al., 2018

A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years

Note: Extracted from Ahmad et al., 2018 and Ahmad et al., 2016 (ref 30)

1.General information	1.1 Date of extraction (dd/mm/yyyy)	21/03/2021
	1.2 Name of person extracting data	SS
	1.3 Study ID (First author, year of publication)	Ahmad, 2018
	1.4 Title	Family-based intervention using face-to- face sessions and social media to improve Malay primary school children's adiposity: a randomized controlled field trial of the Malaysian REDUCE programme.
	1.5 Journal	Nutrition Journal
	1.6 Source of funding, country	The research was funded by Universiti Putra Malaysia, grant number GP-IPS/ 2013/9398400. The funding agency did not influence the planning and execution of this study.
	1.7 Notes	

	Study characteristic	Eligibility criteria	Location in text *(page/figure/table)*
2. Study eligibility	2.1 Type of study	A two-armed, parallel, randomized controlled field trial	P.2
	2.2 Participants	Age: 7-10 years BMI percentile: N/A BMI: Intervention 25.2(3.5); Control 25.7(3.9) BMI z score: Intervention 2.0(0.4); Control 2.1(0.4) Diagnostic criteria for overweight or obesity: BMI z score > 1SD (WHO Anthroplus software, 2006)	P.3 P.6, T.2 P.3, P.4
	2.3 Intervention	Have at least 1 BCT/ sufficient info to code: Yes	
	2.4 Comparison	Waiting list	P.4
	2.5 Outcomes	Primary: Body Mass Index (BMI) z score Secondary outcomes: Waist circumference (WC), percentage total body fat Have at least 2-month f/u: Yes (Pre-post outcomes, follow-up at 3 and 6-month post training) Subjective/Objective outcomes: Objective outcomes (BMI z score, WC, percent total body fat)	P.4
	2.6 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
3. Method	3.1 Aim of study	…to evaluate the effectiveness of using social media and face-to-face sessions in a family-based intervention on the primary outcome of body mass index (BMI) z-score and secondary outcomes of waist circumference percentile and percentage total body fat.	P.2
	3.2 Type of study design	A two-armed, parallel, randomized controlled field trial	P.2
	3.3 Ethical approval	..approved by the Medical Research Ethics Committee for Human Research, Universiti Putra Malaysia (Ref: UPM/TNCPI/RMC/1.4.18.1(JKEUPM)/F2).	P.12
	3.4 Recruitment & sampling method	An urban area was chosen as the Malaysia National Health and Morbidity Survey showed that prevalence of childhood obesity was slightly higher in the urban areas than in the rural areas. All five primary government schools in this area were selected for this study……Brochures were sent to all the five schools informing parents about the intervention and the study and requesting them for consent to measure weight and height of their school-going children aged 7 to 10 years from August to September 2014. Those children whose parents gave written consent were screened for BMI z-score eligibility in October 2014. Parents who agreed to participate also provided consent on behalf of their children. Parents whose children with BMI z-score of more than 1 standard deviation (SD) were then invited to participate in the study.	P.2-3
	3.5 Study start date	N/A	
	3.6 Study end date	N/A	
	3.7 Notes		

<table>
<tr><th></th><th></th><th>Description as stated in report</th><th>Location in text
(page/figure/table)</th></tr>
<tr><td>4. Participants</td><td>4.1 Total number of participants/sample size/gender</td><td>Number of children:
<table><tr><td></td><td>At baseline</td><td>At follow-up</td></tr><tr><td>Total number</td><td>134</td><td>134</td></tr><tr><td>Gender</td><td></td><td></td></tr><tr><td>Male</td><td>56</td><td>56</td></tr><tr><td>Female</td><td>78</td><td>78</td></tr><tr><td>Intervention group</td><td>67</td><td>67</td></tr><tr><td>Control group</td><td>67</td><td>67</td></tr></table>
Number of parents:
<table><tr><td></td><td>At baseline</td><td>At follow-up</td></tr><tr><td>Total number</td><td>134</td><td>122</td></tr><tr><td>Gender</td><td></td><td></td></tr><tr><td>Male</td><td>28</td><td>30</td></tr><tr><td>Female</td><td>39</td><td>37</td></tr><tr><td>Intervention group</td><td>67</td><td>64</td></tr><tr><td>Control group</td><td>67</td><td>58</td></tr></table>
Note: follow-up at 6-month, participants are parent-child dyads</td><td>P.6, F.1</td></tr>
</table>

<table>
<tr><td></td><td>4.2 Age</td><td>Age group:<table><tr><td></td><td>Mean age</td><td>SD</td></tr><tr><td>Over all (n=134)</td><td>NA</td><td>NA</td></tr><tr><td>Intervention group (n=67)</td><td>9.6</td><td>1.2</td></tr><tr><td>Control group (n=67)</td><td>9.6</td><td>1.2</td></tr></table></td><td>P.6, T.2</td></tr>
<tr><td></td><td>4.3 Setting</td><td>The Faculty of Medicine and Health Sciences, University Putra Malaysia</td><td>P.4</td></tr>
<tr><td></td><td>4.4 Inclusion criteria</td><td>Parents whose children with BMI z-score of more than 1 standard deviation (SD) were then invited to participate in the study. Parent-child dyads of Malay ethnicity who were computer literate, had access to the internet, were willing to use social media for interaction and children 7 to 10 years of age were recruited.</td><td>P.3</td></tr>
<tr><td></td><td>4.5 Exclusion criteria</td><td>Parents who reported children having co-morbidities, chronic diseases, physical disabilities, learning disabilities, on medication for chronic illness or participated in other research were excluded.</td><td>P.3</td></tr>
<tr><td></td><td>4.6 Notes</td><td>-</td><td></td></tr>
</table>

		Description as stated in report	Location in text *(page/figure/table)*	Decision *(Yes/No/Unclear)*
5. Intervention and control conditions	5.1 Name of intervention	The REDUCE (REorganise Diet, Unnecessary sCreen time and Exercise) intervention programme.	P.3	Yes
	5.2 Rationale, theory, goal	Healthy lifestyle programmes that are socio-culturally customized may be more effective and thus this intervention programme was tailored to the Malay ethnicity. Parents can influence the eating behaviour and physical activities of their children; thus intervention programmes that targeted parents as the agent of change had their roots decades ago. However, parents often had other commitments that hindered their adherence to face-face intervention programmes. New approaches to educate parents in nutrition and physical activity have emerged - there is an increasing trend in using social media as a mode of communication among young people and adults. The REDUCE intervention programme to impart information and skills was a newly developed programme by the researchers using **social cognitive theory** (SCT). The programme trained the parents on children's nutrition, physical activity, behaviour modification techniques and parenting skills to improve their children's health behaviours. The SCT posits beahviour as a reciprocal interaction between the person and environmental factors. The person is the child and the environment is the home environment and the parental factors that are conductive to the children's behaviour change.	P.2; P.3	Yes
	5.3 Materials/media used	Facebook and WhatsApp	P.4	Yes
	5.4 Procedure	The child's ultimate daily targeted behaviours included no consumption of sugar-sweetened beverages (SSB) and unhealthy snacks, intake at least	P.3;	Yes

five servings of fruit and vegetables (two serving of fruit and three servings of vegetables), a minimum of 30 min of moderate to vigorous physical activity and a maximum of 120 min of screen time (watching television and playing video games). However, parents and children were empowered to choose which of the five targets to start working towards, first starting with the more manageable to achieve targets and to make small changes, one at a time.

The elements of behaviour modification skills in the SCT include self-monitoring, goal setting, self-efficacy, problem solving, relapse prevention, and stimulus control.

Parents were encouraged to acquire authoritative parenting skills, practice healthy behaviours and improve self-efficacy of child's healthy behaviours.

The training contents are summarized in Table 1

Week	Unit	Approach	Themes	Behaviour modification techniques
1	1	Face-to-face Session one	Introduction, obesity overview, parenting skills and role modelling	Goal setting, self-monitoring, self-efficacy, problem solving and

P.4, T.1

						stimulus control		
			2		Sugar-sweetened beverages			
		2	3	Facebook	Fruits and vegetables	Goal setting, self-monitoring, self-efficacy, problem solving and stimulus control		
			4		Unhealthy snacks			
		3	5		Physical activity			
			6		Screen time			
		4	7	Face-to-face Session two	Risky situations and review of performance	Relapse prevention		
			8		Further roles and actions, exercise tips and success stories			
		All units were delivered to parents only, except for unit 7 and 8 which were delivered to parents and children.						

		The aims of the booster phase were to strengthen parents' knowledge and skills in promoting the targeted behaviours of the REDUCE programme. In this phase the first author (NA) posted on WhatsApp key information and skills provided in the training phase but in the form of a poster, responded to any queries by parents and provided feedback on the adiposity progress of the children based on measurements taken. Parents were encouraged to enquire and discuss with the researcher and to interact with other parents in the intervention group in order to promote programme adherence and maintain motivation using this platform.		
	5.5 Providers	All the training sessions were delivered by the first author (NA) who is a public health physician except for the exercise tips in unit 8 which was conducted by a sports medicine specialist.	P.4	Yes
	5.6 Mode of delivery	All 4 units delivered in the face-to-face sessions were subsequently uploaded on the Facebook after each session. The booster phase…using parents' dedicated WhatsApp group...	P.4	Yes
	5.7 Locations	The face-to-face sessions were conducted at the Faculty of Medicine and Health Sciences, University Putra Malaysia.	P.4	Yes
	5.8 Duration & intensity	The four-month REDUCE intervention programme consisted of 4 weeks of weekly training and 3 months of weekly booster. The four-week training phase of the REDUCE intervention module was comprised of 8 units; 2 units were delivered through half-day face-to-face sessions (session one) followed by 2 units delivered weekly via Facebook	P.3,4	Yes

		for 2 weeks, and finally the last 2 units delivered via half-day face-to-face sessions (session two). The booster phase of the REDUCE intervention programme were weekly one-hour sessions using parents' dedicated WhatsApp group that lasted for 12 weeks. The total contact time between researcher and participants was 22 h. (via WhatsApp) Note: Data collection at baseline, month 4 (at the end of the intervention), month 7 and month 10		
	5.9 Tailoring (if)	However, parents and children were empowered to choose which of the five targets to start working towards, first starting with the more manageable to achieve targets and to make small changes, one at a time.	P.3	Yes
	5.10 Modifications	No information Note: Modified intervention at the study level. This might be because Ahmad study did not have any modification at the study level so this was not report.		NI
	5.11 How well (planned)	Programme adherence was assessed by percentage of parents who attended the face-to-face sessions, and accessed the information in the Facebook as well as message in the WhatsApp. Parents' responses were also compared between Facebook and WhatsApp. **From Ahmad, 2016 (Study protocol)** Intervention's fidelity	P.4; P.101	Yes

		To ensure the intervention's compliance with the training sessions, several measures are taken including incentives for attending training sessions (RM20 per session), returning questionnaires (stationary materials), and fee-free sessions. Intervention fidelity in social media is encouraged by group discussion among participants-researcher and participants-participants and ensuring confidentiality and privacy by creating a dedicated group in Facebook and WhatsApp which can be assessed by selected members only. To encourage participation and prevent drop-outs from the wait list group, incentives are given to children after the child's physical measurements are taken and upon the return of the parent-completed questionnaire for each follow-up. These incentive are similar to those received by the intervention group which are mainly stationary materials.		
	5.12 How well (actual)	Programme adherence 96.9% of parents participated in WhatsApp and 81.3% in Facebook respectively, compared to 68.8% for session one and 42.2% for session two of the face-to-face sessions. One quarter of the parents' responses (82/356) expressed support for the programme. One fifth of the responses (77/356) shared the parents' or their child's progress. One fifth of the responses (75/356) gave simple replies. Children:	P.5	Yes

		There was complete data for anthropometry and body fat percentage of all the children at all four time points. Parents: One hundred and twenty-two parents completed this study giving an overall response rate of 91% among participants (64 parents in the intervention group and 58 parents in the wait-list control group were available for analysis).		
	5.13 Control group	The wait-list control group received the intervention after the completion of the final 6-month follow-up.	P.4	
	5.14 Notes	This study used the CONSORT 2017 Item 3b of CONSORT 2017: Important changes to methods after trial commencement (such as eligibility criteria), with reasons. The answer was not applicable) This was explained about method not intervention so this was not related with 5.10 Modification from TIDieR		

Note: 6 BCTs, see Appendix 3I – BCTs coding

		Description as stated in report	Location in text *(page/figure/table)*
7. Results and finding	7.1 Primary outcomes (BMI, BMI z-score, weight, waist circumference (WC), percentage of body fat (%BF), or other method of body composition analysis determined using methods validated in children with overweight or obesity)	**Table 4** Changes in child's adiposity between intervention and wait-list groups from baseline to 6-month post-training	P.7, T.4

Variables	Data ($N = 134$) Means ± SD			
	Baseline	Immediately post-training	3-month post-training	6-month post-training
BMI z-scores				
Intervention group ($n = 67$)	2.05 ± 0.40	2.03 ± 0.38	1.99 ± 0.41	1.95 ± 0.45
Wait-list group ($n = 67$)	2.11 ± 0.39	2.10 ± 0.36	2.11 ± 0.35	2.09 ± 0.35
t-test (p-value)	- 0.879 ($p = 0.381$)	−1.158 ($p = 0.249$)	−1.730 ($p = 0.086$)	−2.025 ($p = 0.045$)[a]
Mean difference	− 0.06	− 0.07	−0.11	− 0.14
95% CI for mean difference	−0.194 to 0.075	− 0.200 to 0.052	−0.244 to 0.016	- 0.278 to - 0.003
Waist circumference percentile				
Intervention group ($n = 67$)	90.21 ± 7.98	91.09 ± 7.71	90.06 ± 9.56	89.37 ± 9.26
Wait-list group ($n = 67$)	91.28 ± 7.04	93.82 ± 4.31	92.25 ± 6.11	92.55 ± 6.20
t-test (p-value)	− 0.826 ($p = 0.410$)	− 2.532 ($p = 0.013$)[a]	− 1.583 ($p = 0.116$)	−2.335 ($p = 0.021$)[a]
Mean difference	− 1.07	−2.73	− 2.19	−3.18
95% CI for mean difference	−3.647 to 1.498	−4.871 to −0.592	−4.940 to 0.552	−5.876 to − 0.482
Percentage of body fat				
Intervention group ($n = 67$)	37.87 ± 4.20	37.68 ± 4.14	36.66 ± 4.75	36.75 ± 4.75
Wait-list group ($n = 67$)	37.63 ± 4.09	37.23 ± 4.50	37.65 ± 4.25	37.25 ± 4.46
t-test (p-value)	0.333 ($p = 0.740$)	0.603 ($p = 0.548$)	−1.263 ($p = 0.209$)	− 0.630 ($p = 0.530$)
Mean difference	0.24	0.45	−0.98	−0.50
95% CI for mean difference	−1.178 to 1.654	− 1.027 to 1.927	−2.524 to 0.557	− 2.077 to − 1.074

[a]Significant at $p \leq 0.05$, *SD* standard deviation, *CI* confidence interval

P.8, T.5

P.9, T.6

Table 5 Comparison of changes in adiposity within groups between baseline and six-month follow-up

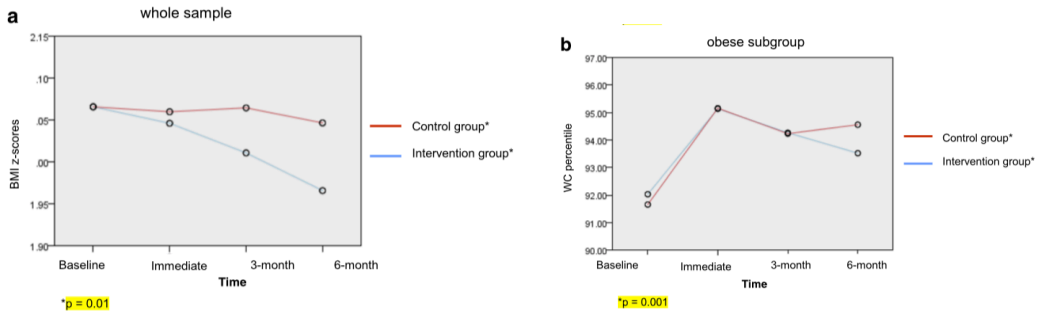
	Mean difference ± SD baseline vs 6-month[c]	t	*p*-value [a]
BMI z-score			
Whole sample			
Intervention group ($n = 67$)	0.100 ± 0.257	3.190	0.002[b]
Wait-list group ($n = 67$)	0.019 ± 0.172	0.907	0.368
Overweight children			
Intervention group ($n = 28$)	0.087 ± 0.367	1.257	0.220
Wait-list group ($n = 27$)	− 0.067 ± 0.185	−1.887	0.070
Obese children			
Intervention group ($n = 39$)	0.109 ± 0.136	5.022	< 0.001[b]
Wait-list group ($n = 40$)	0.077 ± 0.138	3.545	0.001[b]
Waist circumference percentile			
Whole sample			
Intervention group ($n = 67$)	1.373 ± 11.079	1.014	0.314
Wait-list group ($n = 67$)	−1.343 ± 9.019	−1.219	0.227
Overweight children			
Intervention group ($n = 28$)	5.357 ± 14.095	2.011	0.054
Wait-list group ($n = 27$)	0.963 ± 9.382	0.533	0.598
Obese children			
Intervention group ($n = 39$)	−1.487 ± 7.207	−1.289	0.205
Wait-list group ($n = 40$)	− 2.900 ± 8.533	−2.149	0.038[b]
Percentage of total body fat			
Whole sample			
Intervention group ($n = 67$)	0.912 ± 6.053	1.234	0.222
Wait-list group ($n = 67$)	0.655 ± 6.694	0.801	0.426
Overweight children			
Intervention group ($n = 28$)	2.451 ± 6.736	1.926	0.065
Wait-list group ($n = 27$)	1.963 ± 5.961	1.711	0.099
Obese children			
Intervention group ($n = 39$)	−0.193 ± 5.330	−0.226	0.822
Wait-list group ($n = 40$)	−0.227 ± 7.083	−0.203	0.840

[a]Using paired t-test; SD: standard deviation
[b]Significant at $p \leq 0.05$;
[c]This difference is baseline minus 6 month, with minus value depicting a higher measurement at 6-month post-training compared to baseline

Table 6 Comparison of anthropometric measurements and body fat percentage between study groups, controlling for covariates

Variable	Parameter	F	df1	df2	p-value[a]
BMI z-scores					
Whole sample	Group	7.050	1	517	0.008[b]
($n = 134$)	Group x Time	2.817	6	517	0.010[b]
Overweight subgroup	Group	9.341	1	201	0.003[b]
($n = 55$)	Group x Time	1.218	6	201	0.299
Obese subgroup	Group	0.033	1	297	0.855
($n = 79$)	Group x Time	6.072	6	297	< 0.001[b]
Waist circumference percentile					
Whole sample	Group	13.935	1	517	< 0.001[b]
($n = 134$)	Group x Time	1.410	6	517	0.209
Overweight subgroup	Group	30.245	1	201	< 0.001[b]
($n = 55$)	Group x Time	1.683	6	201	0.127
Obese subgroup	Group	0.084	1	297	0.772
($n = 79$)	Group x Time	3.998	6	297	0.001[b]
Body fat percentage					
Whole sample-	Group	1.454	1	517	0.228
($n = 134$)	Group x Time	0.802	6	517	0.569
Overweight subgroup	Group	0.575	1	201	0.449
($n = 55$)	Group x Time	2.526	6	201	0.022[b]
Obese subgroup	Group	0.093	1	297	0.760
($n = 79$)	Group x Time	0.628	6	297	0.708

[a]Using generalized linear mixed model adjusted for child's age, child's gender, parents' body mass index, mother's education, father's education, family income, and child's baseline data (BMI z-score, waist circumference percentile and body fat percentage respectively)
[b]Significant at $p \leq 0.05$

		 **Fig. 2** Changes in BMI z-scores, waist circumference percentile and body fat percentage from the mixed model analysis, between baseline and at 6 months	P.10, Figure 2
	7.2 Secondary outcomes	Behaviour change in dietary: NA	
		Behaviour change in physical activity: NA	
		Mental health/quality of life/ self-esteem: NA	
	7.3 Other outcomes	NA	
	7.4 Notes	Age sub-group analyses were not available	

		Description as stated in report	Location in text *(page/figure/table)*
8. Limitation and mitigation strategy	8.1 Strength	NA	
	8.2 Limitation	1)Generalizability is limited due to the sample being among urban, Malay and educated parents. The respondents could possibly have been highly motivated parents. Parents' BMI was self-reported with possibility of recall bias being introduced. 2)The poor attendance in face-to-face sessions could have affected the effectiveness of the intervention. 3).the effect of other influences outside the home environment was not control for. 4)This study was retrospectively registered. However, there was no element of selective reporting for the study with the original protocol uploaded in its entirety.	P.11
	8.3 Strategies to overcome limitation	To minimize the poor attendance effect, the respective materials of the module were uploaded to Facebook, and the parents' adherence in Facebook was assessed by the number and percentage who accessed this module. However, we were not able to determine the association between adherence and outcomes as we did not measure individual adherence scores. Note: Only 2) had strategies to overcome the limitation	P.11
	8.4 Notes	Suggestion: future research should be conducted to have a longer follow-up with a cost-effectiveness study before implementing this programme in child obesity prevention programme.	P.11

	Domain	Signaling questions	Description as stated in report	Location in text *(page/figure/table)*	Extractors' note *(Y/PY/PN/N/NI/NA)**	Extractors' judgement *(low/some concerns/high)*
9. Risk of Bias (RoB)	9.1 Randomization process	9.1.1 Was the allocation sequence random?	Each parent-child dyad from all five schools was number coded by the first author (NA) and sent to a research assistant who performed a computer generated randomization list which allocated parents into intervention or waiting-list control groups using a simple randomization procedure of an online software (Research Randomiser) with 1:1 allocation.	P.3	Y	
		9.1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	This ensured the concealment of allocation from the rest of the researchers and participants.	P.3	Y	
		9.1.3 Did baseline differences between intervention groups suggest a problem with the randomization process? Note: Is this mean between intervention and control group?	There was no significant difference between the intervention and control groups at baseline. There was no unintended effect reported by the participants in the intervention and wait-list group	P.5	N	
		RoB judgment 9.1				Low

	9.2 Intended intervention	9.2.1 Were participants aware of their assigned intervention during the trial?	Participating parents were informed that the intervention would be done in stages. So, parents would have the understanding that some of them would be participating earlier than others. Eventually all in the wait-listed control group would undergo the same intervention as parents in the intervention group after the final data collection. Parents in the wait-list control group were not informed of the starting of the intervention for the intervention group. The intervention group was informed not to share their social media experience with other parents; in addition they did not know who were in the wait-listed group, hence minimizing contamination.	P.3	N	
		9.2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	The list was then provided to the first author to invite the intervention group for the REDUCE intervention program. Note: A person who was delivering the intervention aware of participants' assigned intervention i.e. first author who provided intervention	P.3	Y	
		Answer either ***effect of assignment to intervention*** (9.2.3-9.2.7) or ***effect of adhering to intervention*** (9.2.8-9.2.11)				
		Effect of assignment to intervention 9.2.3 If Y/PY/NI to 9.2.1 or 9.2.2: Were there deviations from the intended intervention that arose because of the trial context?	NI	NI	NI	
		9.2.4 If Y/PY to 9.2.3:	NA	NA	NA	

		Were these deviations likely to have affected the outcome?				
		9.2.5 If Y/PY/NI to 9.2.4: Were these deviations from intended intervention balanced between groups?	NA	NA	NA	
		9.2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	All follow-up outcomes were analysed with intention to treat analysis	P.5	Y	
		9.2.7 If N/PN/NI to 9.2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	NA	NA	NA	
		Effect of adhering to intervention 9.2.8 [If applicable:] If Y/PY/NI to 9.2.1 or 9.2.2: Were important non-protocol interventions balanced across intervention groups?	NA	NA	NA	
		9.2.9 [If applicable:]	NA	NA	NA	

		Were there failure in implementing the intervention that could have affected the outcome?				
		9.2.10 [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcome?	NA	NA	NA	
		9.2.11 If N/PN/NI to 9.2.8 or Y/PY/NI to 9.2.9 or 9.2.10: Was an appropriate analysis used to estimate the effect of adhering to intervention?	NA	NA	NA	
		RoB judgment 9.2				Some concern
	9.3 Missing outcome data	9.3.1 Were outcome data available for all, or nearly all, participants randomization?	Children: There was complete data for anthropometry and body fat percentage of all the children at all four time points. Parents: One hundred and twenty-two parents completed this study giving an overall response rate of 91% among parents (64 parents in the intervention group and 58 parents in the wait-list control group were available for analysis).	P.5	Y	

			Note: In Cochrane guideline stated that for continuous outcomes, availability of data from 95% of the participants will often be sufficient. This study included parent and child dyad as participants and we are focusing on children data which is completed so will identified as “yes”			
		9.3.2 If N/PN/NI to 9.3.1: Is there evidence that the result was not biased by missing outcome data?	All follow-up outcomes were analysed with intention to treat analysis Note: intention-to-treat analysis is a method that analyses all participants who are randomized and according to a group they were originally assigned.	P.5	Y	
		9.3.3 if N/PN to 9.3.2: Could missingness in the outcome depend on its true value?	NA	NA	NA	
		9.3.4 If Y/PY/NI to 9.3.3: Is it likely that missingness in the outcome depended on its true value?	NA Note: Reasons of withdrawal were busy with other commitments and not interested	NA P.6, F.1	NA	
		RoB judgment 9.3				Low

	9.4 Measurement of the outcome	9.4.1 Was the method of measuring the outcome inappropriate?	BMI z-score which was determined using the WHO Anthroplus software with weight in kg, height in cm, gender and age. Height was measured using a portable Seca stadiometer to the nearest 0.1 cm with bare feet. Weight was measured using the Omron Karada Scan (model HBF 212) to the nearest 0.1 kg with light clothing on and empty pockets. Waist circumference was measured using Seca non-extensible tape meter at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest at the end of normal expiration. The waist circumference was then converted to waist circumference percentile for Malaysian children by reading off the table on percentile values of WC (cm) by age and gender. Percentage of body fat was measured after weight measurement using the same scale to the nearest 0.1%. All physical measurements were per- formed by trained research assistants who were blinded regarding the allocation status of these children. The implementer of the intervention (NA) was not involved in any of these measurements. Each type of measurement was assigned to a designated trained research assistant to minimize inter-rater measurement bias.	P.4-P.5	N	
		9.4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?	Assessments were completed at baseline, immediate post-training, 3 months and 6 months post-training.	P.5	N	

		Note: Is it mean between intervention and control group or between intervention and intervention group in case they had more than 1 intervention groups? = Answer: intervention and control group	Note: used the same method in both groups (i.e. intervention and control group) see 9.4.1			
		9.4.3 If N/PN/NI to 9.4.1 and 9.4.2: Were outcome assessors aware of the intervention received by study participants?	This ensured the concealment of allocation from the rest of the researchers and participants. The implementer of the intervention was not involved in any of these measurements. Each type of measurement was assigned to a designated trained research assistant to minimize inter-rater measurement bias. Note: It is not clear whether accessors were blinded or not, only stated researchers and participants From Ahmad,2016 Parents and assessors who are research assistants (RAs) are unaware of the group allocation.	P.3; P.5; P.97	N	
		9.4.4 If Y/PY/NI to 9.4.3:	NA	NA	NA	

		Could assessment of the outcome have been influenced by knowledge of intervention received?				
		9.4.5 If Y/PY/NI to 9.4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	NA	NA	NA	
		RoB judgment 9.4				Low
	9.5 Selection of the report result	9.5.1 Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis	From Ahmad, 2016 (Protocol) All analysis followed the intention-to- treat principle where all parents and children for whom data are available on the basis of the group they are allocated regardless of their adherence to the protocol. Data analyses will be performed using SPSS version 22.0. Normality check will be conducted on all data prior to further analysis. Not normally distributed data will be transformed accordingly. Descriptive analysis will use mean with standard deviation, 95% Confidence Interval with p value significant at ≤ 0.05. Baseline demographic characteristics, BMI z-score, waist circumference percentile and percentage of total body fat will be compared between the intervention and wait-list control groups using Student's t-test and chi square	P.105	Y	

			test/ Fisher's exact test for continuous and categorical data respectively. Changes in BMI z-scores, waist circumference percentile, and percentage of total body fat will be compared between intervention and wait-list control groups using Student's t-test for continuous variables. A further analysis using the mixed model, adjusted for baseline covariates, will be performed. Parental mediation skills (knowledge, healthy lifestyles practices, authoritative feeding styles, and parents' self-efficacy) and children's mediation skills (eating behaviours, dietary intake, physical activity, and screen time) will be analysed similarly (and will also include chi square test for categorical variables). Note: Results were analyzed same as pre-specific plan in protocol.			
		Is the numerical result being assessed likely to have been selected, on the basis of the results, from.. (9.5.2 and 9.5.3)				
		9.5.2 Multiple eligible outcome measurements (e.g. scales,	BMI z-score which was determined using the WHO Anthroplus software with weight in kg, height in cm, gender and age. Height was measured using a portable Seca stadiometer to the	P.4-P.5	N	

		definitions, time points) within the outcome domain? (check from a trial protocol or statistical analysis plan)	nearest 0.1 cm with bare feet. Weight was measured using the Omron Karada Scan (model HBF 212) to the nearest 0.1 kg with light clothing on and empty pockets. Waist circumference was measured using Seca non-extensible tape meter at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest at the end of normal expiration. The waist circumference was then converted to waist circumference percentile for Malaysian children by reading off the table on percentile values of WC (cm) by age and gender. Percentage of body fat was measured after weight measurement using the same scale to the nearest 0.1%. Assessments were completed at baseline, immediate post-training, 3 months and 6 months post-training.			
		9.5.3 Multiple eligible analyses of the data? (check from a trial protocol or statistical analysis plan)	Data were analysed using SPSS version 22.0. Tests for normality were done using skewness, kurtosis, and graphs (histogram with normal distribution curve, whisker boxplot, and Q-Q and P-P plots) before further analyses were conducted. Non-normally distributed data were log transformed first before further analysis. **Differences between intervention and wait-list control at baseline** were tested using independent t-test (continuous variables) or chi-square test or Fischer's exact test (categorical variables) to examine the homogeneity between	P.5	N	

			groups. All follow-up outcomes were analysed with intention-to-treat analysis. **Changes in BMI z-score, waist circumference percentile and percentage of total body fat** were compared between intervention and wait-list control groups using independent t-test for continuous variables. **The effectiveness of the intervention was evaluated using generalized linear mixed modelling adjusted for baseline covariates**. Covariates included were variables that could affect body weight - child's age, child's gender, parents' BMI, parents' education, family income, and child's adiposity baseline measurements (BMI z-score, waist circumference percentile and percentage body fat). **Subgroup analysis was conducted for overweight and obese children.** Note: In the results, they reported all analysis according to the statistical analysis plan			
		RoB judgment 9.5				Low
	9.4 Overall judgment (9.1-9.5)					Some concern
	9.5 Notes					

*Y=Yes, PY=Probably yes, PN=Probably no, N=No, NI=No information, NA=Not applicable

3H2: Croker et al., 2012

A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years

Note: Extracted from Croker et al., 2012 and a supplement file

1.General information	1.1 Date of extraction (dd/mm/yyyy)	25/04/2021
	1.2 Name of person extracting data	Srila Satoh
	1.3 Study ID (First author, year of publication)	Croker, 2012
	1.4 Title	Family-based behavioural treatment of childhood obesity in a UK National Health Service setting: randomized controlled trial
	1.5 Journal	*Int J Obes (Lond)*
	1.6 Source of funding, country	Cancer Research UK, Great Ormond Street Hospital and Weight Concern, UK
	1.7 Notes	This trial was registered at http://www.controlled-trials.com/ as ISRCTN51382628

	Study characteristic	Eligibility criteria	Location in text *(page/figure/table)*
2. Study eligibility	2.1 Type of study	RCT	P.2
	2.2 Participants	Age: 8-12 years BMI percentile: NA BMI: 30.6(5.3) Intervention 30.6(5.1); Control 30.6(5.7) BMI z score: NA Intervention NA; Control NA BMI SDS 3.2(0.6) Intervention 3.1(0.6); Control 3.3(0.6) Diagnostic criteria for overweight or obesity: according to the International Obesity Task Force (IOTF) definition (Cole, Bellizzi, Flegal, and Dietz, 2000).	P.3; P.15, T.1; P.3
	2.3 Intervention	Have at least 1 BCT/ sufficient info to code: Yes	P.3
	2.4 Comparison	Waiting-list control	
	2.5 Outcomes	Primary outcome: post-treatment BMI SDS and BMI Secondary outcomes: post treatment %BMI, weight, weight SDS, height, height SDS, waist, and waist SDS, fat mass index, fat free mass index, blood pressure, and psychosocial outcomes Have at least 2-month f/u: Yes Subjective/objective outcomes: Objective outcomes: (BMI SDS, weight, height); Subjective outcomes: Psychosocial outcomes	P.4
	2.7 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
3. Method	3.1 Aim of study	The primary aim of the present study was to examine the impact of a 6 month FBBT programme carried out in a hospital setting on level of overweight (indexed by BMI SDS and BMI) in overweight and obese children aged 8-12 years, compared with a waiting list control group. We also examined effects on waist circumference, body composition, blood pressure, well-being (mood, self-esteem, quality of life), and eating attitudes.	P.2
	3.2 Type of study design	RCT	P.2
	3.3 Ethical approval	the Research Ethics Committee at Great Ormond Street/ Institute of Child Health (registration number 03BS18)	P.3
	3.4 Recruitment & sampling method	Participants were recruited through local professional networks in primary and secondary care, from schools and through information in local media. Families responding through the media were asked to seek a referral from their general practitioner (GP) to ensure that the intervention was properly integrated with their health care. Referred children were invited to an assessment appointment with one of the study clinicians, and an outpatient appointment with a paediatrician and a researcher who took anthropometric and body composition measures.	P.3
	3.5 Study start date	June 2004	P.3
	3.6 Study end date	January 2008	P.3
	3.7 Notes		

<table>
<tr><th></th><th></th><th>Description as stated in report</th><th>Location in text
(page/figure/table)</th></tr>
<tr><td>4. Participants</td><td>4.1 Total number of participants/sample size/gender</td><td>Number of children:
<table><tr><td></td><td>At baseline</td><td>At follow-up*</td></tr><tr><td>Total number</td><td>72</td><td>63</td></tr><tr><td>Gender</td><td></td><td></td></tr><tr><td>Male</td><td>22</td><td>NA</td></tr><tr><td>Female</td><td>50</td><td>NA</td></tr><tr><td>Intervention group</td><td>37</td><td>33</td></tr><tr><td>Control group</td><td>35</td><td>30</td></tr></table>Note: *Number at the end of the intervention (month 6). Follow-up at 6 months after intervention finished only in the intervention group where only n=19 for BMI and n=17 for WC.

Number of parents:
<table><tr><td></td><td>At baseline</td><td>At follow-up</td></tr><tr><td>Total number</td><td>59</td><td>NA</td></tr><tr><td>Gender</td><td></td><td></td></tr><tr><td>Male</td><td>NA</td><td>NA</td></tr><tr><td>Female</td><td>NA</td><td>NA</td></tr><tr><td>Intervention group</td><td>NA</td><td>NA</td></tr><tr><td>Control group</td><td>NA</td><td>NA</td></tr></table></td><td>P.14, F.1;
P.15, T.1;
P.18, T.2</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>4.2 Age</td><td>Age group: 8-12 years
<table><tr><td></td><td>Mean age</td><td>SD</td></tr><tr><td>Over all (n=72)</td><td>10.3</td><td>1.6</td></tr><tr><td>Intervention group (n=37)</td><td>10.8</td><td>1.6</td></tr><tr><td>Control group (n=35)</td><td>9.8</td><td>1.4</td></tr></table></td><td>P.3;
P.15, T.1</td></tr>
<tr><td></td><td>4.3 Setting</td><td>Great Ormond Street Hospital for children (GOSH), London</td><td>P.3</td></tr>
<tr><td></td><td>4.4 Inclusion criteria</td><td>Children were eligible to participate if they were 8-12 years of age, overweight or obese according to the International Obesity Task Force (IOTF) definition, had at least one parent or guardian willing to participate in treatment, and parent and child had sufficient command of English to participate in groups and understand the programme materials.</td><td>P.3</td></tr>
<tr><td></td><td>4.5 Exclusion criteria</td><td>Exclusion criteria were an identified medical cause for obesity (e.g. hypothyroidism, Prada Willi syndrome, single gene defects), type 2 diabetes, taking obesity medication, undergoing obesity treatment, significant learning difficulties, significant mental health problems in child or parent, or currently receiving psychological or psychiatric treatment including psychotrophic medication.</td><td>P.3</td></tr>
<tr><td></td><td>4.6 Notes</td><td>-</td><td></td></tr>
</table>

		Description as stated in report	Location in text *(page/figure/table)*	Decision *(Yes/No/Unclear)*
5. Intervention and control conditions	5.1 Name of intervention	A family-based behavioural treatment (FBBT)	P.1	Yes
	5.2 Rationale, theory, goal	FBBT is a structured intervention comprising advice on whole-family lifestyle change with a behavioural weight control programme for the overweight child. Children were required to attend with one parent or carer with a maximum of 8-10 families per group. The aims were to reduce fat and energy intake, increase physical activity, and change parent-child interactions. The behavioural programme is based on learning theory and uses behaviour modification techniques such as self-monitoring (daily food and activity diaries), goal setting, positive reinforcement, stimulus control, and relapse prevention to modify behaviour..	P.3-4	Yes
	5.3 Materials/media used	Eatwell plate, Traffic Light	P.4	Yes
	5.4 Procedure	Parents are instructed in behaviour management principles to support their child's behavior change and make changes to the home environment to encourage family-wide uptake of healthy lifestyle behaviours.	P.4	Yes

Cognitive component of the programme include advice on managing teasing and general problem-solving.

The key dietary targets were i) to follow a regular eating pattern, ii) to reduce snacking to no more than two occasions per day, and iii) to consume a balanced diet (as described in the 'eatwell plate' and 'Traffic Light system' in appropriate quantities.

Key physical activity targets were i) to reduce time spent in sedentary behaviours and ii) to increase the time spent in lifestyle or structured activity in line with the current UK recommendation of 60 minutes a day.

From supplement table1

Session & overall aims	Parent group content	Child group content
Session 1 **Introduction to the program** Icebreakers	SETTING UP THE GROUP Introductions Goals of the programme	SETTING UP THE GROUP Icebreakers Goals of the programme

		Anthropometric measures	Group rules KEY TOPICS Process of change Self-monitoring Introduction to the 'traffic light system' Modelling HOMEWORK Labelling foods using the 'traffic light system' Read chapter	Group rules KEY TOPICS Process of change Obesity – friend or foe Self-monitoring Introduction to the 'traffic light system' HOMEWORK Labelling foods using the 'traffic light system' Read chapter		
		Session 2 **Goal setting** Collect info re keeping a diary – problem solve difficulties Was goal achieved?	REVIEW HOMEWORK KEY TOPICS Stimulus control – no red foods at home Praise and rewards	REVIEW HOMEWORK KEY TOPICS More on the 'traffic light system' Goal setting (SMART)		

				Goal setting (SMART) Regular eating pattern HOMEWORK **Set a goal** Generate list of rewards	Stimulus control – no red foods at home Regular eating pattern HOMEWORK Set a goal		
			Session 3 **Nutrition (1)** Introduce healthy eating First feedback on diary	REVIEW HOMEWORK KEY TOPICS Regular eating pattern Eating the right balance of foods HOMEWORK	REVIEW HOMEWORK KEY TOPICS Regular eating pattern Learning about food groups HOMEWORK		
			Session 4 **Physical Activity**	REVIEW HOMEWORK KEY TOPICS	REVIEW HOMEWORK		

		Overview of different types of physical activity And monitoring sedentary behaviours	Increasing lifestyle exercise Decreasing sedentary behaviour HOMEWORK **Monitor sedentary behaviours**	KEY TOPIC Getting more active HOMEWORK Monitor sedentary behaviours			
		Session 5 **Nutrition (2)** Introduce portion sizes	REVIEW HOMEWORK KEY TOPICS Portion sizes Nutritional claims HOMEWORK **Set goal to reduce sedentary behaviours**	REVIEW HOMEWORK KEY TOPICS Food groups and target number of daily servings HOMEWORK Set goal to reduce sedentary behaviours			
		Session 6	REVIEW HOMEWORK	REVIEW HOMEWORK			

		Nutrition and Exercise review	KEY TOPICS **Increasing fruit and vegetable intake** Modelling HOMEWORK	KEY TOPIC Setting a good example Getting support from friends HOMEWORK			
		Session 7 **Cue control (1)**	REVIEW HOMEWORK KEY TOPICS Internal and external triggers to eating or inactivity Stimulus Control Response substitution HOMEWORK	REVIEW HOMEWORK KEY TOPICS Learning cues (internal and external triggers) Cue control (5 Only's) Response substitution HOMEWORK			
		Session 8	REVIEW HOMEWORK	REVIEW HOMEWORK			

		Social support **Cue control (2)**	KEY TOPICS Social Support Modelling HOMEWORK	KEY TOPIC Social support Managing teasing and bullying HOMEWORK			
		Session 9 **Planning ahead (1)**	REVIEW HOMEWORK KEY TOPICS Problem solving difficult situations HOMEWORK	REVIEW HOMEWORK KEY TOPICS Problem solving difficult situations HOMEWORK			
		Session 10 **Planning ahead (2)**	NB – no more chapters REVIEW HOMEWORK	NB – no more chapters REVIEW HOMEWORK			
			JOINT SESSION: KEY TOPICS Recap on managing difficult situations Managing the longer gap between sessions				

				HOMEWORK		
			Session 11 **Maintenance (1)**	REVIEW OF 2 WEEK GAP JOINT SESSION (Recap about healthy eating) Using food labels Red foods School lunches (healthy packed lunch and cooked lunch choices) Snack choices HOMEWORK		
			Session 12 **Maintenance (2)**	REVIEW HOMEWORK JOINT SESSION (Family problem solving) HOMEWORK		
			Session 13 **Maintenance (3)**	REVIEW HOMEWORK JOINT SESSION (Improving self-esteem) 'Marvellous Me' HOMEWORK		
			Session 14 **Maintenance (4)**	REVIEW HOMEWORK JOINT SESSION (Overview of program) Quiz		

		HOMEWORK		
		Session 15 **Ending** Post-treatment assessments and evaluation Farewell party, with healthy foods as a modelling exercise		
	5.5 Providers	The parents' groups were delivered by clinicians with experience of working with parents and families (psychologist, family therapist or experienced dietitian) and children's groups were delivered by a dietitian with experience of working with children and a researcher who assisted. Additional researchers carried out the brief one to-one family reviews	P.4	Yes
	5.6 Mode of delivery	Face-to-face, Group		Yes
	5.7 Locations	Great Ormond Street Hospital for children (GOSH), London		Yes
	5.8 Duration & intensity	The intervention comprised 15 sessions over 6 months (10 weekly, 3 fortnightly, 2 monthly). Sessions took place in the afternoon (after the school day) and lasted for approximately 1.5 hours; each consisted of a brief review (5-10 minutes) with individual families where they were given feedback and weighed, followed by concurrent but separate parent and child group sessions as in Epstein's protocol.	P.4	Yes

		Note: Data collection at baseline, month 6 (at the end of the intervention) and month 12.		
	5.9 Tailoring (if)	No information		No
	5.10 Modifications	No information		No
	5.11 How well (planned)	FBBT has sound theoretical underpinning, is well described in the literature, and in the present study, clinicians adhered to a treatment protocol. We were not able to formally evaluate fidelity to the protocol, but the same core group of clinicians carried out all treatment, and the programme had been manualized. Note: They stated clinician adhered to a treatment protocol but did not explain how. They stated that they did not assess fidelity. So, should this say yes or no or not available?	P.8	Unclear
	5.12 How well (actual)	22 of the children randomized to the treatment group completed the 6 month intervention (59% of those randomized and 73% of those starting treatment). The median number of sessions attended was 9.0 (IQR 10.50), and 18 (48.6%) children attended 10 or more sessions. 24 children in the	P.6	Unclear

		control group entered treatment at the end of the waiting list period with 16 completing. Note: See 5.11		
	5.13 Control group	A 6 month waiting-list control group Note: Had 2-month f/u outcomes only in the intervention group	P.3	
	5.14 Notes	This study used CONSORT 2010.		

Note: 6 BCTs, see Appendix 3I – BCTs coding

		Description as stated in report	Location in text *(page/figure/table)*
7. Results and findin	7.1 Primary outcomes (BMI, BMI z-score, weight, waist circumference (WC), percentage of body fat (%BF), or other method of body composition analysis determined using methods validated in children with overweight or obesity)	**Table 2** Between group changes over the 6 month intervention period	P.18, T.2;
			P.20-21, T.3

Outcome variable	Adjusted post intervention mean (sd)		Test statistic F (df)	P value
	Treatment group (n=33)	Control group (n=30)		
Anthropometric outcomes			**Wilks's Δ=0.68 3.53 (6, 44)**	**0.006** **
BMI	30.15 (1.17)	30.61 (1.18)	1.95 (1, 49)	0.17
Weight (kg)+	66.37 (3.03)	68.87 (3.06)	10.46 (1, 49)	0.002**
Height (cm)	149.92 (1.99)	151.37 (2.01)	6.75 (1, 49)	0.01*
Waist	89.58 (3.28)	90.48 (3.31)	0.97 (1, 49)	0.33
FM index	13.14 (1.12)	13.18 (1.13)	0.02 (1, 49)	0.90
FFM index	17.08 (0.77)	17.27 (0.78)	0.77 (1, 49)	0.38
Anthropometric outcomes (excl outlier)			**Wilks's Δ=0.65 3.84 (6, 43)**	**0.004** **
BMI	30.11 (0.97)	30.74 (0.98)	5.14 (1,48)	0.03*
Weight (kg) +	66.37 (2.70)	69.34 (2.73)	17.51 (1,48)	<0.001**
Height (cm)	150.01 (2.00)	151.45 (2.02)	6.41 (1,48)	0.02*
Waist	89.47 (3.24)	90.54 (3.28)	1.35 (1,48)	0.25
FM index	13.11 (1.00)	13.27 (1.01)	0.35 (1,48)	0.56
FFM index	17.09 (0.76)	17.32 (0.76)	1.20 (1,48)	0.28
Anthropometric outcomes (SDS)			**Wilks's Δ=0.86 1.96 (4, 48)**	**0.12**
BMI SDS+	3.11 (0.17)	3.09 (0.17)	-	-
Weight SDS	2.94 (0.15)	3.03 (0.16)	-	-
Height SDS	1.23 (0.26)	1.37 (0.26)	-	-
Waist SDS	3.30 (0.19)	3.30 (0.19)	-	-

Table 3

Within group changes over the 6 month intervention period

Outcome variable	Within group adjusted mean change (SD)	
	Treatment group (n= 33)	Control group (n=30)
BMI	−0.36 (1.06)	−0.03 (1.07)
BMI SDS	−0.11 (0.16) **	−0.10 (0.16) **
BMI (excluding outlier)	−0.35 (0.90)	+0.11 (0.91)
BMI SDS (excluding outlier)	−0.11 (0.14) **	−0.09 (0.14) **
% BMI	−3.74 (6.44) **	−2.88 (6.47) *
Weight (kg)	+0.79 (2.84) *	+2.78 (2.85) **
Weight SDS	−0.09 (0.15) **	−0.04 (0.15) *
Height (cm)	+1.67 (1.83) **	+3.11 (1.84) **
Height SDS	−0.005 (0.14) **	+0.07 (0.14)
Waist (cm)	−0.51 (3.23)	+0.18 (3.24)
Waist SDS	−0.09 (0.19) **	−0.10 (0.20) **
FM index (kg/m^2)	−0.15 (1.07)	−0.21 (1.07)
FFM index (kg/m^2)	0.15 (0.80)	0.33 (0.80)
Systolic BP SDS	−0.24 (0.71) *	−0.30 (0.71)
Diastolic BP SDS	−0.03 (0.86)	−0.14 (0.86)
SDQ total score[37]*b*	−1.07 (4.22)	−0.42 (4.23)
PedsQL total score[38]*a*		
Parent reported	+3.81 (9.08) *	+3.02 (9.10)
Child reported	+0.84 (11.79)	+4.01 (11.80)
CDI *t*-score[36]*b*	−1.80 (6.31)	−1.45 (6.33)
Harter global score[35]*a*	+0.20 (0.64) +	+0.14 (0.64)
CHEAT[39-40]*b*		
Total score	−2.30 (6.41) *	+0.17 (6.42)
Dieting scale	−1.70 (4.86) *	−0.81 (4.86)
Bulimia/ food	−0.76 (1.76) *	+0.18 (1.76)
preoccupation scale		
Oral control scale	+0.20 (2.20)	+0.76 (2.20)

* p<0.05, ** p<0.01, + p=0.05 (using paired t-tests or Wilcoxon signed-rank tests);

ITT analyses conducted using baseline values carried forward; change values adjusted for age (in months); outlier was a child in the control group; Numbers if data missing, for treatment and control group respectively, are: weight, height and BMI, n=27 for the control group; waist, n=31 and n=27; body composition, n=31and n=28; BP, n=29 and n=28; SDQ, n=21 and n=22; Harter, n=30 and n=26; CHEAT/ PedsQL/ CDI, n=31 and n=26;

[a] Increased score indicates an improvement; [b] Decreased score indicates an improvement: Abbreviations are: BMI=body mass index; FM=fat mass; FFM=fat free mass; BP=blood pressure; SDS=standard deviation score; SDQ=Strengths and Difficulties questionnaire; PedsQL=Pediatric Quality of Life Inventory; CDI=Children's Depression Inventory; CHEAT=Children's Eating Attitudes Test

		Table 4 Completers' analysis for the treatment group over the intervention and follow up period	P.22, T.4
	7.2 Secondary outcomes	NA	
	7.3 Other outcomes		P.18, T.2

Variable	Mean (SD)			F	P value	Post hoc tests (mean difference)		
	T1 (0 months)	T2 (6 months)	T3 (12 months)			T1-T2	T2-T3	T1-T3
BMI *(n=19)*	30.86 (5.55)	30.30 (5.67)	31.37 (5.62)	5.37	0.02 *	−0.56 *	+1.07 *	+0.51
BMI SDS *(n=19)*	3.14 (0.72)	2.98 (0.75)	3.03 (0.78)	6.18	0.005 **	−0.16 **	+0.06	−0.11
Weight (kg) *(n=19)*	71.50 (19.32)	72.54 (19.62)	77.15 (19.87)	21.63	0.00 **	+1.04	+4.61 **	+5.65 **
Weight SDS *(n=19)*	3.10 (0.99)	2.98 (1.01)	3.01 (1.02)	2.92	0.09	−0.12 **	+0.03	−0.10
Waist (cm) *(n=17)*	92.00 (10.42)	91.32 (10.17)	92.88 (10.93)	1.38	0.27	−0.68	+1.55	+0.88
Waist SDS *(n=17)*	3.53 (0.45)	3.42 (0.48)	3.41 (0.49)	3.36	0.047 *	−0.11 +	−0.01	−0.12 +

* p<0.05,

** p<0.01,

+ p<0.08 BMI=body mass index; SDS=standard deviation score; Post hoc tests done using Bonferroni correction

Note: Follow-up at 12-month only in intervention group

Table 2

Between group changes over the 6 month intervention period

Outcome variable	Adjusted post intervention mean (sd)		Test statistic F (df)	P value
	Treatment group (n=33)	Control group (n=30)		
Cardiovascular outcomes			**Wilks's Δ=1.00 0.08 (2,51)**	**0.06**
Systolic BP SDS	0.16 (0.63)	0.15 (0.63)		
Diastolic BP SDS	0.84 (0.82)	0.77 (0.83)		
Psychosocial outcomes			**Wilks's Δ=0.82 0.78 (6, 21)**	**0.60**
SDQ total score[37;b]	13.30 (3.05)	12.34 (3.09)	-	-
PedsQL total score (parent reported)[38;a]	67.60 (10.21)	68.27 (10.33)	-	-
PedsQL total score (child reported)[38;a]	70.08 (11.98)	74.35 (12.12)	-	-
CDI *t*-score[36;b]	49.24 (6.91)	48.13 (6.97)	-	-
Harter global score[35;a]	2.80 (0.51)	2.85 (0.51)	-	-
CHEAT dieting scale[39-40;b]	8.28 (5.16)	7.60 (5.20)	-	-
NP data	**Post intervention median (IQR)**		**U**	**P value**

Outcome variable	Adjusted post intervention mean (sd)		Test statistic F (df)	P value
	Treatment group (n=33)	Control group (n=30)		
CHEAT bulimia/ food preoccupation scale[39-40;b]	0.00 (2.00)	0.00 (3.00)	517.00	0.14
CHEAT oral control scale[39-40;b]	1.00 (3.00)	1.50 (3.25)	457.50	0.70

*p<0.05, **p<0.01;

ITT analyses conducted using baseline values carried forward; post intervention mean values adjusted for age (in months) and baseline levels; main analyses were MANCOVA tests, sub analyses only carried out where significant differences seen at MANCOVA level. Numbers if data missing, for treatment and control group respectively, are: anthropometric, n=31 and n=27; CV, n=29 and n=28; psychosocial, n=20 and n=15;

+Reported means are anti-logs of the mean of the logged data, standard deviations of the original data are given; [a]Increased score indicates an improvement; [b]Decreased score indicates an improvement;

Abbreviations are BMI=body mass index; FM=fat mass; FFM=fat free mass; BP=blood pressure; SDS=standard deviation score; SDQ=Strengths and Difficulties questionnaire; PedsQL=Pediatric Quality of Life Inventory; CDI=Children's Depression Inventory; CHEAT=Children's Eating Attitudes Test; NP=non parametric; IQR= interquartile range

	Look at P.20-21, T.3	P.20-21, T.3
7.4 Notes	Age sub-group analyses were not available	

		Description as stated in report	Location in text *(page/figure/table)*
8. Limitation and mitigation strategy	8.1 Strength	NA	
	8.2 Limitation	There were limitations to the study. Retention in children attending the intervention was modest (59%), although comparable to other studies. Full baseline data were not available for 11 children, due to non-attendance at assessment appointments, therefore we could not include them in the analyses. Given the nature of the intervention, it was not possible to blind families or researchers/clinicians to group allocation. Because of cost restraints, we were not able to formally evaluate fidelity to the protocol, but the same core group of clinicians carried out all treatments, and the programme had been manualised. Since we used a waiting list control design, we do not have any long-term follow-up data in the control group and are unable to show whether reductions in BMI SDS were sustained without further input. Additionally, ITT analyses were only used for the 6 months outcomes.	P.8
	8.3 Strategies to overcome limitation	NA	
	8.4 Notes		

	Domain	Signaling questions	Description as stated in report	Location in text *(page/figure/table)*	Extractors' note *(Y/PY/PN/N/NI/NA)**	Extractors' judgement *(low/some concerns/high)*
9. Risk of Bias (RoB)	9.1 Randomization process	9.1.1 Was the allocation sequence random?	Families were randomly allocated, in equal numbers, to an intervention group or a 6-month waiting list control group. Families were recruited and randomized in five waves, each with approximately 15 children.	P.3	Y	
		9.1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Randomisation was carried out by a statistician; each child was given an ID code, and computer-generated random numbers were used to allocate them to a treatment condition.	P.3	Y	
		9.1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	There were no significant differences between groups for baseline demographic, psychosocial, body composition, blood pressure, or anthropometric variables apart from age and height, where the treatment group were significantly older and taller than the control group.	P.6	N	

		Note: Is this mean between intervention and control group?				
		RoB judgment 9.1				Low
	9.2 Intended intervention	9.2.1 Were participants aware of their assigned intervention during the trial?	Families were informed of their allocation and commenced treatment or entered the waiting list period (with no input provided from the study team); treatment began with in one month of randomisation.	P.3	Y	
		9.2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	It was not possible to blind families or clinicians to treatment allocation because of the nature of the intervention, but the researcher collecting anthropometric data was blinded to group allocation unless families disclosed this information.	P.3	Y	
		Answer either ***effect of assignment to intervention*** (9.2.3-9.2.7) or ***effect of adhering to intervention*** (9.2.8-9.2.11)				
		Effect of assignment to intervention 9.2.3 If Y/PY/NI to 9.2.1 or 9.2.2: Were there deviations from the intended intervention that arose because of the trial context?	NI	NI	NI	
		9.2.4 If Y/PY to 9.2.3:	NA	NA	NA	

		Were these deviations likely to have affected the outcome?				
		9.2.5 If Y/PY/NI to 9.2.4: Were these deviations from intended intervention balanced between groups?	NA	NA	NA	
		9.2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	All 6 month outcomes were analysed on an ITT basis using baseline values carried forward if outcome data were missing.	P.5	Y	
		9.2.7 If N/PN/NI to 9.2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	NA	NA	NA	
		Effect of adhering to intervention	NA	NA	NA	

		9.2.8 [If applicable:] If Y/PY/NI to 9.2.1 or 9.2.2: Were important non-protocol interventions balanced across intervention groups?				
		9.2.9 [If applicable:] Were there failure in implementing the intervention that could have affected the outcome?	NA	NA	NA	
		9.2.10 [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcome?	NA	NA	NA	
		9.2.11 If N/PN/NI to 9.2.8 or Y/PY/NI to 9.2.9 or 9.2.10:	NA	NA	NA	

		Was an appropriate analysis used to estimate the effect of adhering to intervention?				
		RoB judgment 9.2				Some concern
	9.3 Missing outcome data	9.3.1 Were outcome data available for all, or nearly all, participants randomization?	22 of the children randomized to the treatment group completed the 6 month intervention (59% of those randomized and 79% of those starting treatment) Note: Waiting list group only analysed at baseline and 6-month while intervention group had 1 additional at 12-month.	P.6	N	
		9.3.2 If N/PN/NI to 9.3.1: Is there evidence that the result was not biased by missing outcome data?	All 6 month outcomes were analysed on an ITT basis using baseline values carried forward if outcome data were missing.	P.5	Y	
		9.3.3 if N/PN to 9.3.2: Could missingness in the outcome depend on its true value?	NA	NA	NA	

		9.3.4 If Y/PY/NI to 9.3.3: Is it likely that missingness in the outcome depended on its true value?	NA	NA	NA	
		RoB judgment 9.3				Low
	9.4 Measurement of the outcome	9.4.1 Was the method of measuring the outcome inappropriate?	Standard deviation scores for BMI, weight, height, and waist were calculated from raw values by adjusting for age and gender using British 1990 reference data. The LMS growth macro (http://homepage.mac.com/tjcole) was used. We included %BMI to allow for comparison with results reported by Epstein and colleagues, calculated using the percentage of the median BMI for the child's age and gender. Weight was measured using Tanita electronic scales (model HD 352, Tanita) and height using a Harpenden stadiometer (Holtain, UK). Weights and heights were measured by trained personnel according to a standard protocol.	P.4-P.5	N	

			All waist measurements were taken by a single researcher, not involved with delivering the intervention, who had received training. The majority of the height and weight measurements were taken by this researcher, but where not available, measures taken by one of the clinical researchers delivering the intervention were used in order to maximise the data set. Inter-person variation for the measurements taken by two researchers was found to be non-significant. Fat mass index and fat free mass index were measured using the 3-component (3C) model which requires measures of total body water (TBW), body volume (BV) and weight. The 3C model was used since it produces similar body composition values in obese children to 4C model, which further incorporates measurement of bone mineral.[33] The 3C component model was considered adequate in this study as mineral mass and the protein-mineral ratio were considered unlikely to change over the duration of the intervention. TBW			

			was measured using deuterium oxide dilution and BV by air-displacement plethysmography using BODPOD (Life Measurement Instruments); methods have previously been described in detail. Fat mass (FM) and fat free mass (FFM) were derived using established equations and index values calculated by dividing each by height squared to take height into account. Blood pressure (BP) was measured using a validated electronic sphygmomanometer; three measures were taken and mean diastolic and systolic readings calculated. These were converted into SD scores using UK paediatric reference norms. Pubertal status was measured by self-assessment using pictures of the Tanner stages of pubertal development. Psychosocial outcomes were measured using questionnaires completed by parents and children. This included measures of self-esteem (the Harter scale), mood (the Children's			

			Depression Inventory), parent-reported child difficulties (the Strengths and Difficulties questionnaire, SDQ), and quality of life (the child- and parent-reported Pediatric Quality of Life Inventory, PedsQL). Children's attitudes towards eating and weight were measured using the Children's Eating Attitudes Test (CHEAT). Raw scores from the CDI were converted into t-scores for analysis. All measures have been validated in children aged 8-12 years.			
		9.4.2 Could measurement or ascertainment of the outcome have differed between intervention groups? Note: Is it mean between intervention and control group or between intervention and intervention group in case they had more than 1 intervention	All outcome measures were taken at baseline and at the end of the 6 month intervention or waiting list period. Additional 12 month anthropometric outcomes were collected for children in the treatment group who completed the programme. **Control data are not available past 6 months because waiting list children were subsequently offered treatment.** Note: used the same method in both groups (i.e. intervention and control group) see 9.4.1 but different time point as the data at 12-month in control group were not available. However, in the article they explained very clear that they only have	P.5	PN	

		groups? = Answer: intervention and control group	baseline and 6 month data in both group and 12 month as additional data for intervention group so this will identified as "probably no"			
		9.4.3 If N/PN/NI to 9.4.1 and 9.4.2: Were outcome assessors aware of the intervention received by study participants?	Weight and heights were measured by trained personnel according to standard protocol. All waist measurements were taken by a single researcher, **not involved with delivering the intervention**, who had received training. The majority of the height and weight measurements were taken by this researcher, but where not available, measures taken by one of the clinical researchers delivering the intervention were used in order to maximise the data set. Note: It is not clear that the outcome assessors aware of the intervention received by study participants or not. However, they mentioned that the assessors not involved with delivering intervention.	P.4	PN	
		9.4.4 If Y/PY/NI to 9.4.3:	NA	NA	NA	

		Could assessment of the outcome have been influenced by knowledge of intervention received?				
		9.4.5 If Y/PY/NI to 9.4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	NA	NA	NA	
		RoB judgment 9.4				Low
	9.5 Selection of the report result	9.5.1 Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis	Differences in baseline variables between the treatment and control conditions were tested using independent t-tests or Mann-Whitney tests (continuous variables) or chi-squared tests (categorical variables). All 6 month outcomes were analysed on an ITT basis using baseline values carried forward if outcome data were missing.	P.5-P.6	PY	

			Outcomes were post-treatment (6 month) data; these were tested for normality using Kolmogorov-Smirnov tests and transformations done as appropriate. Multivariate analysis of covariance (MANCOVA) tests, with age and baseline values as covariates and randomisation group as the fixed factor, were used to test group differences for parametric data. Box's test was non-significant for all, indicating homogeneity of variance-covariance matrices. Four MANCOVA tests were run: anthropometric outcomes; anthropometric SDS outcomes; cardiovascular (CV) outcomes; psychosocial outcomes. The total CHEAT score and %BMI were excluded from these analyses to ensure independence of outcomes. Sub-analyses (univariate analysis of covariance) were conducted only where the overall MANCOVA test was significant. The numbers included in the psychosocial outcomes MANCOVA were reduced by missing SDQ data,			

			however analyses excluding the SDQ scores did not change the results (which are not presented). Where data were not normally distributed, Mann Whitney tests were used. Analyses on anthropometric data were also done including pubertal stage as a covariate; this did not change the results and tests adjusting for age and baseline values only are presented. Paired t-tests or Wilcoxon signed-rank tests were used to examine within group changes over the intervention. No significant demographic differences were found between those with and without complete baseline anthropometric data (11 children had incomplete baseline weight and height data, 3 did not complete baseline questionnaires). One child in the control group was identified as an outlier for BMI SDS, %BMI and BMI change (−0.6, −28.8 and −4.2 respectively; all approximately 4 SD's of the mean change), so analyses on anthropometric data were additionally run excluding data from this child.			

			Change at 12 months (6 months post-treatment) for children in the treatment group completing treatment was analysed using one-way correlated analysis of variance; only those attending both 6 and 12 month follow-ups were included. Post hoc tests were done using Bonferroni correction; analyses were not adjusted for age. Note: Results were analyzed same as mentioned in statistical analysis plan.			
		Is the numerical result being assessed likely to have been selected, on the basis of the results, from.. (9.5.2 and 9.5.3)				
		9.5.2 Multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain?	See 9.4.1, 9.4.2 and 9.5.1 Note: used the same method in both groups (i.e. intervention and control group) see 9.4.1 but different time point as the data at 12-month in control group were not available. However, they reported all of intended outcome measurements except some sub-analysis	P.4, P.5, P.6	PN	

		(check from a trial protocol or statistical analysis plan)				
		9.5.3 Multiple eligible analyses of the data? (check from a trial protocol or statistical analysis plan)	See 9.5.1 Note: They reported all of intended outcome measurements except some sub-analysis.		PN	
		RoB judgment 9.5				Low
	9.4 Overall judgment (9.1-9.5)					Some concern
	9.5 Notes					

*Y=Yes, PY=Probably yes, PN=Probably no, N=No, NI=No information, NA=Not applicable

3H3: Golley et al., 2007

A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years

Note: Extracted from Golley et al., 2007 and Golley, Perry, Magarey and Daniels, 2007 (ref 22)

1.General information	1.1 Date of extraction (dd/mm/yyyy)	26/04/2021
	1.2 Name of person extracting data	Srila Satoh
	1.3 Study ID (First author, year of publication)	Golley, 2007
	1.4 Title	Twelve-month effectiveness of a parent-led, family-focused weight-management program for prepubertal children: A randomized, controlled trial.
	1.5 Journal	PEDIATRICS
	1.6 Source of funding, country	The Australian Health Management Group Assistance to Health and Medical Research Fund. Dr Golley was supported by Australian National Health and Medical Research Council Postgraduate Research Scholarship 229978, Australia
	1.7 Notes	Australian Clinical Trial Register 00001103 Note: Could not access

	Study characteristic	Eligibility criteria	Location in text *(page/figure/table)*
2. Study eligibility	2.1 Type of study	A single-blinded, RCT	P.518
	2.2 Participants	Age: 6-9 years BMI percentile: N/A BMI: 24.3(2.6) Intervention (P+DA) NA; Intervention (P) NA; Control (WLC) NA BMI z score: 2.75(0.52) Intervention (P+DA) 2.74(0.58); Intervention (P) 2.76(0.58); Control (WLC) 2.75(0.39) Diagnostic criteria for overweight or obesity: Overweight according to the International Obesity Task Force definition (Cole, Freeman, and Preece, 1990; Cole, Bellizzi, Flegal, and Dietz, 2000) Note: P+DA = Parenting-skills training with intensive lifestyle education; P=Parenting-skill training alone; WLC=Wait-list	P.518, P.522, T.2
	2.3 Intervention	Have at least 1 BCT/ sufficient info to code: Yes	
	2.4 Comparison	Wait-list control group	P.518
	2.5 Outcomes	Primary outcome: BMI z score, waist-circumference, Secondary outcomes: blood pressure, fasting glucose, total cholesterol, high-density lipoprotein cholesterol, triacylglycerol level Have at least 2-month f/u: Yes Subjective/objective outcomes: Objective outcomes (BMI z score, blood pressure, fasting glucose, total cholesterol, high-density lipoprotein cholesterol, triacylglycerol level)	P.519
	2.7 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
3. Method	3.1 Aim of study	To evaluate the relative effectiveness of parenting-skills training as a key strategy for the treatment of overweight children.	P.518
	3.2 Type of study design	A single-blinded, RCT	P.518
	3.3 Ethical approval	Was approved by the Flinders Clinical Research Ethics and the Women's and Children's Hospital's ethics committees.	P.518
	3.4 Recruitment & sampling method	Families were recruited between July 2002 and August 2003 predominantly via media publicity and school newsletter.	P.518
	3.5 Study start date		
	3.6 Study end date		
	3.7 Notes		

		Description as stated in report	Location in text *(page/figure/table)*
4. Participants	4.1 Total number of participants/sample size/gender	Number of children:	P.520, T.1 P.521, F.1

	At baseline	At follow-up
Total number	111	91
Gender		
Male	41	33

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>Female</td><td>70</td><td>58</td></tr>
<tr><td>Intervention group</td><td></td><td></td></tr>
<tr><td>P+DA</td><td>38</td><td>31</td></tr>
<tr><td>P</td><td>37</td><td>29</td></tr>
<tr><td>Control group</td><td>36</td><td>31</td></tr>
</table>
Note: follow-up at 12 months

Number of parents: -
</td><td></td></tr>
<tr><td></td><td>4.2 Age</td><td>Age group: years

<table>
<tr><td></td><td>Mean age</td><td>SD</td></tr>
<tr><td>Over all (n=111)</td><td>8.2</td><td>1.1</td></tr>
<tr><td>Intervention group (n=)</td><td>NA</td><td>NA</td></tr>
<tr><td>Control group (n=)</td><td>NA</td><td>NA</td></tr>
</table>
</td><td>P.520, T.1</td></tr>
<tr><td></td><td>4.3 Setting</td><td>Conducted at 2 metropolitan teaching hospitals in Adelaide, South Australia.</td><td>P.518</td></tr>
<tr><td></td><td>4.4 Inclusion criteria</td><td>Child age 6 to 9 years, overweight (according to the International Obesity Task Force definition), and Tanner stage 1 with caregiver willing to attend sessions and able to read and understand English.</td><td>P.518</td></tr>
<tr><td></td><td>4.5 Exclusion criteria</td><td>BMI z score > 3.5, diagnosed with a syndromal cause of obesity, using medications that influence weight gain or loss, a diagnosis of physical or developmental disability or chronic illness, and a sibling enrolled in the study.</td><td>P.518</td></tr>
<tr><td></td><td>4.6 Notes</td><td>-</td><td></td></tr>
</table>

		Description as stated in report	Location in text *(page/figure/table)*	Decision *(Yes/No/Unclear)*
5. Intervention and control conditions	5.1 Name of intervention	A family-focused child weight-management program	P.518	Yes
	5.2 Rationale, theory, goal	The evidence supporting parent-led family lifestyle management for treatment of overweight in young children has not been replicated in other populations. In addition, effective strategies to facilitate parents initiating and maintaining recommended eating and activity behaviors have not been explored. Although parents play a significant part in shaping and influencing child behavior, they rarely receive support or training for this role. Parents perceive they possess appropriate nutrition knowledge and are able to assess the dietary adequacy of their child's diets. If this so, then a focus on behavior modification rather than on nutrition education may be appropriate. Parent-skills training may be an effective age-appropriate child behavior-modification strategy applicable to the management of overweight in young children. Parenting-skills training was used to facilitate and support parents to undertake family lifestyle change. Triple P (the Positive, Parenting Program)	P.518; P.519	Yes

		is based on **child development theory and social learning principles** and aims to promote parental competence to manage their child's behavior.		
	5.3 Materials/media used	the Positive, Parenting Program (Triple P, Families International, University of Queensland/Health Department Western Australia, 2000, www.triplep.net), a standardized and evaluated general parenting program. Application of Triple P to eating and activity behaviors was supported by provision of a general healthy-lifestyle pamphlet From Golley, Perry, Magarey, and Daniels, 2007 The Australian Guide to healthy Earing (AGHE)	P.519 P.146, T.2	Yes
	5.4 Procedure	The mode of both intervention was "parent only" with parents having sole responsibility for attending program sessions and implementing family lifestyle change. Children did not attend any education sessions, and families were encouraged to implement change at the family, not child level. P group	P.518; P.519	Yes

		Participants participated in the Positive, Parenting Program (Triple P, Families International, University of Queensland/Health Department Western Australia, 2000, www.triplep.net), a standardized and evaluated general parenting program. From Golley, Perry, Magarey, and Daniels, 2007 Parenting component included positive parenting, promoting children's development, managing behaviour change, and planning ahead. P+DA group ..completed the Triple P program…. Participated in an additional 7 intensive lifestyle support group sessions. These sessions focused on lifestyle knowledge and skills including the following: family-focused healthy eating with specific core food serve recommendations, monitoring, label reading, snacks, modifying recipes, being active in a variety of ways, roles and responsibilities around eating, managing appetite, self-esteem, and teasing. While parents attended the lifestyle sessions, children in the P+DA group attended structured, supervised activity sessions developed by physical activity experts. The session consisted of fun, noncompetitive games	P.146, T.2 P.519	

		designed around aerobic activity and development of fundamental motor skills. Sessions were designed as play rather than exercise and were diversional rather than interventional. The activities required minimal equipment and were deliverable by nonexpert staff and easily replicate at home. From Golley, Perry, Magarey, and Daniels, 2007 Healthy lifestyle component included the Australian Guide to Healthy Eating (AGHE), nutrition skills, being active in a variety of ways, family food tasks and managing appetites, recipe modification/eating on the run, self-esteem and teasing, and progress review. Note: Did not explain in the article what was in the Triple P program but had a reference (Sanders, 1999; Golley, Perry, Magarey, and Daniels, 2007) –	P.146, T.2	
	5.5 Providers	All intervention sessions were conducted by the same dietitian (Dr Golley) who had developed the lifestyle education component and undertaken accredited training for the parenting component.	P.518; P.519	Yes

		While parents attended the lifestyle sessions, children in the P+DA group attended supervised activity sessions developed by physical activity experts, deliverable by nonexpert staff and easily replicate at home.		
	5.6 Mode of delivery	Group		Yes
	5.7 Locations	The study was conducted at 2 metropolitan teaching hospital in Adelaide, South Australia	P.518	Yes
	5.8 Duration & intensity	P group The program consisted of 4 weekly 2-hour group sessions followed by 4 weekly, then 3 monthly 15- to 20-minute individual telephone sessions. Note: Intervention 6 months P+DA group ..completed the Triple P program…. Participated in an additional 7 intensive lifestyle support group sessions. These sessions commenced after completion of the 4 weekly parenting sessions, every 2 weeks at first, then monthly.	P.519	Yes

		Note: Data collection at baseline, month 6 (at the end of intervention), and month 12		
	5.9 Tailoring (if)	From Golley, Perry, Magarey, and Daniels, 2007 P+DA group Parents are encouraged to compare current eating patterns of each family member with age-appropriate AGHE food group serve recommendations. Based on their findings and family eating patterns and habits, modifications required to meet AGHE recommendations are individually identified and goals for change are set. Gradual 'whole family' changes are promoted	P.147	Yes
	5.10 Modifications	No information		No information
	5.11 How well (planned)	Compare with previous studies, considerable attention was paid to defining effectiveness and based on broad criteria, the results suggest potential for overall intervention effectiveness. However, study power, intervention adherence, and dilution of effect size with intention-to-treat analysis may be factors in the failure of these trends to convert to statistical significance and the moderate results compared with previous studies.	P.524	Unclear
	5.12 How well (actual)	No information		No information
	5.13 Control group	At the time of group allocation, the WLC group received the same general healthy-lifestyle pamphlet as the P group. During the 12-month wait-listed	P.519	

		period, the WLC group was contacted by telephone 3 to 4 times for 5 minutes as a retention strategy. Researcher contact with the WLC families was minimized to avoid the potential placebo effect of therapist contact.		
	5.14 Notes	This study used the CONSORT 2001		

Note: 6 BCTs, see Appendix 3I – BCTs coding

		Description as stated in report	Location in text *(page/figure/table)*
7. Results and finding	7.1 Primary outcomes	TABLE 2 **Anthropometric Outcomes (Mean ± SD) for Study Participants According to Study Group**	P.522, T.2;

	BMI *z* Score[a]				Waist Circumference *z* Score[b]			
	Baseline ($n = 111$)	6 mo ($n = 57$)	12 mo ($n = 91$)	Difference ($n = 91$)[c]	Baseline ($n = 111$)	6 mo ($n = 57$)	12 mo ($n = 91$)	Difference ($n = 91$)[c]
P+DA	2.74 ± 0.58	2.52 ± 0.53	2.43 ± 0.68	−0.24 ± 0.43	3.27 ± 0.73	3.00 ± 0.67	2.85 ± 0.78	−0.31 ± 0.53
P	2.76 ± 0.58	2.63 ± 0.53	2.56 ± 0.79	−0.15 ± 0.47	3.20 ± 0.67	3.08 ± 0.52	2.93 ± 0.69	−0.17 ± 0.50
WLC	2.75 ± 0.39	—	2.60 ± 0.57	−0.13 ± 0.40	3.14 ± 0.56	—	3.14 ± 0.75	−0.02 ± 0.58

— indicates no data collected.
[a] Linear mixed model: $P = .76$ group by time.
[b] Linear mixed model: $P = .03$ group by time; posthoc analysis (Bonferroni method): $P < .01$ for P+DA at 12 months versus baseline, $P = .01$ for P+DA at 12 vs 6 months, and $P = .05$ for 12 months versus baseline; for all other comparisons, $P > .05$.
[c] Mean differences between 12 months and baseline.

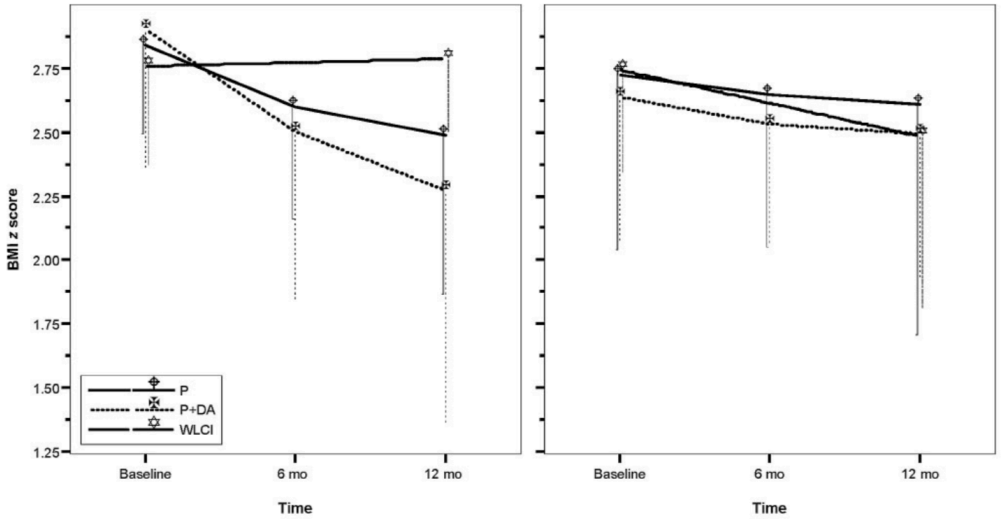
		 FIGURE 2 Mean (SD) BMI *z* score for study participants at baseline (40 boys, 71 girls) and 6 months (20 boys, 37 girls) and 12 months (33 boys, 59 girls) after intervention or wait-listing for intervention. BMI *z* score linear mixed model: $P = .04$ group by time with gender; posthoc analysis (Bonferroni method): $P = .004$ boys in P group at 6 months versus baseline, $P = .01$ boys in P group at 12 months versus baseline, $P = .02$ boys in P+DA group at 6 months versus baseline, and $P = .01$ boys in P+DA group at 12 months versus baseline; all other comparisons: $P > .05$.	P.522, F.2
			P.522

		TABLE 3 Total Cholesterol and Fractions, Triacylglycerol, Blood Pressure, Glucose, and Insulin (Mean ± SD) for 6- to 9-Year-Old Prepubertal Children at Baseline and 12 Months	

	Baseline ($n = 11$)	12 mo ($n = 71$)	P[a]
Total cholesterol	4.9 ± 0.9	4.5 ± 0.7	.47
Low-density lipoprotein cholesterol[b]	2.8 ± 0.8	2.9 ± 0.7	.42
High-density lipoprotein cholesterol[b]	1.3 ± 0.2	1.2 ± 0.3	.96
Triacyglycerol	0.7 ± 0.6	0.7 ± 0.5	.98
Systolic blood pressure	116 ± 11	117 ± 8	.49
Diastolic blood pressure	58 ± 7	57 ± 7	.82
Glucose	4.4 ± 0.8	4.5 ± 0.4	.88
Insulin	79 ± 37	89 ± 59	.84

[a] Linear mixed model: group by time interaction.
[b] Linear mixed model: main effect of time ($P < .05$).

	7.2 Secondary outcomes	Behaviour change in dietary: NA Behaviour change in physical activity: NA Mental health/quality of life/ self-esteem: NA
	7.3 Other outcomes	NA
	7.4 Notes	Age sub-group analyses were not available

		Description as stated in report	Location in text *(page/figure/table)*
8. Limitation and mitigation strategy	8.1 Strength	Our study address 5 of the major design limitations of child weight-management studies highlighted in a recent Cochrane review including (1) using recruitment and retention strategies to achieve the calculated sample size and <20% drop out at 12 months, (2) blinded allocation and outcome assessment to minimize measurement bias (3) intervention delivery using standard protocols and a single, trained facilitator to limit site bias and enhance internal study validity, (4) health outcome assessment inclusive of adiposity and obesity-related health consequences at 12 months which included a follow-up period after treatment had ceased, and (5) primary analysis performed by intention to treat to properly assess intervention effectiveness. Furthermore, the narrow age range ensure age-appropriate intervention.	P.524
	8.2 Limitation	Compared with previous studies, considerable attention was paid to defining effectiveness and based on broad criteria, the results suggest potential for overall intervention effectiveness. However, study power, intervention adherence, and dilution of effect size with intention-to-treat analysis may be factors in the failure of these trends to convert to statistical significance and the moderate results compared with previous studies. Sample size based on the	P.524

		primary outcome assumed there would be no change in adiposity in the control group. Hence, the unanticipated reduction in BMI *z* score in the control group produces the potential for type II error. The apparent motivation of the control group limits generalizability; however, in the current obesity epidemic environment and associated media coverage, such bias may be difficult to avoid.	
	8.3 Strategies to overcome limitation	No information	
	8.4 Notes		

	Domain	Signaling questions	Description as stated in report	Location in text *(page/figure/table)*	Extractors' note *(Y/PY/PN/N/NI)*	Extractors' judgement *(low/some concerns/high)*
9. Risk of Bias (RoB)	9.1 Randomization process	9.1.1 Was the allocation sequence random?	Randomization schedules were computer generated using a 3-block design stratified for gender and site of recruitment.	P.518	Y	
		9.1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Individual group allocations were sealed in opaque envelopes, with the next envelope opened on a child's completion of baseline measurements. Researchers involved in recruitment,	P.518	Y	

			participant allocation and intervention delivery or data collection were not involved in the randomization process			
		9.1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	At the baseline, there were no significant differences for any child or family characteristics by study group	P.520	N	
		RoB judgment 9.1				Low
	9.2 Intended intervention	9.2.1 Were participants aware of their assigned intervention during the trial?	NI	NI	NI	
		9.2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	NI	NI	NI	
		Answer either ***effect of assignment to intervention*** (9.2.3-9.2.7) or ***effect of adhering to intervention*** (9.2.8-9.2.11)				
		Effect of assignment to intervention 9.2.3 If Y/PY/NI to 9.2.1 or 9.2.2:	NI	NI	NI	

		Were there deviations from the intended intervention that arose because of the trial context?				
		9.2.4 If Y/PY to 9.2.3: Were these deviations likely to have affected the outcome?	NA	NA	NA	
		9.2.5 If Y/PY/NI to 9.2.4: Were these deviations from intended intervention balanced between groups?	NA	NA	NA	
		9.2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	Intention-to-treat analysis was performed, with all participants included in the analysis according to original group allocation, and follow-up was maximized regardless of program attendance Secondary analyses were undertaken (1) with gender as a factor and (2) by “per-protocol analysis” including families who attended >75% of the program sessions.	P.520	Y	

			Note: They analyzed both intention-to-treat and per-protocol			
		9.2.7 If N/PN/NI to 9.2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?	NA	NA	NA	
		Effect of adhering to intervention 9.2.8 [If applicable:] If Y/PY/NI to 9.2.1 or 9.2.2: Were important non-protocol interventions balanced across intervention groups?	NA	NA	NA	
		9.2.9 [If applicable:] Were there failure in implementing the intervention that could have affected the outcome?	NA	NA	NA	

		9.2.10 [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcome?	NA	NA	NA	
		9.2.11 If N/PN/NI to 9.2.8 or Y/PY/NI to 9.2.9 or 9.2.10: Was an appropriate analysis used to estimate the effect of adhering to intervention?	NA	NA	NA	
		RoB judgment 9.2				Some concern
	9.3 Missing outcome data	9.3.1 Were outcome data available for all, or nearly all, participants randomization?	Randomized 111, completed 91 Note: outcome data available for 91/111 participants ~ 90%. In Cochrane guideline stated that for continuous outcomes, availability of data from 95% of the participants will often be sufficient.	P.521, F.1	N	

		9.3.2 If N/PN/NI to 9.3.1: Is there evidence that the result was not biased by missing outcome data?	Intention-to-treat analysis was performed, with all participants included in the analysis according to original group allocation, and follow-up was maximized regardless of program attendance. Secondary analyses were undertaken (1) with gender as a factor and (2) by "per-protocol analysis" including families who attended ≥75% of the program sessions. Note: They analyzed both intention-to-treat and per-protocol	P.520	Y	
		9.3.3 if N/PN to 9.3.2: Could missingness in the outcome depend on its true value?	NA	NA	NA	
		9.3.4 If Y/PY/NI to 9.3.3: Is it likely that missingness in the outcome depended on its true value?	NA	NA	NA	
		RoB judgment 9.3				Low

	9.4 Measurement of the outcome	9.4.1 Was the method of measuring the outcome inappropriate?	Height to the nearest 1.0 mm was measured with a Trumeter stadiometer (Trumeter, Manchester, United Kingdom), and weight was measured to the nearest 0.1 kg with SECA electronic scales (SECA, Hamburg, Germany). In the absence of national Australian data, BMI was calculated and converted to a BMI *z* score by using United Kingdom reference data provided as a computer program (Child Growth Foundation, London, United Kingdom). Waist-circumference measurement was recorded to the nearest millimeter, midway between the tenth rib and the iliac crest, with participants in a standing position, using a non-elastic flexible tape, and converted to a *z* score by using United Kingdom reference data. For categorical analysis, participants were classified as non-overweight, overweight, or obese using the International Obesity Task Force definition. Parental height and weight were either assessor-measured or self-measured (5%–13% of mothers and 71%–78% of fathers self-measured at baseline and follow-up measurements), and	P.519-520	N	

			BMI was calculated. Parents' weight status was classified using the World Health Organization definition, with BMI $\geq$25kg/m^2 overweight and $\geq$30kg/m^2 obese. Blood pressure was measured on the right arm by using a Dinamap automated blood pressure monitor (GE Healthcare, Giles, Buckinghamshire, United Kingdom). A variety of cuff sizes were used to ensure appropriate fit for arm circumference. A single measurement was taken after supine rest for 10 minutes after collection of the blood sample and anthropometric measures. Fasting glucose, total cholesterol, high-density lipoprotein cholesterol, and triacylglycerol levels were analyzed within 4 hours of collection by standard automotive techniques using a Synchron CX5 Pro analyzer (Beckman Coulter Inc, Fullerton, CA) in the Clinical Diagnostic Laboratory, Women's and Children's Hospital, Adelaide, South Australia. Low-density lipoprotein cholesterol was calculated by using the Friedewald equation: cholesterol - (high-density lipoprotein +			

			triacylglycerol/2.2). Immediately after sample collection, se rum was drawn off and stored at -70°C until fasting serum insulin was measured in batched samples in the Endocrine Diagnostic Laboratory, Royal Prince Alfred Hospital, Sydney, Australia by radio-immunoassay using the Linco human insulin-specific assay kit (Linco Research Inc, St Charles, MO). Note: Although some parents were measured themselves for height and weight, the effectiveness of the programme was looking in children.			
		9.4.2 Could measurement or ascertainment of the outcome have differed between intervention groups? Note: Is it mean between intervention and control group or between intervention and intervention group in case they	Baseline measurements occurred before randomization with outcome measures assessed at program completion (6months) for participants in intervention groups and at 12 months after baseline for all participants. Note: 1) In wait-list control group did not measure at 6-month	P.519	Y	

		had more than 1 intervention groups? = Answer: Between intervention and control group	2)Used the same method in both groups (i.e. intervention and control group) see 9.4.1			
		9.4.3 If N/PN/NI to 9.4.1 and 9.4.2: Were outcome assessors aware of the intervention received by study participants?	NA	NA	NA	
		9.4.4 If Y/PY/NI to 9.4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?	NA	NA	NA	
		9.4.5 If Y/PY/NI to 9.4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	NA	NA	NA	

		RoB judgment 9.4				High
	9.5 Selection of the report result	9.5.1 Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis (check from a trial protocol or statistical analysis plan)	Analyses were performed using SPSS for Windows version 11.5 (SPSS Inc, Chicago, IL). Where the distribution of variables is normal, data are expressed as mean±SD and proportions. Potential covariates were measured at baseline (weight status, growth potential, gen- der, parental weight status, ethnicity, age, and socioeconomic status), and **differences by study group and/or gender** were explored by using 1- or 2-way analysis of variance or x^2. **Baseline differences between those who did and did not attend follow-up measurements** were explored by using separate variance *t* tests. **Intention-to-treat analysis** was performed, with all participants included in the analysis according to original group allocation, and follow-up was maximized regardless of program attendance. Where variables were normally distributed and had equality of variance of residuals, a linear mixed model (SPSS MIXED) including time (as repeated factor), group, and	P.520	PY	

			their interaction, with Bonferroni correction for posthoc multiple comparison, was used to **determine whether there was a significant time by group effect between baseline, 6, and 12 months.** Where group by time interactions were non-significant, average intervention effects of the follow-up period were estimated and tested by using the Bonferroni method for posthoc analysis. Secondary analyses were undertaken (1) with gender as a factor and (2) by "per-protocol analysis" including families who attended ≥75% of the program sessions. Note: 1) Could not access protocol 2) They reported all results according to statistical analysis			
		Is the numerical result being assessed likely to have been selected, on the basis of the results, from.. (9.5.2 and 9.5.3)				
		9.5.2.Multiple eligible outcome measurements (e.g. scales,	Baseline measurements occurred before randomization with outcome measures assessed at program completion	P.519	PN	

		definitions, time points) within the outcome domain? (check from a trial protocol or statistical analysis plan)	(6months) for participants in intervention groups and at 12 months after baseline for all participants. Note: 1) In wait-list control group did not measure at 6-month 2) Used the same method in both groups (i.e. intervention and control group) see 9.4.1 3) They reported all results correspondence to all intended outcome measurement			
		9.5.3..Multiple eligible analyses of the data? (check from a trial protocol or statistical analysis plan)	Intention-to-treat analysis was performed, with all participants included in the analysis according to original group allocation, and follow-up was maximized regardless of program attendance. Secondary analyses were undertaken (1) with gender as a factor and (2) by “per-protocol analysis” including families who attended ≥75% of the program sessions.	P.520	PN	

			Note: Multiple analyzed but reported all results			
		RoB judgment 9.5				Low
	9.4 Overall judgment (9.1-9.5)					High
	9.5 Notes					

*Y=Yes, PY=Probably yes, PN=Probably no, N=No, NI=No information, NA=Not applicable

3H4: Janicke et al., 2008

A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years

Note: Extracted from Janicke et al., 2008 and Janicke et al., 2008 (ref 24)

1.General information	1.1 Date of extraction (dd/mm/yyyy)	25/04/2021
	1.2 Name of person extracting data	Srila Satoh
	1.3 Study ID (First author, year of publication)	Janicke, 2008
	1.4 Title	Comparison of parent-only vs family-based interventions for overweight children in underserved rural settings: outcomes from project STORY
	1.5 Journal	*Arch Pediatr Adolesc Med.*
	1.6 Source of funding, country	The study was supported by grant R34 DK071555-01 from the National Institute for Diabetes and Digestive and Kidney Diseases. Additional supplemental funding for the preliminary pilot work for this study was supplied by the Institute for Child and Adolescent Research and Evaluation at the University of Florida, USA
	1.7 Notes	

	Study characteristic	Eligibility criteria	Location in text *(page/figure/table)*
2. Study eligibility	2.1 Type of study	A 3-arm randomized controlled clinical trial	P.1
	2.2 Participants	Age: 8-14 years BMI percentile: NA BMI: NA BMI z score: Intervention (Family-based) 2.160; Intervention (Parent-only) 2.015; Control (Wait-list) 2.133 Diagnostic criteria for overweight or obesity: BMI above the 85th percentile for age and sex	P.2; P.14, T.1
	2.3 Intervention	Have at least 1 BCT/ sufficient info to code: Yes	
	2.4 Comparison	Wait-list control	
	2.5 Outcomes	Primary outcome: change in children's standardized BMI Secondary outcomes: The Youth/Adolescent Food Frequency Questionnaire Have at least 2-month f/u: Yes Subjective/objective outcomes: Objective outcomes (weight, height, BMI z score)	P.1

	2.7 Notes		

		Description as stated in report	**Location in text** *(page/figure/table)*
3. Method	3.1 Aim of study	To evaluate the effects of a behavioral family-based (FB) intervention and a behavioral parent-only (PO) intervention delivered through rural Cooperative Extension Service (CES) officers on children's weight status.	P.2
	3.2 Type of study design	A 3-arm randomized controlled clinical trial	P.1
	3.3 Ethical approval	The protocol for the study was approved by the governing institutional review board. Note: is this ethic?	P.2
	3.4 Recruitment & sampling method	From 4 rural counties designated in whole or in part as health professional shortage areas. Families were recruited through direct mailings, distribution of brochure through local schools, and community presentations. Interested parents were invited to call our office toll-free to learn about the study, complete a telephone screen, and schedule an in-person screening visit. At the in-person screening, children and their parent(s) completed consent from s and had their height and weight	P.2; P.3

		measured. Families who met eligibility criteria were scheduled for baseline assessment.	
	3.5 Study start date	NA	
	3.6 Study end date	NA	
	3.7 Notes		

		Description as stated in report	**Location in text** *(page/figure/table)*
4. Participants	4.1 Total number of participants/sample size/gender	Number of children: At baseline: 93 (Total number); Gender: Male 28, Female 43; Intervention group: Family-based 33, Parent-only 34; Control group: Wait-list 26 At follow-up: 71 (Total number); Gender: Male NA, Female NA; Intervention group: Family-based 24, Parent-only 26; Control group: Wait-list 21	P.11, F.1; P.14, T.1

<table>
<tr><td></td><td></td><td>Note: follow-up at month 10</td><td></td></tr>
<tr><td></td><td>4.2 Age</td><td>Age group: years
<table><tr><td></td><td>Mean age</td><td>SD</td></tr><tr><td>Over all (n=93)</td><td>NA</td><td>NA</td></tr><tr><td>Intervention group</td><td></td><td></td></tr><tr><td>Family-based (n=33)</td><td>11.4</td><td>NA</td></tr><tr><td>Parent-only (n=34)</td><td>11.0</td><td>NA</td></tr><tr><td>Control group</td><td></td><td></td></tr><tr><td>Wait-list (n=26)</td><td>11.0</td><td>NA</td></tr></table></td><td>P.14, T.1</td></tr>
<tr><td></td><td>4.3 Setting</td><td>All assessment and intervention took place at the Cooperative Extension Service (CES) office in participating counties.</td><td>P.3</td></tr>
<tr><td></td><td>4.4 Inclusion criteria</td><td>Children were between the ages of 8 and 14 years, with a BMI above the 85th percentile for age and sex. There was no requirement for parental weight.</td><td>P.2</td></tr>
<tr><td></td><td>4.5 Exclusion criteria</td><td>Families were excluded if the child or parental had a medical condition that contraindicated mild energy restriction or moderate physical activity, were using prescription weight loss drugs, or were enrolled in another weight loss program.</td><td>P.3</td></tr>
<tr><td></td><td>4.6 Notes</td><td>-</td><td></td></tr>
</table>

		Description as stated in report	Location in text *(page/figure/table)*	Decision *(Yes/No/Unclear)*
5. Intervention and control conditions	5.1 Name of intervention	Behavioral family-based (FB) and parent-only (PO) intervention	P.2	Yes
	5.2 Rationale, theory, goal	Behavioral, FB, group interventions that include both child and parent have demonstrated success in producing weight loss in children. Alternatively, recent studies suggested that working only with the parent(s) may lead to greater decreases in weight status for overweight children that interventions that include both children and parent. To our knowledge, only 1 study has published data comparing FB and PO intervention Most pediatric weight management trials have consisted of efficacy studies conducted with middle-class participants and delivered in “optimal” (ie, academic research) venues rather than “real-world” community settings. Despite their methodologic strengths, efficacy studies are limited in their ability to estimate the treatment effects that can be expected in community settings. Unfortunately, few generalizable, effective, and sustainable weight management interventions have been translated into practice and, to our		

		knowledge, no published randomized clinical trials address weight management for children in rural settings.		
	5.3 Materials/media used	Spotlight Diet (Epstein and Squires, 1988) **From Janicke et al, 2008 (Ref24)** Treatment manuals for both child and parent participants, as well as group leaders, have been developed for this project. Note: Did not explain how it look like and where they can access it	P.4; P.7	Yes
	5.4 Procedure	**FB** Parent and child dyads participated in simultaneous but separate groups. In parent group, the first portion of the meeting involved a review of the progress made in implementing the strategies developed for changing their eating and exercise habits. Difficulties reported by the parents were addressed through group support and discussion. The second segment focused on knowledge and skill training related to nutrition, physical activity, and behavior management strategies. At the end of each session, children and parents were brought together to develop goals for the week and specific plans to achieve these goals.	P.4;	Yes

		The child group sessions included 3 segments: (1) a review of progress during the previous week, (2) a physical activity to demonstrate strategies to keep active, and (3) preparation of a healthy snack. Children and parents were weighed in private at alternating group sessions. **PO** Only the participating parent(s) attended group meetings. Each session included 3 segments, similar to the parent group for the FB intervention. An emphasis was placed on teaching parents how to work with their children to set goals. Each week interventionists suggested a range of dietary and physical activity targets that would be appropriate for each child and parent. Parents were encouraged to meet with their children to set individual goals within the suggested range. Parents were weighed every other week. Children were only weighed at baseline, posttreatment (month 4), and follow-up (month 10) assessments. **From Janicke et al, 2008 (Ref24)**	P.5; P.15, T.2;	

Behavioral Strategies Utilized in Project STORY

Self-Monitoring	An important self-control technique that involves observing and recording one's behavior. Monitoring is associated with attendance and success in weight management programs [32]. Children and parents will be taught to monitor and record their dietary intake and steps each day.
Goal Setting	Children and parents will be taught the importance of goal setting to facilitate behavior change. Goals will be set on a weekly basis to help modify the intake of high-fat "Red foods", the intake of fruits and vegetables, increase physical activity and decrease sedentary activity. Goals will be tailored to the individual needs of each family.
Shaping	Shaping is a strategy to target gradual changes in behavior to ultimate lyattain a desired goal behavior. This strategy will be implemented by setting weekly goals for gradual change. This is designed to increase self-efficacy and success, and to limit frustration, with the goal of promoting long-term behavior change.
Stimulus Control	Stimulus control is a strategy designed to help participants alter their environment to maximize cues to build positive lifestyle habits/choices and minimize barriers to positive change. Children and parents will be instructed on the principles of stimulus control, as well as specific environmental changes to implement in their home and daily life.
Behavioral Contracting	Behavioral contracting involves developing an agreement by which the child receives specific privileges if they complete a specific task. Parents will be instructed on the use of behavioral contracting and develop specific plans for implementation of a contract.
Contingent Attention	Parents will be encouraged to provide positive attention when children make healthy food and activity choices, but to limit negative interactions when children select sub-optimal dietary and physical activity options.
Positive Reinforcement	Children and parents will be encouraged to provide verbal praise for family members when they make healthy food and activity choices.
Modeling	Modeling is an effective strategy to build healthy lifestyle behaviors in which children learn to emulate their parent's behavior. Parents will be instructed on how their dietary and exercise behaviors, as well as their self-statements, impact their child's attitude and behavior.
Role Playing	Role playing is an effective strategy for facilitating positive interactions and communication. Group sessions with parents will include role play scenarios to practice implementing and communicating strategies with children and other family members.
Incentives	A drawing for a $5 gift card will be held each week in the child group. Children who attended the session will be eligible for the gift card if they complete their monitoring forms.
Portion Size Control	Children and parents will be instructed on the importance of portion control to help limit dietary intake. Specific examples will be reviewed to help participants learn typical and suggested portion sizes for common foods.

Schedule of Group Session Topics

Week	Child Sessions	Parent Sessions
1	Self-Monitoring	Self-Monitoring
2	Stoplight Food System	Stoplight Food System
3	Physical Activity	Physical Activity
4	Healthy Eating Patterns &Eating Breakfast	Healthy Eating Patterns &Eating Breakfast
5	Healthy Snacks; Increasing Fruits & Vegetables	Behavioral Strategies for Motivating Your Child; Increasing Fruits & Vegetables
6	Eating Away from Home & Handling Special Occasions; Healthy School Lunch Choices	Eating Away from Home & Handling Special Occasions; Healthy School Lunch Choices
7	Screen Time & Physical Activity; Behavioral Contracts	Screen Time & Physical Activity; Behavioral Contracts
8	Portion Control & The Mealtime Environment	Portion Control, The Mealtime Environment, & Healthy Cooking Strategies
9	Managing Hunger &Emotional Eating	Managing Hunger &Emotional Eating
10	Self-Esteem & Body Image	Self-Esteem & Body Image
11	Handling Teasing &Positive Self-Talk	Handling Teasing &Positive Self-Talk
12	Long-Term Maintenance	Long-Term Maintenance

P.16, T.3

	5.5 Providers	Intervention were delivered by Family and Consumer Sciences (FCS) agents in collaboration with a postdoctoral psychologist (B.J.S) and graduate students in clinical psychology.	P.4	Yes

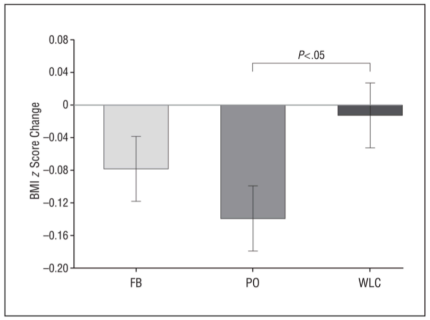
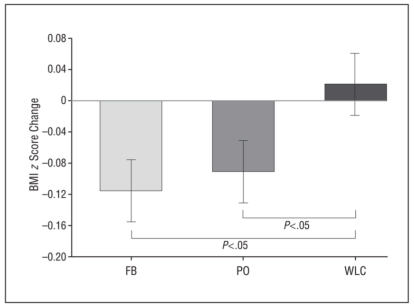
		The FCS agents have a bachelor's or master's degree, often with a concentration in nutrition, and are commonly employed by the CES to deliver nutrition education programs. All interventionist received 2 full days of training before the intervention and 6 hours of booster training midway through the intervention. Fifteen individuals were trained as interventionists; 6 were FCS agents. Although we originally planned for 50% of interventionist to be FCS agents, 1 of these agents withdraw because of health problem. Interventionists participated in weekly supervision meetings with the principal investigator (D.M.J.) Each primary group leader led both the PO and FB intervention in each county. The FCS agents were always paired with either the postdoctoral psychologist or a psychology graduate student.		
	5.6 Mode of delivery	Face-to-face, group	P.4	Yes
	5.7 Locations	All assessment and intervention took place at the Cooperative Extension Service (CES) office in participating counties.	P.3	Yes
	5.8 Duration & intensity	4 months	P.3; P.4	Yes

		For both intervention conditions, weekly group sessions were held for the first 8 weeks, then biweekly for the next 8 weeks. Sessions lasted 90 minutes. Note: Data collection at baseline, month 4 (at the end of the intervention), and month 10		
	5.9 Tailoring (if)	**From Janicke et al, 2008 (Ref24)** Program goals will be based on their baseline level of steps and will target an increase of at least 3000 steps/day by the end of the program for both children and parents. If excessive television viewing is not a concern for a given family, group leaders may target non-homework based computer time. Goals will be tailored to the individual needs of each family	P.7; P.15, T.2	Yes
	5.10 Modifications	No information		No information
	5.11 How well (planned)	**From Janicke et al, 2008 (Ref24)** Treatment adherence Adherence to dietary protocol and goals will be assessed with **a seven-day food log**, which we refer to as their "**habit log**". Children and parents will be	P.6	Yes

		asked to work together to complete the child's habit log on a daily basis. Parents will also track their personal dietary intake on their own habit log. Children and parents will be trained to complete the daily habit log during the initial group treatment session. Abbreviated habit logs will be available for families who struggle with completing the full monitoring logs. Abbreviated logs will include recording of fruit and vegetables and high fat-high calorie "Red Foods." Children and parents will **wear a pedometer** to track the number of steps they take each day. Steps will be recorded on the daily habit log and average steps per day will be calculated over the course of each week. Starting in week 6 of the program, children and parents will also **use their habit logs to track time spent** watching television and playing video games.		
	5.12 How well (actual)	Participants in the PO condition attended, on average, 74% of the sessions compared with 63% in the FB condition. Note: 76% (71/93) completed at month 10	P.5	Yes

		From Janicke et al, 2008 (Ref24) All interventionists for Project STORY will undergo extensive training and certification in the treatment protocols. The PI will conduct periodic direct observation of group sessions to monitor interventionist's performance and assess treatment fidelity. The interventionists will also participate in weekly supervision meetings with the PI to review each family's progress, discuss group interactions, and prepare for the next group session. Note: couldn't find what PI is?	P.11, F.1 P.7	
	5.13 Control group	WLC Completed assessments on the same schedule as those in the intervention conditions and received a weight management intervention after the final follow-up.	P.5	
	5.14 Notes			

Note: 6 BCTs, see Appendix 3I – BCTs coding

		Description as stated in report	Location in text *(page/figure/table)*
7. Results and finding	7.1 Primary outcomes (BMI, BMI z-score, weight, waist circumference (WC), percentage of body fat (%BF), or other method of body composition analysis determined using methods validated in children with overweight or obesity)	 **Figure 2.** Mean change in child body mass index (BMI) *z* score from pretreatment to posttreatment (month 4). BMI is calculated as weight in kilograms divided by height in meters squared. FB indicates family based; PO, parent only; and WLC, wait-list control. Error bars indicate SD.  **Figure 3.** Change in child body mass index (BMI) *z* score from pretreatment to follow-up (month 10). BMI is calculated as weight in kilograms divided by height in meters squared. FB indicates family based; PO, parent only; and WLC, wait-list control. Error bars indicate SD.	P.12, F2; P.13, F.3;
		Table 2 Outcome Data by Treatment Condition **Outcome** / **Family-Based Condition** / **Parent-Only Condition** / **Wait-List Control Condition** Child BMI *z* score, mean (SD) Month 0: 2.133 (0.43) / 2.160 (0.35) / 2.015 (0.41) Month 4: 2.055 (0.52) / 2.021 (0.47) / 2.003 (0.48) ΔMonth 0–4: −0.078 (0.16)[a] / −0.139 (0.19) / −0.012 (0.15) Month 10: 2.018 (0.53) / 2.069 (0.44) / 2.037 (0.48) ΔMonth 0–10: −0.115 (0.22)[a] / −0.091 (0.20)[a] / 0.022 (0.17) Child energy intake, mean (SD), kcal/d Month 0: 2311 (807) / 2256 (641) / 2259 (1321) Month 4: 1818 (696)[b] / 1840 (703)[b] / 1891 (1026)[b] ΔMonth 0–4: 493 (828) / 416 (686) / 368 (639) Month 10: 1921 (899)[b] / 1815 (669)[b] / 1861 (823) ΔMonth 0–10: 390 (784) / 441 (663) / 398 (910) Parent BMI, mean (SD) Month 0: 32.86 (6.8) / 35.47 (8.2) / 35.66 (9.3) Month 4: 32.12 (6.7) / 34.53 (7.9) / 34.93 (9.0) ΔMonth 0–4: −0.74 (1.0) / −0.94 (1.6) / −0.73 (2.6) Month 10: 33.07 (6.9) / 34.90 (8.0) / 35.11 (9.6) ΔMonth 0–10: 21 (1.5) / −0.57 (2.4) / −0.55 (3.6) Abbreviation: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared). [a] Statistically significantly different compared with the wait-list control condition at *P*<.05 (between-group difference). [b] Statistically significantly different compared with the pretreatment energy intake at *P*<.05 (within-group difference).	P.15, T.2

	7.2 Secondary outcomes	Energy intake from table 2	P.1, T.2
	7.3 Other outcomes	NA	
	7.4 Notes	Age sub-group analyses were not available	

		Description as stated in report	Location in text *(page/figure/table)*
8. Limitation and mitigation strategy	8.1 Strength	Findings from this study have potential implications for community-based treatment of overweight youth. Implementation of PO interventions will likely require fewer personnel and material resources than FB interventions, a consideration that is critical for communities with limited resources. Furthermore, families living in rural settings often have limited access to medical and preventive health services. The CES offers an established network of non-	P.8

		medical facilities that exist in almost every county in the United States. Thus, there is great potential for dissemination of this intervention across the country.	
	8.2 Limitation	Several limitations of the present study must be noted. First, the clinical significance of these findings is unclear. Kirk and colleagues[31] have reported that a 0.15 BMI z score unit decrease was associated with significant improvements in lipids and insulin levels for obese children. In our study, approximately 38% of children in the FB condition and 31% of children in the PO condition demonstrated a decrease of at least 0.15 BMI z score unit at follow-up compared with only 5% in the control condition. Second, this study did not include objective or criterion standard measures of physical activity and dietary intake, which limits our ability to draw inferences about the effect of these interventions on specific lifestyle behaviors. Third, we did not obtain program satisfaction data from children assigned to the PO condition. Fourth, the median income of families in the study, although lower than national averages, was higher than that commonly seen in rural communities.	P.7, P.8

		Finally, the parents in the present study did not experience significant decreases in weight status, which contrasts with previous FB efficacy trials. One potential explanation is that not all parents in the present study were overweight. In addition, parents in the present study did not monitor their caloric intake, which is a key strategy associated with successful adult weight loss. Despite these limitations, these data suggest that a PO intervention represents a potentially viable alternative to the FB intervention model. There are a number of possible benefits to including only parents in treatment groups. The first possible benefit is that the parent may be forced to take greater responsibility for learning and explaining strategies to adopt healthier lifestyle habits, as well as implementing those changes in the family environment. Second, attending weight management interventions may be stigmatizing for some children, thereby diminishing their motivation for active participation and increasing their resistance to healthy lifestyle changes. Third, PO sessions may be easier for parents to attend. Finally, PO interventions may allow parents more time for problem solving and receiving support from	

		other parents. Indeed, many parents in this condition reported that groups were their time for a “break from the family.”	
	8.3 Strategies to overcome limitation	NA	
	8.4 Notes		

	Domain	Signaling questions	Description as stated in report	Location in text *(page/figure/table)*	Extractors' note *(Y/PY/PN/N/NI/NA)**	Extractors' judgement *(low/some concerns/high)*
9. Risk of Bias (RoB)	9.1 Randomization process	9.1.1 Was the allocation sequence random?	At this visit, families were notified of their randomization to 1 of 2 lifestyle intervention programs that lasted for 4 months or a wait-list control (WCL) condition. Before the baseline assessment, all families were randomized via **computer assignment**, based on availability, to 1 of the 2 specific weeknights or the WCL condition. After randomization of all families, the intervention (PO or FB) were assigned randomly to the specific weeknights. Families were notified of their group assignment at pretreatment assessment.	P.3	Y	

		9.1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Families were notified of their group assignment at pretreatment assessment.	P.3	N	
		9.1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?	Baseline demographic and weight status data are given in Table 1. No statistically significant differences were found between conditions on these variables.	P.5	N	
		RoB judgment 9.1				High
	9.2 Intended intervention	9.2.1 Were participants aware of their assigned intervention during the trial?	Families were notified of their group assignment at pretreatment assessment.	P.3	Y	
		9.2.2 Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?	NI	NI	NI	
		Answer either ***effect of assignment to intervention*** (9.2.3-9.2.7) or ***effect of adhering to intervention*** (9.2.8-9.2.11)				
		Effect of assignment to intervention	NI	NI	NI	

		9.2.3 If Y/PY/NI to 9.2.1 or 9.2.2: Were there deviations from the intended intervention that arose because of the trial context?				
		9.2.4 If Y/PY to 9.2.3: Were these deviations likely to have affected the outcome?	NA	NA	NA	
		9.2.5 If Y/PY/NI to 9.2.4: Were these deviations from intended intervention balanced between groups?	NA	NA	NA	
		9.2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?	Analysis was completed on all participants who completed month 4 and month 10 follow-up assessment, with no exclusion based on attendance. Note: Did not analyzed all participants who randomized	P.5	PN	
		9.2.7 If N/PN/NI to 9.2.6: Was there potential for a substantial impact (on the result) of the failure to analyse	NI	NI	NI	

		participants in the group to which they were randomized?				
		Effect of adhering to intervention 9.2.8 [If applicable:] If Y/PY/NI to 9.2.1 or 9.2.2: Were important non-protocol interventions balanced across intervention groups?	NA	NA	NA	
		9.2.9 [If applicable:] Were there failure in implementing the intervention that could have affected the outcome?	NA	NA	NA	
		9.2.10 [If applicable:] Was there non-adherence to the assigned intervention regimen that could have affected participants' outcome?	NA	NA	NA	

		9.2.11 If N/PN/NI to 9.2.8 or Y/PY/NI to 9.2.9 or 9.2.10: Was an appropriate analysis used to estimate the effect of adhering to intervention?	NA	NA	NA	
		RoB judgment 9.2				High
	9.3 Missing outcome data	9.3.1 Were outcome data available for all, or nearly all, participants randomization?	Note: 76% (71/93) completed at month 10	P.11, F.1	N	
		9.3.2 If N/PN/NI to 9.3.1: Is there evidence that the result was not biased by missing outcome data?	Analysis was completed on all participants who completed month 4 and month 10 follow-up assessment, with no exclusion based on attendance.	P.5	N	
		9.3.3 if N/PN to 9.3.2: Could missingness in the outcome depend on its true value?	NI	NI	NI	

		9.3.4 If Y/PY/NI to 9.3.3: Is it likely that missingness in the outcome depended on its true value?	NI	NI	NI	
		RoB judgment 9.3				High
	9.4 Measurement of the outcome	9.4.1 Was the method of measuring the outcome inappropriate?	Height and weight were assessed for the child and parent. Height without shoes was measured to the nearest 0.1 cm using a Harpendon stadiometer (Holtain Ltd, Crosswell, United Kingdom). Weight was measured to the nearest 0.1 kg with 1 layer of clothing on and without shoes using a calibrated balance beam scale. Height and weight were measured 3 times, and the average of each was used for analysis. The Youth/Adolescent Food Frequency Questionnaire was used to assess the child's dietary intake during the preceding month.	P.3	N	
		9.4.2 Could measurement or ascertainment of the outcome	Note: Same measurement both groups	P.14-P.15, T.1-T.2	N	

		have differed between intervention groups? Note: Is it mean between intervention and control group or between intervention and intervention group in case they had more than 1 intervention groups? = Answer: intervention and control group				
		9.4.3 If N/PN/NI to 9.4.1 and 9.4.2: Were outcome assessors aware of the intervention received by study participants?	NI	NI	NI	
		9.4.4 If Y/PY/NI to 9.4.3: Could assessment of the outcome have been influenced	NI	NI	NI	

		by knowledge of intervention received?				
		9.4.5 If Y/PY/NI to 9.4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?	NI	NI	NI	
		RoB judgment 9.4				High
	9.5 Selection of the report result	9.5.1 Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis	Analysis was completed on all participants who completed month 4 and month 10 follow-up assessments, with no exclusions based on attendance. Analysis of covariance (ANCOVA), with corresponding baseline values entered as covariates, was used to assess changes in **weight status and caloric intake across conditions**. When the omnibus ANCOVA was significant, planned comparisons were used to examine differences between the 2 active interventions relative to the WLC condition. Analyses were conducted using a	P.5	PY	

			commercially available software program (SPSS 15.0; SPSS Inc, Chicago, Illinois). Post hoc power analyses were used to determine the detectable change in BMI z score from 0 to 10 months for the FB and PO interventions relative to the WLC condition. Effect sizes detectable with 80% power and 2-sided level .05 tests were used. Standard deviations and sample sizes were set equal to their observed values. For comparing the FB and WLC conditions, we had 80% power to detect a shift from 0.022 to −0.145. For comparing the PO and WLC conditions, we had 80% power to detect a shift from 0.022 to −0.135. Note: No statistically analysis reported in protocol (Janicke,2008; design and method). Following the analysis in the articles, they reported all results			
		Is the numerical result being assessed likely to have been selected, on the basis of the results, from.. (9.5.2 and 9.5.3)				

		9.5.2 Multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain? (check from a trial protocol or statistical analysis plan)	Height and weight were assessed for the child and parent. Height without shoes was measured to the nearest 0.1 cm using a Harpendon stadiometer (Holtain Ltd, Crosswell, United Kingdom). Weight was measured to the nearest 0.1 kg with 1 layer of clothing on and without shoes using a calibrated balance beam scale. Height and weight were measured 3 times, and the average of each was used for analysis. The Youth/Adolescent Food Frequency Questionnaire was used to assess the child's dietary intake during the preceding month. Note: Same in both three groups	P.3; P.12, F.1; P.13, F.2; P.14, T.1; P.15, T.2;	N	
		9.5.3 Multiple eligible analyses of the data? (check from a trial protocol or statistical analysis plan)	Analysis was completed on all participants who completed month 4 and month 10 follow-up assessments, with no exclusions based on attendance. Analysis of covariance (ANCOVA), with corresponding baseline values entered as covariates, was used to assess changes in **weight status and caloric intake across conditions**. When the omnibus ANCOVA was significant, planned comparisons were used to examine differences between the 2 active interventions relative	P.5	N	

			to the WLC condition. Analyses were conducted using a commercially available software program (SPSS 15.0; SPSS Inc, Chicago, Illinois). Post hoc power analyses were used to determine the detectable change in BMI z score from 0 to 10 months for the FB and PO interventions relative to the WLC condition. Effect sizes detectable with 80% power and 2-sided level .05 tests were used. Standard deviations and sample sizes were set equal to their observed values. For comparing the FB and WLC conditions, we had 80% power to detect a shift from 0.022 to −0.145. For comparing the PO and WLC conditions, we had 80% power to detect a shift from 0.022 to −0.135. Note: One way for each outcome			
		RoB judgment 9.5				Low
	9.4 Overall judgment (9.1-9.5)					High
	9.5 Notes					

*Y=Yes, PY=Probably yes, PN=Probably no, N=No, NI=No information, NA=Not applicable

Appendix 3l

Behaviour change techniques (BCTs) coding

Discussion and summary by SS, AM &RF

Ahmad et al., 2018

		Description as stated in report	Location in text *(page/figure/table)*
6. Behaviour change techniques (BCTs)	6.1 Intervention group	**SS:** BCT quote: The programme trained the parents on children's nutrition, physical activity, behaviour modification techniques and parenting skills to improve their children's health behaviours. …. Parents were **encouraged to acquire authoritative parenting skills, practice healthy behaviours and improve self-efficacy of child's healthy behaviours**. BCT label: 3.1 Social support (unspecified) Note: Encouragement is being provided **Support sentence from Ahmad, 2016 (Study protocol)** BCT quote: Parenting skills and roles **AMM:** BCT quote: "Parents were encouraged to acquire authoritative parenting skills, practice healthy behaviours" BCT label: 13.1 Identification of self as role model Note: This is implicit rather than explicit but "role modelling" is also referred to in Table 1p	P.3 Ref30 P.100, T.1 MP P.3, C.2

		Discussion: **SS:** I think this should code as 3.1 Social support (unspecified) as a definition of 13.1 is inform that one's own behaviour may be an example to others. In this sentence explained that they encourage parents who will look after their children which is a main target participant. See definition of BCT 3.1 **AM: Practice healthy behaviour is demonstrating, I agree that role model is not the best one. Practice healthy behaviour as parents then doing as model for their children** **RF: 3.1 might appropriate than modeling because you advice parents to do this. The intervention does not actually include them doing this. Check 13.1 might be more appropriate from an example of BCTTv1 and authoritative parenting skills match 3.1. RF 13/09/21 – does this need further discussion?** **Final decision:** 3.1 Social support (unspecified) 13.1 Identification of self as role model	
		SS: BCT quote: The child's ultimate **daily targeted** behaviours included no consumption of sugar-sweetened beverages (SSB) and unhealthy snacks, intake **at least five servings of fruit and vegetables (FV) (two servings of fruit and three servings of vegetables)**, **a minimum of 30 min of moderate to vigorous physical activity and a maximum of 120 min of screen time (watching television and playing video games).** However, parents and children were **empowered to choose which of the five targets to start working towards, first starting with the more manageable to achieve targets and to make small changes, one at a time.**	P.3 Ref30 P.100, T.1

		Support sentence from Ahmad, 2016 (Study protocol) BCT quote: Target for SSB, Target for FV, Target for snack, Target for physical activity, Target for screen time BCT label: 1.1 Goal setting (behaviour) 1.4 Action planning 8.7 Graded tasks Note: **AMM:** BCT quote: “parents and children were empowered to choose which of the five targets to start working towards” BCT label: 1.1 Goal setting (behaviour) Note: Although this sentence does not identify the targets, the previous sentence describes five behaviour targets (not outcomes) BCT quote: “starting with the more manageable to achieve targets and to make small changes, one at a time” BCT label: 8.7 Graded tasks Note: This is implicit rather than explicit – is this detailed enough? **Discussion:** **SS:** Agreed 1.1, 8.7 **AM**: Will you agree to code 1.4?, 14/09/2021: I don’t’ this that is planning it’s more like a goal. Not code 1.4	MP P.3, C.2 MP P.3, C.2

		RF: I think 1.4 is unclear/ not explicit from this limited information. I think this is ultimate goal of the programme, not specific for children. **14/09/2021; We all agreed not code 1.4** **Final decision:** 1.1 Goal setting (behaviour) 8.7 Graded tasks	
		SS: BCT quote: The elements of behaviour modification skills in the SCT include self-monitoring, goal setting, self-efficacy, **problem solving, relapse prevention**, and stimulus control. BCT label: - Note: This is only mentioned techniques but did not explain how did they use. Same words can be translate in the difference ways, so I try to avoid to code the word which they don't have any explanation. **Support sentence from Ahmad, 2016 (Study protocol)** Contents included; BCT quote: Scenario of problem and suggested solutions of SSB, FV, unhealthy snack/junk food, physical activity, screen time, risky situations and review of performance, feedback and discussion at the end of the sessions BCT label: 1.2 Problem solving Note: This was contents that given to participants.	P.3 Ref30 P.100, T.1 MP

		AMM: BCT quote: “problem solving, relapse prevention” BCT label: 1.2 Problem solving Note: although text is not explicit here, it is repeated on page 4, Table 1 **AMM:** BCT quote: “self-monitoring” BCT label: Note: No code given: considered 2.3 and 2.4 but not clear what is being monitored or by whom **Discussion:** **SS: Even they repeated but there was no information explain here how did they use the technique 1.2 as the definition of 1.2 itself have 2 main important parts i.e., analyse or prompt the person to analyse factors influencing the behaviour AND generate and select strategies that include overcoming barriers, I try to avoid to code from key word as they might have difference approach but call it in the same way however will consider code 1.2 as support sentence from Ref30 (P.100, T.1 see above)** **Agreed, not coded 2.3** **AM: Agreed, not coded 2.3.** **Will you agree not to code 1.2?** **The problem solving itself is a bit vague but there is a part in the training (BCTTv1) talk about relapse prevention being on of this term that is use in behaviour change and they said when you have something like counseling you called it “social support” and when relapse prevention you called it “problem solving”.** **Technical term ‘Relapse Prevention’ use in BCT that is interpret as ‘problem solving’**	P.3, C2 MP P.4, T.1

		RF:- **Final decision:** 1.2 Problem solving	
		SS: BCT quote: In this phase the first author (NA) posted on WhatsApp key information and skills provided in the training phase but in the form of poster, responded to any queries by parents and **provided feedback on the adiposity progress of the children based on the measurements taken.** BCT label: 2.7 Feedback on outcome(s) of behaviour Note: **AMM:** BCT quote: “provided feedback on the adiposity progress of the children based on the measurements taken“ BCT label: 2.7 Feedback on outcome(s) of behaviour Note: **Discussion:** **SS:** Agreed 2.7 **AM:** Agreed 2.7 **RF:-** **Final decision:** 2.7 Feedback on outcome(s) of behaviour	P.4 MP P.4, C.1

		SS: BCT quote: The programme **trained the parents on children's nutrition, physical activity, behaviour modification techniques and parenting skills to improve their children's health behaviours.** **Support sentence from Ahmad, 2016 (Study protocol)** Contents included; BCT quote: Why SSB bad for health?, Why FV good for health?, Why snack bad for health?, Why physical activity good for health?, Why prolong screen time bad for health? BCT label: 5.1 Information about health consequences Note: This was contents that given to participants. **AMM:** BCT quote: "Why SSB bad for health?" BCT label: 5.1 Information about health consequences Note: Several other examples **Discussion:** **SS:** Agreed 5.1 **AM:** Agreed 5.1 **RF:-** **Final decision:** 5.1 Information about health consequences	P.3 Ref30 P.100, T.1 Ref30 P.6, T.1

		SS: BCT quote: The programme **trained the parents on children's nutrition, physical activity, behaviour modification techniques and parenting skills to improve their children's health behaviours.** **From Ahmad, 2016 (Study protocol)** Contents included; BCT quote: Tips to reduce SSB intake, Tips to increase FV intake, Tips to reduce snack intake, Tips to increase physical activity, Tips to reduce screen time, Example of servings for fruits and vegetable, How to cook vegetables, Example of moderate and vigorous activities, Example of activity to strengthen muscles and bones, How to deal with 'risky situations', Exercise tips, Calories needed and example of serving according to age and sex. BCT label: 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour Note: This was contents that given to participants. **AMM:** BCT quote: "Physical activity" BCT label: Note: No code given as not clear what this comprises; previously, describes this as "tips" but might possibly have included 4.1, 6.1 and 8.1 **AMM:** BCT quote: "What is physical activity?", "Examples of moderate and vigorous activities"	P.3 Ref30 P.100, T.1 MP P.4, T.1

		BCT label: 4.1 Instruction on how to perform the behaviour Note: Other examples in table **Discussion:** **SS:** Agreed 4.1 **AM:** Agreed 4.1, Will you agree 6.1?, 14/09/2021 - Agree 6.1 **RF: Add 6.1 - via images of appropriate portions and examples of servings.** **Final decision:** 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour	
		SS: **From Ahmad, 2016 (Study protocol)** BCT quote: Examples of success stories BCT label: Note: This was contents that given to participants Can this coded as 9.1 credible source or 13.1 Identification of self as role model? but I don't think this can code. Insufficient info. **Discussion:** **SS:** Not coded ***AM: Did not code** **RF: Code as 9.1 as intention to persuade? Although this is implied not explicit.** **Final decision:**	Ref30 P.100, T.1
		SS: **From Ahmad, 2016 (Study protocol)** BCT quote: How to fill up food record, SSB diary, SSB and FV diary, Food record, Physical activity record, Physical activity record including screen time	Ref30 P.100, T.1

		BCT label: - Note: This was contents that given to participants. Considered 2.3 self-monitoring of behaviour. It is not clear whether they only taught them how to record or they asked them to record but they mentioned that they used self-monitoring. Example of BCT quote: participants were **asked to record each exercise session, noting what they did, when they started and for how long they exercised.** The problem is that they don't have the exact sentence where they stated that they asked participants to record but sentence from table 1 about "diary and record" demonstrated that they more likely to record. **If this code 2.3, Croker_2012 article (see P.10 in word file) should code as well.** **Discussion:** **SS: Should we code 2.3 Self-monitoring of behaviour?** **AM: Will you consider to code 2.3?** **14/09/2021 Agree code 2.3** **RF: Code as 2.3 – clear that method is being established.** **Final decision:** **2.3 Self-monitoring of behaviour.**	
		AMM: BCT quote: "exercise tips in unit 8 which was conducted by a sports medicine specialist" BCT label: 9.1 Credible source Note: Public health physician also involved at other sessions **Discussion:** **SS: Agreed to code 9.1** **AM: Agreed to code 9.1**	MP P.4, C.1

		RF:- **Final decision:** 9.1 Credible source	
		AMM: BCT quote: “strengthen parents’ knowledge and skills in promoting the targeted behaviours” BCT label: 5.3 Information about social and environmental consequences Note: I don’t think this is explicitly about health so should use the more general code 5.3 **Discussion:** **SS:** Not coded as I don’t think these are consequences. But if we are going to code 5.1 or 5.3 I think the contents were about health see Ref30 (study protocol). In MP, P.3 explained that the programme trained the parents on children’s nutrition, physical activity, BCT and parenting skills to improve their children’s health behaviour. It should code as 5.1 **AM: I think this is consequences but it’s not explicitly health so code 5.3** **RF:** Probably was not 5.3 because this is not consequences at all, considered 4.1 because advise how to perform the behaviour. In this case is lack of detail there. ‘Parents skill’ can be 4.1 where ‘knowledge’ perhaps lacks of information to code one or another. 13/09/21 considered 4.1 because advise how to perform the behavior. In this case is lack of detail there. ‘Parents skill’ can be 4.1 where ‘knowledge’ lacks information to code one or another. Still undecided re including 5.3? **Final decision:** 4.1 Instruction on how to perform a behaviour	MP P.4, C.1
		AMM: BCT quote: “small incentives (mainly stationeries) were given to the children each time they participated in the physical measurements and returned the parent-administered questionnaires” BCT label: 10.2 Reward (behaviour)	MP P.4, C.1-2

		Note: Although text states 'incentive' they are providing a reward rather than telling participants about it. The reward is for self-monitoring which is a behaviour **Discussion:** **SS: The rewards provided because of 'physical measurement' and 'return questionnaires' which are not about performing behaviour (target behaviour: eating, physical activity). This monitoring was part of data collection.** **AM: Agreed, not coded** **RF: Agree as per previous example.** **Final decision:** **Not coded**	
		AMM: BCT quote: "informed of their children's progress via WhatsApp after each data collection immediately post-training" BCT label: Note: No code given: this relates to parents only; not clear what feedback is on; 2.7 Feedback on outcomes of behaviour considered but this has already been assigned **Discussion:** **SS: Agreed, not coded. From def 2.7 means monitor and provide feedback to target population which is parents and children but from the sentence this was parents provide to the researcher** **AM: 11/08/2021 Agreed, not coded.** **RF: -** **Final decision:** **Not coded**	MP P.4, C.2

		AMM: BCT quote: “texting phrases such as ‘to make healthy and happy family’ and congratulating group members who managed to reduce their children’s BMI” BCT label: 3.1 Social support (unspecified) Note: Arranged for parents to support each other **Discussion:** **SS: I have not coded this quote because I only considered information from intervention in the article. This info is part of result but will considered to add 3.1. Also considered 10.4 because they congratulating group member (parents) who manage to reduce their children’s BMI. Agreed 10.10** **AM: 11/08/2021 Will you agree 10.4?. weight loss is outcome rather than behaviour. From definition of 10.4 if reward is for outcome coded 10.10 So, 10.10 coded** **RF: -** **Final decision:** 3.1 Social support (unspecified) 10.10 Reward (outcome)	MP P.5, C.2

	6.2 Number of BCTs in intervention group		

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	
1.2 Problem solving	X	X	
1.4 Action planning	X		
2.7 Feedback on outcomes of behaviour	X	X	
3.1 Social support (unspecified)	X	X	
4.1 Instruction on how to perform the behaviour	X	X	
5.1 Information about health consequences	X	X	
5.3 Information about social and environmental consequences		X	
6.1 Demonstration of the behaviour	X		
8.7 Graded tasks	X	X	
9.1 Credible source		X	SS agreed to code
10.2 Material reward (behaviour)		X	AMM agreed not to code; Not coded
13.1 Identification of self as role model		X	
Number of BCTs	9	11	

Note: Although In table 1 (P.4) they stated that self-monitoring, goal setting, problem solving, only goal setting and problem solving had sufficient information to code.

Update: 15/09/2021

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	X
1.2 Problem solving	X	X	X
1.4 Action planning	X		Not code
2.3 Self-monitoring of behaviour			X
2.7 Feedback on outcomes of behaviour	X	X	X
3.1 Social support (unspecified)	X	X	X
4.1 Instruction on how to perform the behaviour	X	X	X
5.1 Information about health consequences	X	X	X
5.3 Information about social and environmental consequences		X	Not code
6.1 Demonstration of the behaviour	X		X
8.7 Graded tasks	X	X	X
9.1 Credible source		X	X
10.2 Material reward (behaviour)		X	Not code
10.10 Reward (outcome)			X
13.1 Identification of self as role model		X	X
Number of BCTs	9	11	12

Note : Check P.10 with AMM for 9.1 I missed this one, It's already code somewhere but would like to check if that sentence can also be coded

	6.2 Control group	**SS:** The wait-list control group received the intervention after the completion of the final 6-month follow-up. **AMM:** BCT quote: “small incentives (mainly stationeries) were given to the children each time they participated in the physical measurements and returned the parent-administered questionnaires” BCT label: 10.2 Material Reward (behaviour) Note: Although text states ‘incentive’ they are providing a reward rather than telling participants about it. The reward is for self-monitoring which is a behaviour **Discussion:** **SS: The rewards provided because of ‘physical measurement’ and ‘return questionnaires’ which are not about performing behaviour (target behaviour: eating, physical activity). This monitoring was part of data collection.** **AM: 11/08/2021 Agreed, not coded** **RF:** Note: Same as intervention group P.13 which is not coded. **Final decision:** **Not coded**	P.4 MP. P.4, C.1-2
	6.3 Categorized by	SS & AMM	
	6.4 Notes	Version 20210811	

Croker et al., 2012

		Description as stated in report	Location in text *(page/figure/table)*
6. Behaviour change techniques (BCTs)	6.1 Intervention group	**SS:** BCT quote: Parents are **instructed in behaviour management principles to support their child's behavior change and make changes to the home environment to encourage family-wide uptake of healthy lifestyle behaviours.** BCT label: 3.1 Social support (unspecified) Note: - **AMM:** BCT quote: "instructed in behaviour management principles to support their child's behavior change" BCT label: 3.1 Social support (unspecified) Note: - BCT quote: "make changes to the home environment to encourage family-wide uptake of healthy lifestyle behaviours" BCT label: 12.1 Restructuring the physical environment **Discussion:** **SS: Agreed to code 3.1, 12.1** **AM: Agreed to code 3.1, 12.1** **RF:-**	P.4 MP P.4 MP P.4

		Final decision: 3.1 Social support (unspecified) 12.1 Restructuring the physical environment	
		SS: BCT quote: Cognitive component of the programme include **advice on managing teasing and general problem-solving.** **Support sentence from supplement table1** BCT quote: **Managing teasing and bullying** Note: It was in a session 8 Social support, cue control BCT label: 3.3 Social support (emotional)+ Note: **Discussion:** **SS: Can we code 3.3?** ***AM: Will you agree to code 3.3?** **14/09/2021: Not code 3.3 – too general** **RF: Code 3.3** **14/09/2021 : I am thinking not quite for 3.3, Agree not code** **Final decision:** Not code 3.3	P.4
		SS: BCT quote: The key dietary targets were i) to follow a regular eating pattern, ii) to **reduce snacking to no more than two occasions per day**, and iii) to consume a balanced diet (as described in the 'eatwell plate' and 'Traffic Light system') in appropriate quantities.	P.4

		Key physical activity targets were i) to reduce time spent in sedentary behaviours and ii) to **increase the time spent in lifestyle or structured activity in line with the current UK recommendation of 60 minutes a day.** **Support sentence from supplement table1** **Set a goal** **Collect info re keeping a diary - Problem solve difficulties** **Was goal achieved?** **Feedback on dairy** **Monitor sedentary behaviour** **Modelling, setting a good example** **Learning cues (internal and external triggers to eating or inactivity)** **Cue control (5 Only's)** **Getting support from friends** BCT label: 1.1Goal setting (behaviour) 1.2Problem solving 1.4 Action planning 2.2 Feedback on behaviour 2.3 Self-monitoring of behaviour 3.1 Social support (unspecified) 6.1 Demonstration of the behaviour 7.1 Prompts/cues Note: 1.4 is coded as they mentioned "no more than two occasions per day, 60 mins a day"	

		1.2 is coded as in session 2 goal setting include “problem solve difficulties”. This is not really obvious but it probably. 2.2 is coded as “feedback on diary” where the diary probably about diet as e.g. in session 2 mentioned no red foods at home 2.3 is coded as “Monitor sedentary behaviour” which was a homework so they monitor themselves. 3.1 is coded as “getting support from friends” 6.1 is coded as “modeling”, “setting a good example” in session 6 “Nutrition and exercise review” 7.1 is coded as “Learning cues, Cue control”	
		AMM: BCT quote: “to reduce snacking to no more than two occasions per day” BCT label: 1.1 Goal setting (behaviour) Note: -	MP P.4
		BCT quote: “healthy foods as a modeling exercise” BCT label: 6.1 Demonstration of the behaviour Note: “Modelling” is also referred to earlier in table; insufficient to consider this 13.1 Identification of self as role model.	SP P.3
		BCT quote: “First feedback on diary” BCT label: 2.2 Feedback on behaviour Note: -	SP P1
		BCT quote: “setting a good example” BCT label: 13.1 Identification of self as role model	SP P.2

		Note: Implicit rather that explicit BCT quote: “Internal and external triggers to eating or inactivity” BCT label: - Note: Not coded as this does not explicit link to a behaviour; consider 4.2, 5.3, 7.1 **Discussion:** **SS: Agreed 1.1, 2.2, 6.1, 13.1** **I code 6.1 for “setting a good example”** ***AM: Will you agree to code 1.2, 1.4, 2.3, 3.1, 7.1?** **14/09/2021: Agree with RF, it’s a broad of context; Not code 1.2.** **Agree 1.4, I don’t think probably not 2.3, I think it’s not clear that direct to behaviour, not code 3.1, Too wage for 7.1, not code 7.1.** **RF: Agree add 1.4 (action planning), ~~2.3 (self-monitoring), 3.1 (support).~~ 7.1 considered unclear re: if behavior was performed as described in BCT.** **14/09/2021: Is it not clear enough for 1.2. I am not difficulty of food record vs anything to do with.. when It’s not explicit save to not to than to assume. I take 2.3, 3.1 out. Not explicit 7.1** **Final decision:** **1.1** Goal setting (behaviour) **1.4** Action planning **2.2** Feedback on behaviour **6.1** Demonstration of the behaviour **13.1** Identification of self as role model	SP P.2
		AMM: BCT quote: “they were given feedback and <u>weighed</u>” BCT label: 2.5 Monitoring of outcomes of behaviour without feedback	MP P.4

		Note: - BCT quote: “they were given feedback and weighed” BCT label: 2.7 Feedback on outcomes of behaviour Note: Not clear if this feedback relates to weight or something else **Discussion:** **SS: 2.5 not coded because I am not sure if this weighed as part of behaviour change strategy or data collection, as note in 2.5 from BCTTv1 if monitoring is part of data collection procedure rather than a strategy aimed at changing behaviour, do not code** **2.7 not coded because I am not sure what feedback are they given, was it directed to target behaviour?. I think insufficient info to code.** **15/09/2021: As Roz agree 2.5, so I will add 2.5. If consider 2.7 vs 2.2 I probably go for 2.7 as I am not sure if feedback given for behaviour. Following the guideline of goal setting if it is not clear whether behaviour or outcome, code outcome. And also they given feedback and weight, it might probably feedback on weight which is outcome.** **AM: The example they given for 2.5 from BCTTv1 is record BP, blood glucose, weight loss or physical fitness. So, I think It (weighed) does count as 2.5** **My comment for 2.7 is that it is not clear if this feedback relates to weight or something else. I think this construction of the sentence is not helpful because if they were weighed and given feedback then it would be reasonable clear that given feedback was on the weight. I think you find in some places I coded that as 2.7. If is not clear for outcome or behaviour they said to use outcome.** **RF: Add 2.5 if weight is intervention outcome (i.e., aim for participants). Code as 2.2 as unclear what feedback related to but we know it was given.** **Final decision:** **2.5** Monitoring of outcomes of behaviour without feedback **2.7** Feedback on outcomes of behaviour	

		AMM: BCT quote: “delivered by clinicians with experience of working with parents and families (psychologist, family therapist or experienced dietitian) and the children’s groups were delivered by a dietitian with experience of working with children” BCT label: 9.1 Credible source Note: - **Discussion:** **SS: Not coded but agreed to code 9.1 From quote: The contents of the treatment and maintenance sessions are outlined in Supplemental Table 1. The parents’ groups were delivered by clinicians with experience of working with parents and families (psychologist, family therapist or experience dietitian) and children’s groups were delivered by a dietitian with experience of working with children and a researcher who assisted, Additional researchers carried out the brief one-to-one family reviews.** **AM: Agreed 9.1** **RF:-** **Final decision:** 9.1 Credible source	
		AMM: BCT quote: “Introduction to the traffic light system” BCT label: 5.3 Information about social and environment consequence Note: Most sessions describe topics that appear to provide information to support behaviour change but none of topic explicitly state that this is about health so code 5.3 used	SP P.1

		Discussion: **SS: Not coded. Following the definition of BCT 5.3 the information about social and environment consequences of performing behaviour but in this sentence did not show any consequences** **AM: Agreed not to code 5.3** **RF:-** **Final decision:** Not code	
		AMM: BCT quote: “Praise and rewards” BCT label: 10.4 Social reward Note: Not clear that this is related to behaviour but is during session on “goal setting” **Discussion:** **SS: Not coded. This is not clear whether praise and rewards were directed to target behaviour or not however, as this during “goal setting” session will considered to code 10.4** **AM: As goal setting is a technique that being used therefore it become behaviour. So, I think that probably the basis that I starting on** **RF:-** **Final decision:** **10.4 Social reward**	SP P.1
		AMM: BCT quote: “Response substitution” BCT label: 8.2 Behaviour substitution Note: Limited detail but probably enough to consider “response” to be equivalent to “behaviour”	SP P.2

		Discussion: **SS: Not coded because there was no information explain but agree that response can be equivalent to behaviour. The different between 'respone' and 'behaviour' is that response = single behaviour and behaviour = group of behaviour. Will consider to code 8.2+** **AM: Code 8.2** **RF: Suggest no code – insufficient detail** **Final decision:** Not code	
		AMM: BCT quote: "Planning ahead" BCT label: - Note: Not coded; 1.4 Action planning considered but insufficient detail to show context, frequency, duration, intensity **Discussion:** **SS: Agreed, not coded.** **AM: Agreed, not coded** **RF:-** **Final decision:** **Not code**	SP P.2
		AMM: BCT quote: "Marvellous Me" BCT label: - Note: Not coded as not explicit linked to behaviour; considered 13.4 Value self-identity **Discussion:** **SS: Agreed, not coded.** **AM: Agreed, not coded.**	SP P.3

		RF: **Final decision:** Not code	
		AMM: BCT quote: “Self-monitoring (daily food and activity diaries)” BCT label: 2.3 Self-monitoring of behaviour Note: - **Discussion:** SS: I am not sure but if this code 2.3, Ahmad_2018 article **(see P.10 in word file)** should code as well. Example of BCT quote for 2.3 label: participants were **asked to record each exercise session, noting what they did, when they started and for how long they exercised. Agreed to code 2.3** AM: - RF:- **Final decision:** **2.3 Self-monitoring of behaviour**	MP P.3-4
		AMM: BCT quote: “Relapse prevention to modify behaviour” BCT label: 1.2 Problem solving Note: - **Discussion:** **SS: Agreed to code 1.2. If follow strict rule this should not be code** **AM: Agreed to code 1.2** **RF:-**	MP P.4

		Final decision: **1.2 Problem solving**	
	6.2 Number of BCTs in intervention group		

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	
1.2 Problem solving	X	X	
1.4 Action planning	X		
2.2 Feedback on behaviour	X	X	
2.3 Self-monitoring of behaviour	X	X	
2.5 Monitoring of outcomes of behaviour without feedback		X	
2.7 Feedback on outcomes of behaviour		X	
3.1 Social support (unspecified)	X	X	
3.3 Social support (emotional)?	X		
5.3 Information about social and environmental consequences		X	
6.1 Demonstration of the behaviour	X	X	
7.1 Prompts/cues	X		
8.2 Behaviour substitution		X	
9.1 Credible source		X	
10.4 Social reward		X	
12.1 Restructuring the physical environment		X	
13.1 Identification of self as role model		X	
Number of BCTs	9	14	

Note:

Update: 15/09/2021

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	X
1.2 Problem solving	X	X	X
1.4 Action planning	X		X
2.2 Feedback on behaviour	X	X	X
2.3 Self-monitoring of behaviour	X	X	X
2.5 Monitoring of outcomes of behaviour without feedback		X	X
2.7 Feedback on outcomes of behaviour		X	X
3.1 Social support (unspecified)	X	X	X
3.3 Social support (emotional)?	X		Not coded
5.3 Information about social and environmental consequences		X	Not coded
6.1 Demonstration of the behaviour	X	X	X
7.1 Prompts/cues	X		Not coded
8.2 Behaviour substitution		X	Not coded
9.1 Credible source		X	X
10.4 Social reward		X	X
12.1 Restructuring the physical environment		X	X
13.1 Identification of self as role model		X	X
Number of BCTs	9	14	13

6.2 Control group

SS:

No BCT

		Waiting-list control AMM: None identified: waiting list control Note: -	
	6.3 Categorized by	SS & AMM	
	6.4 Notes	Version 20210811	

SP=Supplementary paper

Golley et al., 2007

		Description as stated in report	**Location in text** *(page/figure/table)*
6. Behaviour change techniques (BCTs)	6.1 Intervention group	**<u>Both groups (P & P+DA)</u>** **SS:** BCT quote: The mode of both interventions was "parent only," with parents having sole responsibility for attending program sessions and implementing **family lifestyle change**. Children did not attend any education sessions, and families were **encouraged to implement change at the family,** not child level. BCT label: 3.1 Social support (unspecified) Note: Encouragement is being provided which is directed to target behaviour i.e. lifestyle change. **Support sentence from Golley, Perry, Magarey, and Daniels, 2007 (Ref 22)**	P.518 Ref 22 P.145

		BCT quote: Triple P aims to **promote parental competence to facilitate appropriate child behaviour by providing parents with the skills to plan implement and maintain behaviour change**. BCT label: 3.1 Social support (unspecified) 4.1 Instruction on how to perform a behaviour Note: As the program was parenting skill training which this framework includes in BCTs of 4.1 **Discussion:** **SS: -** ***AMM: Will you agree 3.1, 4.1?** **14/09/2021: Agree 3.1, 4.1** **RF: Agree 3.1 (unspecified) and 4.1 as per support sentence re: skills.** **Final decision:** 3.1 Social support (unspecified) 4.1 Instruction on how to perform a behaviour	
		<u>Both groups (P & P+DA)</u> **SS:** **From Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** BCT quote: managing behaviour change (Table2, week4) by **setting ground rules about TV viewing time, providing clear instructions about between-meal access to fridge.** BCT label: 1.1 Goal setting (behaviour) 9.1 Credible source Note: Provider was a dietitian and this is identified as credible source, in favour of TB (i.e. eating, between-meal access to fridge)	Ref22 P.145

		Discussion: **SS: -** ***AMM: Will you agree 1.1, 9.1** **RF: 1.1 and 9.1** **Final decision:** 1.1 Goal setting (behaviour) 9.1 Credible source	
		<u>Both groups (P & P+DA)</u> **SS:** **From Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** BCT quote: The 'Planned Activities Routine' (PAR) introduce in week 5 is an integral part of the program (Table3). It provides the framework for promoting lifestyle behaviour modification and is the interface between the acquisition of **parenting skill** and lifestyle knowledge. The PAR **provides a problem-solving framework to manage situations that could jeopardies achievement of goals or rules, termed 'high risk' situations' (e.g. school holidays, birthday parties, after school snacking).** The PAR highlights the importance of **identifying and preparing for potential high-risk situations, setting positive rules and times, and having backups or consequences for times of misbehavior.** It aims **to promote behaviour change by emphasizing preparedness and forward thinking and reinforcing positive behaviour.** Example of PAR **Identify the high-risk situation, list any advance planning and preparation needed, decide on rules or goals,** list rewards for new behaviours or habits, **list strategies to manage old behaviours or habits**, hold **follow-up discussions and note any new goals (praise the child for following the rules and adjust rule to choosing non-food show bags)**.	Ref22 P.145; P.147 Ref22 P.147, T.3

		BCT label: 1.1 Goal setting (behaviour) 1.2 Problem solving 1.4 Action planning 1.5 Review behaviour goal(s) 4.1 Instructions on how to perform the behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice and rehearsal 10.4 Social reward Note:	Ref22 P.2, C.2
		AMM: BCT quote: “Planned Activities Routine” BCT label: - Note: Not coded as not explicit about context, frequency, duration or intensity but could be 1.4 Action planning BCT quote: “Goal setting” and “set activity goals” BCT label: 1.1 Goal setting behaviour Note: -	Ref22 P.3, T.2
		BCT quote: “List any advance planning and preparation needed •Have lunch / dinner before going to the show or theme park etc.” BCT label: 1.4 Action planning Note: Following bullet point meet criteria of context, frequency, duration or intensity BCT quote: “Praise the child using specific, descriptive phrases (e.g. ‘I am really pleased with the way you are staying close to me while we walk’)”	Ref22 P.4, T.3 Ref22

		BCT label: 10.4 Social reward Note: Although the example given is not explicit related to healthy eating or physical activity, this session relates to “new behaviour” which are part of the intervention. **Discussion:** **SS: I also code 1.1 but from difference quote so agreed to code 1.1, 1.4, 10.4** **15/09/2021 : Agree not to code 6.1 and 8.1 as it is not explicit, It seem like they only list but did not demonstrate and practice.** ***AMM: Will you agree to code 1.2, 1.5, 4.1, 6.1, 8.1?** **14/09/2021 Agree 1.2, Disagree 1.5, 6.1, 8.1** **RF: I’m not sure 6.1 explicit from the description. I’m not sure 1.5 fits as unclear being amended jointly with the child. Suggest adding 1.2 and 4.1.** **Final decision:** **1.1Goal setting behaviour** **1.2** Problem solving **1.4 Action planning** **4.1** Instructions on how to perform the behaviour **10.4 Social reward**	P.4, T.3
		<u>Both groups (P & P+DA)</u> **SS:** **From Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** P group and P+DA group BCT quote: Pros and cons of being a healthy weight BCT label: 9.2 Pros and cons Note: This stated in table 2 but did not contain verb in the sentence e.g. parents were advised to compare pros and cons of being a healthy weight.	Ref 22 P.146, T.2

		AMM: BCT quote: “Pros and cons of being a healthy weight” BCT label: 5.1 Information about health consequences Note: **Discussion:** **SS: It is not clear from the sentence however it could be both 5.1 and/or 9.2** ***AMM: Should we code both?** **14/09/2021: Not code 9.2** **RF: Code 5.1 only – re: 9.2, unclear if pros and cons participant led** **Final decision:** **5.1** Information about health consequences **Not code 9.2**	
		<u>P+DA group</u> **SS:** BCT quote: Parents in P+DA group **participated in an additional 7 intensive lifestyle support group sessions**. These sessions focused on lifestyle knowledge and skills including the following: family-focused healthy eating with specific core food serve recommendations, **monitoring**, label reading, snacks, modifying recipes, being active in a variety of ways, roles and responsibilities around eating, managing appetite, self-esteem, and teasing. **Support sentence from Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** BCT quote: **Monitoring food intake**, physical activity recommendations, **overcoming obstacles to being active**, **how to limit physical inactivity**, **encouraging healthy eating habits**, responsibilities around food and eating**, recipe modification, healthy eating-out choices, healthy eating for busy families, food and special occasions, review of progress** and future planning.	P.519; Ref22 P.146,147, T.2

		Parents **watch last 15 minutes of the activity session** Parents are **provided a handout of each activity session**. Parents are **encouraged to set activity goals using games and active family leisure time.** BCT label: 1.2 Problem solving 1.5 Review behaviour goal(s) 2.3 self-monitoring of behaviour 3.1 Social support (unspecified) 9.1 Credible sources Note: 1.2 is coded from '**overcoming obstacles to being active**, **how to limit physical inactivity'** 2.3 is coded from '**Monitoring'** from main paper and support sentence from ref 22 '**Monitoring food intake'** but it is not clear who was monitor and there is no evidence that they record or not like others articles they might have food log or diary. From definition it should **monitor and record**. 3.1 is coded from '**encouraging healthy eating habits'** in parent-only session and **'encouraged to set activity goals using games and active family leisure time'** in child activity session. Encouragement is being provided to parent in parent-only session which is directed to target behaviour (healthy eating habits) and in child activity session, not really directed to target behaviour but to set goal that directed to target behaviour (activity) so code 3.1 1.5 is coded from '**review of progress'**. It is not clear what progress did they review? but as the contents were about behaviour. So, code 1.5 9.1 is coded from '**watch last 15 minutes of the activity session**' and '**provided a handout of each activity session**' as all intervention were conducted by dietitian (P.518) and had undertaken accredited training for parenting component. If the **recipe modification** session was cooking session **then 4.1, 6.1, and 8.1 will also coded**	MP

			P.3, C.1
		AMM: BCT quote: “focused on lifestyle knowledge and skills including the following: family-focused healthy eating with specific core food serve recommendations” BCT label: 6.1 Demonstration of the behaviour Note: -	MP P.3, C.1
		BCT quote: “label reading, snack, modifying recipes, being active in a variety of ways” BCT label: 4.1 Instruction on how to perform the behaviour Note: -	Ref 22 P.3, T.2
		BCT quote: “Monitoring behaviour” and “Monitoring food intake” BCT label: 2.3 Self-monitoring of behaviour Note: This is described later as being at family level so is considered ‘self’ monitoring rather than monitoring by others	Ref22 P.4, T.2
		BCT quote: “Review of progress • Review of progress” BCT label: 1.7 Review of outcome Note: It is not clear what is being reviewed (1.5 behaviour or 1.7 outcome) so 1.7 outcome used as per instruction	
		Discussion: **SS: Agreed to change from 1.5 to 1.7. Agreed to code 2.3.** **Agreed to code 4.1 and 6.1 and also code from ‘recipe modification’ and also add 8.1** ***AMM: Will you agree to code 1.2, 3.1, 9.1? and add 8.1?** **My interpretation for 6.1 is that they provided an observable of demonstration of the picture of what would be a healthy eating and actually giving serving recommendation**	

		which are demonstration of the behaviour. Because the behaviour relate serving in appropriate amount. Somebody might not have an experience of what is appropriate to serve where is they doing is they showing the food serving recommendation **14/09/2021 Agree 1.2, 3.1 it quite wage but I think its ok, 9.1 that make the definition of credible source,** **RF: Agree to use 1.7 (instead of 1.5) as unclear what is being reviewed. Add 9.1, 1.2. I find 3.1 a tricky code but think this is appropriate here so add. Unclear if practice re: 8.1. Suggest: 1.2, 1.7, 2.3, 3.1, 4.1, 6.1 and 9.1** **14/09/2021 from the description, I initially thought it's a topic they were covering 'recipe modification' there it might not cooking session. They might have recipe there and then say adding meat instead of plant base protein. I can't see that is practice session. It's just theoretical. If it's practice session they should say in the paper because that's great. So, my feeling is if they have not explicit mention it, probably was not.** **Final decision:** 1.2 Problem solving 1.7 Review of outcome 2.3 Self-monitoring of behaviour 3.1 Social support (unspecified) 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour 9.1 Credible sources	
		<u>P+DA group</u> **SS:** BCT quote: While parents attended the lifestyle sessions, children in the P+DA group **attended structured, supervised activity sessions developed by physical activity experts. The session consisted of fun, noncompetitive games designed around aerobic activity and**	P.519;

		development of fundamental motor skills. Sessions were designed as play rather than exercise and were diversional rather than interventional. The activities required minimal equipment and were deliverable by nonexpert staff and easily replicate at home. **Support sentence from Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** Children **demonstrate sessions games and adaptation for use at home is highlighted**. BCT label: 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice/rehearsal Note: children attended exercise class so 3 BCTs above are included **AMM:** BCT quote: “attended structured, supervised activity sessions developed by physical activity experts” BCT label: 8.1 Behavioural practice/rehearsal Note: Also 4.1 and 6.1 already coded. Considered for 9.1 but not coded as sessions delivered by non-experts. **Discussion:** **SS: Agreed to code 4.1, 6.1, 8.1** **AMM: Agreed to code 4.1, 6.1, 8.1** **RF:-** **Final decision:** 4.1 Instruction on how to perform the behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice/rehearsal	Ref22 P.146, T.2 MP P.3, C.1

		<u>P+DA group</u> **SS:** **From Golley, Perry, Magarey, and Daniels, 2007 (Ref22)** BCT quote: Parents are **encouraged to compare current eating patterns of each family member with age-appropriate AGHE food group serve recommendations**. Based on their findings and family eating patterns and habits, **modifications required to meet AGHE recommendations are individually identified and goals for change are set**. Gradual 'whole family' changes are promoted. Parents **observe the final minutes of the children's activity sessions and remain responsible for setting activity goals at home,** supported by booklet outlining the activities undertaken during each session. The activity recommendations aim to address both physical and sedentary behaviours to gradually increase child and family activity level (Table 4). Parents **consider child and family barriers to being active and plan ways to overcome these.** BCT label: 1.1 Goal setting (behaviour) 1.2 Problem solving 3.1 Social support (unspecified) 2.1 Monitoring of behaviour by others without feedback Note: AGHE = The Australian Guide to Healthy Eating 1.1 is coded from '**modifications required to meet AGHE recommendations are individually identified and goals for change are set**' and '**remain responsible for setting activity goals at home**' 1.2 is coded from '**consider child and family barriers to being active and plan ways to overcome these**'.	Ref22 P.147; P.148, T.4 Ref22 P.4, C2

		3.1 is coded from '**encouraged to compare current eating patterns of each family member with age-appropriate AGHE food group serve recommendations**. Encouragement is being provided to parents and it is directed to behaviour (eating). 2.1 is coded from '**observe the final minutes of the children's activity sessions**' **AMM:** BCT quote: "Parents are encouraged to compare current eating patterns of each family member with age appropriate AGHE food group serve recommendations" BCT label: 6.2 Social comparison Note: - **Discussion:** **SS: Coded as 3.1 but will change to 6.2** ***AMM: Will you agree to code 1.1, 1.2, 2.1?** **14/09/2021 : Agree 1.1,1.2,2.1** **6.2 is coded because they doing all member of family and very clear they making comparison is not they just looking at it. So, I think that much more specific than 3.1. Parents doing it with family member.** **RF: Agree 6.2. Add 1.1, 1.2, 2.1.** **Final decision:** **1.1** Goal setting (behaviour) **1.2** Problem solving **2.1** Monitoring of behaviour by others without feedback **6.2** Social comparison	
		<u>P+DA group</u> **AMM:** BCT quote: "Set good eating and activity examples as children learn habits from adults"	

		BCT label: Note: Could be 6.1 already coded above **Discussion:** **SS: agreed to code 6.1** **AMM: agreed to code 6.1** **RF:-** **Final decision:** **6.1 Demonstration of the behaviour**	
		P+DA group **AMM:** BCT quote: “Phone support session (20 minutes) – content parent-directed facilitated by standard prompts” BCT label: 3.1 Social support (unspecified) Note: This is considered to be implicitly related to behaviour because it follows sessions that are very behaviour-orientated. **Discussion:** **SS: agreed to code 3.1** **AMM: agreed to code 3.1** **RF: -** **Final decision:** 3.1 Social support (unspecified)	Ref22 P.3, T.2
		P+DA group **AMM:** BCT quote: “Promoting self-esteem and body image” BCT label: - Note: Not coded as not explicit but considered for 1.4 Value self-identify	Ref22 P.4, T.2

		Discussion: **SS: Agreed, not coded** **AM: Agreed, not coded** **RF: -** **Final decision:** Not coded	
		AMM: BCT quote: “Switch to low-joule beverages if high-sugar fluids are present in diet” BCT label: 8.2 Behaviour substitution Note: **Discussion:** **SS: Agreed to code 8.2** **AMM: Agreed to code 8.2** **RF: -** **Final decision:** **8.2 Behaviour substitution**	Ref22 P.5, T.4

	6.2 Number of BCTs in intervention group		

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	
1.2 Problem solving	X		
1.4 Action planning	X	X	
1.5 Review behaviour goal(s)	X		
1.7 Review of outcome		X	
2.3 Self-monitoring of behaviour		X	
3.1 Social support (unspecified)	X	X	
4.1 Instruction on how to perform the behaviour	X	X	
5.1 Instruction about health consequences		X	
6.1 Demonstration of the behaviour	X	X	
6.2 Social comparison		X	
8.1 Behavioural practice/rehearsal	X	X	
8.2 Habit substitution		X	
9.1 Credible source	X		
9.2 Pros and cons	X		
10.4 Social reward	X	X	
Number of BCTs	11	12	

Note:

Update: 15/09/2021

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	X
1.2 Problem solving	X		X
1.4 Action planning	X	X	X
1.5 Review behaviour goal(s)	X		Not coded
1.7 Review of outcome		X	X
2.1 Monitoring of behaviour by others without feedback			X
2.3 Self-monitoring of behaviour		X	X
3.1 Social support (unspecified)	X	X	X
4.1 Instruction on how to perform the behaviour	X	X	X
5.1 Instruction about health consequences		X	X
6.1 Demonstration of the behaviour	X	X	X
6.2 Social comparison		X	X
8.1 Behavioural practice/rehearsal	X	X	X
8.2 Habit substitution		X	X
9.1 Credible source	X		X
9.2 Pros and cons	X		Not coded
10.4 Social reward	X	X	X
Number of BCTs	11	12	15

Note: Check sentence on P.5 whether can code as a group of 4.1,6.1,8.1 -checked!!

	6.2 Control group	**SS:** No BCT. At the time of group allocation, the WLC group received the same general healthy-lifestyle pamphlet as the P group. During the 12-month wait-listed period, the WLC group was contacted by telephone 3 to 4 times for 5 minutes as a retention strategy. Researcher contact with the WLC families was minimized to avoid the potential placebo effect of therapist contact. **AMM:** Controls were in waiting list and received pamphlet and phone calls but no BCTs	P.519 MP P.3, C.1
	6.3 Categorized by	SS & AMM	
	6.4 Notes		

Janicke et al., 2008

		Description as stated in report	**Location in text** *(page/figure/table)*
6. Behaviour change techniques (BCTs)	6.1 Intervention group	**<u>Both groups (FB & PO)</u>** **SS:** BCT quote: Child and parent participants in both treatment conditions were **asked to monitor everything they ate** but were not required to record caloric intake. Families had the option of using abbreviated **monitoring forms** after the first 4 weeks or earlier if needed. BCT label: 2.3 Self-monitoring of behaviour	P.4 Ref24 P.7

		Support sentence from Janicke et al, 2008 (Ref24) Child and parent participants will **monitor everything they eat using a daily habit log.** Families will have the option of **using abbreviated monitoring forms** after the first four weeks, or earlier if needed. Children and parents will be **taught to monitor and record their dietary intake and step each day.** Note: As definition of 2.3 is 'Establish a method for the person to **monitor and record**….'. Although, in this BCT quote did not indicate the word 'record' but they used monitoring form this can be indicated that they record what they ate and also from a support sentence, a daily habit log was used. **AMM:** BCT quote: "asked to monitor everything they ate" BCT label: 2.3 Self-monitoring of behaviour **Discussion:** **SS:** Agreed to code 2.3 **AMM:** Agreed to code 2.3 **RF: Agree with code 2.3** **Final decision:** **2.3 Self-monitoring of behaviour**	Ref.24 P.15, T.2 Main Paper (MP) P.4
		<u>Both groups (FB & PO)</u> **SS:** BCT quote:	P.4

		Families and group leaders worked together **to set daily dietary goals** at the end of each group session, which included limiting the consumption of high-fat/high-sugar foods (ie, “red food”) and increasing fruit and vegetable intake. BCT label: 1.1Goal setting (behaviour) Note: The consumption of high-fat/high-sugar foods (i.e. ‘red food’) and increasing fruit and vegetable intake are behaviour. **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: **Daily dietary goals will be set** each week, and will included limiting the consumption of high-fat/high-sugar foods “red food” (with an absolute minimum goal of **2 red foods per day**), and increasing fruit and vegetable intake. BCT label: 1.1Goal setting (behaviour) 1.4Action planning Note: As definition of BCTs 1.4 ‘must include at least one of context, frequency, duration and intensity i.e. 2 red foods per day. Children and parents will be **taught the importance of goal setting to facilitate behaviour change**. Goals will be **set on weekly basis to help modify the intake of high-fat “Red foods”, the intake of fruits and vegetables, increase physical activity and decrease sedentary activity.** Goal will be tailored to the individual needs of each family. **AMM:** BCT quote: ‘set daily dietary goals’	Ref24 P.7 Ref24 P.15, T.2

		BCT label: 1.1Goal setting (behaviour) Note: Examples of goals are stated in the following lines **Discussion**: **SS:** Code 1.1, 1.4 **AMM:** Agreed to code 1.1, 1.4 **RF: Agree with codes 1.1, 1.4** **Final decision:** **1.1 Goal setting (behaviour)** **1.4 Action planning**	
		Both groups (FB & PO) **SS:** BCT quote: Children and adults were **encouraged to eat well-balanced diet based on the food guide pyramid**. BCT label: 3.1 Social support (unspecified) Note: Encouragement is being provided which is directed at target behaviour i.e. healthy eating. For example, Health practice was encouraged to recycle their wasted (Target behaviour (TB): recycling waste, Target participants (TP): Health practices). **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: Children and adults will also be **encouraged to eat well-balanced diet based on the food guide pyramid**. **AMM:**	P.4 Ref24 P.7 MP P.4

		BCT quote: “encouraged to eat well-balanced diet based on the food guide pyramid.” BCT label: 6.1 Demonstration of the behaviour Note: **Discussion:** **SS:** They did not demonstrate the behaviour but encourage to do the behaviour I think this should code as 3.1 **AMM: I agree there is support there but I find 3.1 is quite difficult I use 6.1 because f**ood pyramid is demonstrating, food in quantity format so we could have both if you think it’s appropriate. **RF:** I don’t think that 3.1. fits - it is encouragement but doesn’t align to the type of arrangements described. I think 6.1 is a better fit – if it were food models or images of food/drinks they should aim to eat then I would code but I don’t think the food pyramid quite works as a demonstration of the behavior (as described in the taxonomy). Suggest not to code this. **Final decision:** **Not coded**	
		Both groups (FB & PO) **SS:** BCT quote: Increased physical activity was promoted through a pedometer-based step program. Families were **provided with pedometers**. Children and parents were **encouraged to monitor their physical activity and gradually increase their daily steps.** BCT label: 2.3 Self-monitoring of behaviour + 3.1 Social support (unspecified)++	P.4

		Note: Pedometers were provided to family but they did not mention about form or 'record'. However, I think the pedometer itself can automatically recorded. I am not sure is this can code as 2.3 because they did not 'ask' participant to do that but 'encourage' instead that means it can be coded as 3.1 Social support (unspecified) as 'encouragement is being provided which is directed at target behaviour i.e. physical activity. **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: Increased physical activity will be encouraged through a pedometer-based step program. Children and parents will be **encouraged to monitor their physical activity and gradually increase their steps per day.** Program goals will be **based on their baseline level of steps and will target an increase of at least 3000 steps/day by the end of the program for both children and parents.** Goal will be **set for gradually decreasing sedentary activities so that children will spend no more than 2 hours per day watching television or playing video games**. Shaping is a strategy **to target gradual changes** in behaviour to ultimately attain a desired goal behaviour. This strategy will be **implemented by setting weekly goals for gradual change**. This is designed to increase self-efficacy and success, and to limit frustration, with the goal of promoting long-term behaviour change. BCT label: 1.1 Goal setting (behaviour) 1.4 Action planning 3.1 Social support (unspecified) 8.7 Graded tasks	Ref24 P.7 Ref.24 P.15, T.2

		Note: - **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: Children and parents will be **taught to monitor and record their dietary intake and steps each day.** BCT: label 2.3 Self-monitoring (behaviour) **AMM:** BCT quote: “Increased physical activity was promoted through a pedometer-based step program. Families were provided with pedometers.” BCT label: 12.5 Adding objects to the environment Note: - BCT quote: “Children and parents were encouraged to monitor their physical activity and gradually increase their daily steps.” BCT label: 8.7 Graded tasks Note: - **Discussion:** **SS:** Agreed to add 12.5 from quote ‘Families were **provided with pedometers**’ and agreed to add 8.7 **AMM:** Agree to add 1.1, 1.4, 2.3, 3.1 **RF:** Agree with codes **Final decision:**	Ref24 P.15, T.2 MP P.4 MP P.4

		1.1 Goal setting (behaviour) 1.4 Action planning 2.3 Self-monitoring of behaviour + 3.1 Social support (unspecified) 8.7 Graded tasks 12.5 Adding object to the environment	
		<u>Both groups (FB & PO)</u> **AMM:** BCT quote: "New goals were systematically introduced throughout the program. Self-monitoring and goal setting were individualized to the participants' progress and preferences. BCT label: 1.7 Review outcome goal(s) Note: The type of goals is not specified so default to 1.7 outcomes rather than 1.5 **Discussion:** **SS:** have not code this quote and agreed to add 1.7 **AMM:** - **RF:** Agree **Final decision:** **1.7 Review outcome goal(s)**	MP P.4
		<u>Both groups (FB & PO)</u> **AMM:** BCT quote: "Goals will be individualized to the needs of each family and based on each individual's baseline dietary intake and progress (i.e., goal attainment, <u>weight change</u>)" BCT label: 1.3 Goal setting (outcomes) Note: - **Discussion:** **SS:** have not code this quote and agreed to add 1.3	

		AMM:- **RF:** Agree **Final decision:** **1.3 Goal setting (outcomes)**	
		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)** BCT quote: Children and parents will be **instructed on the principles of stimulus control as well as specific environmental changes to implement in their home and daily life.** BCT label: 12.1 Restructuring the physical environment + Note: Not sure is 12.1 or 12.2 as they did not explain whether physical or social environment **AMM:** BCT quote: “stimulus control” BCT label: - Note: Not coded 7 Association considered but insufficient detail to determine which techniques/s involved. **Discussion:** **SS:** From explanation of stimulus control in Table 2 can be coded as 12.1 **AMM:** It is not clear whether physical or social, social is broader so 12.2 should be coded. Using principle for 5.1 Information about health consequences and 5.3 information about social and environmental consequences; if unspecified consequences code 5.3 **RF:** Code. As 12.2. only – unclear if physical or social	Ref24 P.15, T.2 Ref24 P.15, T.2

		Final decision: **12.2 Restructuring the social environment**	
		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)** BCT quote: Behavioral contracting involves developing an agreement by which **the child receives specific privileges if they complete a specific task.** Parent will be **instructed on the use of behavioral contracting and develop specific plans for implementation of a contract.** BCT label: 1.1 Goal setting behaviour 1.8 Behavioral contract Note: In definition of 1.8 stated that if code 1.8 also code 1.1 **AMM:** BCT quote: “Behavioral contracting” BCT label: 1.8 Behavioural contract Note: - **Discussion:** **SS:** Agreed to code 1.8 **AMM:** Agreed to code 1.1 **RF:** Agree with codes **Final decision:** 1.1 Goal setting behaviour 1.8 Behavioral contract	Ref24 P.15, T.2

		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)** BCT quote: **Positive Reinforcement**: Children and parents will be **encouraged to provide verbal praise for family members when they make healthy food and activity choices.** BCT label: 10.4 Social reward Note: Positive Reinforcement is included in definition of 10.4 and also the explanation in Table 2 is explicit **AMM:** BCT quote: “Positive Reinforcement” BCT label: - Note: Considered 10.4 Social reward but already coded **Discussion:** **SS:** Agreed to coded 10.4 **AMM:** Agreed to coded 10.4 **RF:** Agree **Final decision:** 10.4 Social reward	Ref24 P.15, T.2 Ref24 P.15, T.2
		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)** BCT quote:	Ref24 P.15, T.2

		Modeling is an effective strategy to build healthy lifestyle behaviours in which children learn to emulate their parent's behaviour. Parents will be **instructed on how their dietary and exercise behaviors, as well as their self-statements, impact their child's attitude and behavior.** BCT label: 6.1 Demonstration of the behaviour 13.1 Identification of self as role model Note: As definition of 6.1 includes 'Modeling' **Discussion:** **SS:** Agreed only code 13.1 **AM:** will you agree to code 6.1 and 13.1 for this quote? = Not sure for 6.1 it is modeling it's not explicitly but agreed to code 13.1 **RF:** Agree. 13.1 and not 6.1 **Final decision:** 13.1 Identification of self as role model	
		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)** BCT quote: A drawing for a $5 gift card will be held each week in the child group. Children who attended the session will be eligible for the gift card if they complete their monitoring forms. BCT label: - Note: Not coded. It looks like 10.2 Material reward (behaviour) but they stated that if complete monitoring form which is not directed at target behaviour. As stated in this article "For all child and parent participants, **the primary treatment objectives will be to build healthier dietary habits, increase moderate intensity physical activity, establish a healthier weight status, and build positive self-worth**." (Ref24, P.7)	Ref24 P.15, T.2

		AMM: BCT quote: “Incentives” BCT label: 10.2 Material reward (behaviour) Note: Behaviour is completing the monitoring forms. **Discussion:** **SS:** complete monitoring form is not target behaviour. 15/09/2021: I have checked that monitoring form was about eating behaviour (a daily habit log; monitor everything they eat) – Will agree to code 10.2 as monitoring form was about dietary behaviour which is directed to target behaviour. **AMM:** monitoring is part of assessment process, indirected to target behaviour. It shown that they have put their effort for complete the form. For example, monitoring is something that somebody dose to help them do the behvaiour. If you put a piece of paper on to your mirror to say brush your teeth for 2 minutes that’s a prompt. It’s actually a piece of paper is something that you doing as a reminder to prompt you to brush your teeth. if you write down what you eat or what you exercise that’s not the behaviour the same way that they putting the paper isn’t there but it’s actually helping you to do the behaviour. **RF: Without information on the content of the monitoring form (do we have this?), I’m not sure we can be confident this is contributing towards the outcomes/behaviors of the intervention vs. study reporting. If it was attendance only perhaps. To discuss further.** **Final decision:** 10.2 Material reward (behaviour)	Ref24 P.15 Table2
		<u>Both groups (FB & PO)</u> **SS:** **From Janicke et al, 2008 (Ref24)**	Ref24 P.15, T.2

		BCT quote: Children and parents will be **instructed on the importance of portion control to help limit dietary intake. Specific examples will be reviewed to help participants learn typical and suggested portion sizes for common foods.** BCT label: 6.1 Demonstration of the behaviour 9.1 Credible source Note: As the providers are specialist and have trained in the area so this identified here as a credible source in favour of target behaviour which is portion size (eating). **Discussion:** **SS:** Agreed only code 6.1 **AM:** Will you agree to code 6.1 and 9.1? = Agreed 6.1 but not 9.1 here may be another quote **RF: Agree 6.1 only** **Final decision:** 6.1 Demonstration of the behaviour	
		FB **SS:** BCT quote: In parent group, the first portion of the meeting involved **a review of the progress made in implementing the strategies developed for changing their eating and exercise habits**. Difficulties reported by the parents were addressed through group support and discussion. BCT label: 1.7 Review outcome goal(s) Note: Should this code as 1.5 Review behaviour goal(s)	P.4 MP P.4 (FB only)

		AMM: BCT quote: “Difficulties reported by the parents were addressed through group support and discussion” BCT label: - Note: Not coded. Considered 1.2 Problem solving but this is not explicit directed at behaviour. **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: “review of parent and child progress implementing the strategies developed for changing their eating or exercise habits during the previous session. Difficulties reported by the parents will be dealt with through group support and discussion” BCT label: 1.2 Problem solving Note: Difficulties relating to behaviours are addressed. **Discussion:** **SS:** Agreed to coded 1.2 However, it will be clearer if they state ‘generate or select strategies to overcome the difficulties’ = ‘dealt with’ **AM:** Will you agree to code 1.7 or 1.5? Agreed 1.5 **RF: Agree 1.2, 1.5** **Final decision:** 1.2 Problem solving 1.5 Review behaviour goal(s)	Ref 24 P.8 (FB only)
		FB **AMM:** BCT quote: “Focused on knowledge and skill training related to nutrition, physical activity, and behaviour management strategies” BCT label: 5.3 Information about social and environmental consequences.	MP P.4 (FB only)

		Note: This is implicit rather than explicit. Used more general code of 5.3 rather than 5.1 because health is not specifically mentioned. Also implicit in PO group? “Each session included 3 segments, similar to the parent group for the FB intervention” **Discussion:** **SS:** did not code this quote, I think this is not consequences of performing the behaviour **AMM:** This is not explicit agreed not coded. **RF: agree not coded** **Final decision:** Not coded	MP P.5 (PO only)
		FB **SS:** BCT quote: At the end of each session, children and parents were **brought together to develop goals for the week and specific plans to achieve these goals.** BCT label: 1.3 Goal setting (outcome) Note: develop goals = set goal, goals unspecified so code 1.3 instead of 1.1 **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: At the end of each session, children and parents will be **brought together to develop specific goals, as well as plans to achieve these goals.**	P.4 Ref24, P.8

		AMM: BCT quote: “develop goals for the week and specific plans to achieve these goals” BCT label: - Note: Not coded. Considered 1.4 Action planning but does not meet criteria of context, frequency, duration or intensity **Discussion:** **SS: -** **AMM: Will you agree to code 1.3? = This is not explicit either 1.1 or 1.3** **RF: Suggest code as 1.3 as unspecified.** **Final decision:** **1.3** Goal setting (outcome)	MP P.4 (FB only)
		FB **AMM:** BCT quote: “appropriate method for increasing physical activity, behaviour management, and positive parenting skills” BCT label: 4.1 Instruction on how to perform the behaviour Note: - **Discussion:** **SS:** Not coded but agreed to code 4.1 as stated in definition of 4.1 includes ‘Skill training’ From quote in article “The second segment will focus on knowledge and **skill training related to benefits of weight loss, basics of nutrition and stoplight program, appropriate methods for increasing physical activity, behaviour management,** and **positive parenting skills** (e.g., goal setting, self-monitoring, stimulus control, etc.) (Ref24, P.8). As well as quote from main paper (P.4) “The second segment focused on knowledge and **skill training related to nutrition, physical activity, and behaviour management strategies**.” **AMM: -**	Ref24 P.8 (FB only)

		RF: Agree **Final decision:** 4.1 Instruction on how to perform the behaviour	
		FB **SS:** BCT quote: The child group sessions included 3 segments: (1) **a review of progress during the previous week**, (2) a **physical activity to demonstrate strategies to keep active**, and (3) **preparation of a healthy snack**. BCT label: 1.7 Review outcome goal(s) 6.1 Demonstration of behaviour 8.1 Behavioural practice/rehearsal Note: **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: The child group sessions will include four segments. Each session will begin with **a review of the children's progress in completing their monitoring forms and achieving their dietary and physical activity goals**. The second segment will use fun and educational activities to teach children about nutrition (e.g., recognizing calorie and fat content of foods via "signals" of the Stop-Light program), strategies to increase physical activity, behavioral management skills (self-monitoring and goal settings), and strategies to cope with psychosocial concerns (I.e., building self-esteem). Third, all sessions will **include a physical activity component to demonstrate strategies to help children keep physically active. This will include activities**	P.4 Ref24 P.8

		such as jumping rope, playing frisbee, relay races, and participating in a mini-scavenger hunt. Finally, children will **help prepare a healthy snack for taste testing** during each session. BCT label: 1.7 Review outcome goal(s) 6.1 Demonstration of behaviour 8.1 Behavioural practice/rehearsal 9.1 Credible source Note: Main paper had 3 segments while Ref24 had 4 segments. If code from Ref4, considered to code 9.1 Credible source **AMM:** BCT quote: “review of the children’s progress in completing their monitoring forms and achieving their dietary and physical activity goals” BCT label: 1.5 Review behaviour goals BCT quote: “include a physical activity component to demonstrate strategies to help children keep physically active. This will include activities such as jumping rope, playing frisbee, relay races” BCT label: 8.1 Beahvioural practice/rehearsal **Discussion:** **SS:** Agreed to change from 1.7 to 1.5, agreed to code 8.1, agreed not to code 9.1 **AMM:** Will you agree to code 6.1, 9.1? = Agreed 6.1 but check did they mention somewhere for 9.1 **RF: Agree** **Final decision:** 1.5 Review behaviour goals 6.1 Demonstration of behaviour 8.1 Behavioural practice/rehearsal	Ref24 P.8 (FB only)

		FB **AMM:** BCT quote: “Children and parents were weighed” BCT label: 2.5 Monitoring of outcomes of behaviour without feedback Note: - **PO** BCT quote: “Parent were weighed every other week. Children were only weighed at baseline and posttreatment” BCT label: 2.5 Monitoring of outcomes of behaviour without feedback Note: - **Discussion:** **SS:** Not coded. It is not clear whether they weighed as part of a behavior change strategy or data collection. I find this is difficult to know whether it is part of BC or data collection. However, from Ref24 they mentioned ‘**every other group session’** both in FB (P.7) and PO (P.8) group so I think it might be part of BC **AMM:** They stated in the intervention title part not in the assessment title part in the article. So, I think its part of behaviour change **RF: Code as 2.5 – weight is an outcome of the intervention/behavior change (it does not say that this data was concealed or only taken for the purpose of study data etc.).** **Final decision:** 2.5 Monitoring of outcomes of behaviour without feedback	MP P.4 (FB only) P.5 (PO only)
		PO **SS:** BCT quote: Each session included 3 segments, **similar to the parent group for the FB intervention**. An emphasis was placed on teaching parents how to work with their children to **set goals**. Each	P.5

		week interventionist suggested **a range of dietary and physical activity targets** that would be appropriate for each child and parent. Parents were encouraged to meet with their children to **set individual goals** within the suggested range. BCT label: (Note: will code follow FB group when we have a final decision) Note: As stated that each session included 3 segments, **similar to the parent group for the FB intervention.** So BCT label will coded as 3 segments of FB group which is (Note: will add when we have final decision) Note: Goals were about dietary and physical activity i.e. behaviour not outcome. Although parents were 'encouraged' but for setting goal not for doing something directed at the behaviour. Considered 3.1 Social support (unspecified). **Support sentence from Janicke et al, 2008 (Ref24)** BCT quote: Each session will last 90 minutes and will included three segments, **similar to the parent-group previously described in the Family-Based intervention**. Parents will then be instructed to meet with their child at home and work together to **set individual, achievable goals based on the previous weeks progress.** **Discussion:** **SS: -** **AMM:** **RF:** **Final decision:**	Ref24 P.8

<table>
<tr>
<td></td>
<td></td>
<td><u>PO</u>
AMM:
BCT quote: “encouraged to utilize praise, incentives, and modeling to encourage participation and goal achievement.”
BCT label: 10.4 Social reward
Note: Not explicit related to behaviour but does relate to goals.
Discussion:
SS: Not coded but agreed to code 10.4 as it related to goals where goals were targeted at dietary and physical activity (behaviour) From this quote “Parent will be encouraged to utilize praise, incentives, and modeling to encourage participation and goal achievement.”.
AMM: -
RF:
Final decision:
10.4 Social reward</td>
<td>P.5</td>
</tr>
<tr>
<td></td>
<td>6.2 Number of BCTs in intervention group</td>
<td>
<table>
<tr><th>BCTs</th><th>SS</th><th>AMM</th><th>Decision</th></tr>
<tr><td>1.1 Goal setting (behaviour)</td><td>X</td><td>X</td><td></td></tr>
<tr><td>1.2 Problem solving</td><td></td><td>X</td><td></td></tr>
<tr><td>1.3 Goal setting (outcomes)</td><td>X</td><td>X</td><td></td></tr>
<tr><td>1.4 Action planning</td><td>X</td><td></td><td></td></tr>
<tr><td>1.5 Review behaviour goals</td><td></td><td>X</td><td></td></tr>
<tr><td>1.7 Review outcome goals</td><td>X</td><td>X</td><td></td></tr>
<tr><td>1.8 Behavioural contract</td><td>X</td><td>X</td><td></td></tr>
<tr><td>2.3 Self-monitoring of behaviour</td><td>X</td><td>X</td><td></td></tr>
</table>
</td>
<td></td>
</tr>
</table>

		2.5 Monitoring of outcomes of behaviour without feedback		X		
		3.1 Social support (unspecified)	X			
		4.1 Instruction on how to perform the behaviour		X		
		5.3 Information about social and environmental consequences		X		
		6.1 Demonstration of the behaviour	X	X		
		8.1 Behavioural practice/rehearsal	X	X		
		8.7 Graded tasks	X	X		
		9.1 Credible source	X			
		10.2 Material reward (behaviour)		X		
		10.4 Social reward	X	X		
		12.1 Restructuring the physical environment	X			
		12.5 Adding objects to the environment		X		
		13.1 Identification of self as role model	X			
		Number of BCTs	14	16		

Note:

Update: 15/09/2021

BCTs	SS	AMM	Decision
1.1 Goal setting (behaviour)	X	X	X
1.2 Problem solving		X	X
1.3 Goal setting (outcomes)	X	X	X
1.4 Action planning	X		X
1.5 Review behaviour goals		X	X

		1.7 Review outcome goals	X	X	X	
		1.8 Behavioural contract	X	X	X	
		2.3 Self-monitoring of behaviour	X	X	X	
		2.5 Monitoring of outcomes of behaviour without feedback		X	X	
		3.1 Social support (unspecified)	X		X	
		4.1 Instruction on how to perform the behaviour		X	X	
		5.3 Information about social and environmental consequences		X	Not coded	
		6.1 Demonstration of the behaviour	X	X	X	
		8.1 Behavioural practice/rehearsal	X	X	X	
		8.7 Graded tasks	X	X	X	
		9.1 Credible source	X		Not coded	
		10.2 Material reward (behaviour)		X	X	
		10.4 Social reward	X	X	X	
		12.1 Restructuring the physical environment	X		Not coded	
		12.2 Restructuring the social environment			X	
		12.5 Adding objects to the environment		X	X	
		13.1 Identification of self as role model	X		X	
		Number of BCTs	14	16	19	
		BCTs	Decision			
		1.1 Goal setting (behaviour)	12 times, weekly for first 8 week and biweekly for next 8 week When: at the end of each session			

			1.2 Problem solving	They used after 1.5 and or 1.7. Probably 11 times When: After 1.5 and/or 1.7	
			1.3 Goal setting (outcomes)	Note: see 1.1, It is not clear whether when they used 1.1 or 1.3	
			1.4 Action planning	Probably used together with 1.1 and/or 1.3. 12 times. When: At the end of each session	
			1.5 Review behaviour goals	11 times as they reviewed progress of previous week. When: at the beginning of each session	
			1.7 Review outcome goals	Note: See 1.5	
			1.8 Behavioural contract	Probably use together with 1.1 and/or 1.3. So 12 times?	
			2.3 Self-monitoring of behaviour	They used a daily habit log but it is not clear how often did they use this technique	
			2.5 Monitoring of outcomes of behaviour without feedback		
			3.1 Social support (unspecified)		
			4.1 Instruction on how to perform the behaviour		

		5.3 Information about social and environmental consequences	
		6.1 Demonstration of the behaviour	
		8.1 Behavioural practice/rehearsal	
		8.7 Graded tasks	
		9.1 Credible source	
		10.2 Material reward (behaviour)	
		10.4 Social reward	
		12.1 Restructuring the physical environment	
		12.5 Adding objects to the environment	
		13.1 Identification of self as role model	
		FB group: they participated in simultaneous but separated	
	6.2 Control group		
	6.3 Categorized by		
	6.4 Notes	Version: 20210812	

Appendix 3J

PRISMA 2020 Checklist

Study 1: **A systematic review of behaviour change techniques used in weight management interventions in children aged 5-15 years**

Section and topic	Item	Checklist item	Location where item is reported
Title			
Title	1	Identify the report as a systematic review.	Title
		Report an informative title that provides key information about the main objective or question the review addresses (e.g., the population(s) and intervention(s) the review addresses).	Title
Abstract			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	-
Introduction			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Background and rationale Section 2.1.1
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Aim and objectives Section 2.1.2
Methods			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methodology, Section 2.2.1-2.2.5
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methodology, Section 2.2.1;

			Appendix B, search strategies
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Methodology, Section 2.2.6; Appendix B, search strategies
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methodology; Section 2.2.6
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methodology; Section 2.2.6
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methodology; Section 2.2.5
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Methodology, Section 2.2.5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methodology, Section 2.2.7
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Methodology, Section 2.2.8

Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methodology, Table 2.1; Appendix G
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	None
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Methodology, Section 2.2.7; Appendix E
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Methodology, Section 2.2.8
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Not applicable
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Methodology, Section 2.2.7
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Methodology Section 2.2.7
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Methodology Section 2.2.7
Results			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Results, Figure 2.1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Results, Figure 2.1
Study characteristic	17	Cite each included study and present its characteristics.	Results

			Table 2.1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Results, Section 2.3.6 and Table 2.4; Appendix G
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Results Section 2.3.6; Table 2.4; Appendix G
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Results Table 2.1; Section 2.3.6; Appendix G
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Results Section 2.3.6; Table 2.4; Appendix G
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Results Section 2.3.6; Table 2.4; Appendix G
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Results Section 2.3.6; Table 2.4; Appendix G

Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Results Section 2.3.6; Table 2.4; Appendix G
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Results Section 2.3.7 Table 2.5
Discussion			
	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion Section 2.3
	23b	Discuss any limitations of the evidence included in the review.	Discussion Section 2.3
	23c	Discuss any limitations of the review processes used.	Discussion Section 2.3
	23d	Discuss implications of the results for practice, policy, and future research.	Discussion Section 2.3
Other information			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Methodology, Section 2.2.1
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Methodology, Section 2.2.1
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Protocol was published on Prospero before SR started and

			any amendments was described on the protocol[a]
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review	Acknowledgment
Competing interests	26	Declare any competing interests of review authors.	None
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	Appendix A to H

Reference: Page et al., 2021

[a] The age range was updated: the reason for amending the age range is to narrow the scope of the study sample to match a comparable public health intervention in the UK. Therefore, a comparison can be made between this intervention and the finding of this review; Databases: removed three databases i.e., google scholar, ScieneDirect, and InterNurse because some had problems with accessing and some were covered with other databases;

Appendix 4A

Standard for reporting qualitative research (SRQR) - Study 2

A qualitative exploration of behaviour change techniques used in a family weight management programme in children aged 5-15 years in England.

No	Topic	Item	Reported in
	Title and abstract		
S1	Title	Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Title
S2	Abstract	Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	-
	Introduction		
S3	Problem formulation	Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Background
S4	Purpose or research question	Purpose of the study and specific objectives or questions	Aim and objectives
	Methods		
S5	Qualitative approach and research paradigm	Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale	Methodology
S6	Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	Methodology
S7	Context	Setting/site and salient contextual factors; rationale	Methodology
S8	Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale	Methodology
S9	Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Methodology, Appendix
S10	Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process,	Methodology

		triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale	
S11	Data collection instruments and technologies	Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Methodology
S12	Units of study	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Results
S13	Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/deidentification of excerpts	Methodology
S14	Data analysis	Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale [b]	Methodology
S15	Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale	Strengths and limitations
	Result/findings		
S16	Synthesis and interpretation	Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Results
S17	Links to empirical data	Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Results
	Discussion		
S18	integration with prior work, implications, transferability, and contribution(s) to the field	Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/ generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Discussion
S19	Limitations	Trustworthiness and limitations of findings	Strengths and limitations
	Other		
S20	Conflicts of interest	Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	None
S21	Funding	Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Acknowledgment

Developed from O'Brien et al. (2014)

Appendix 4B

BCT Taxonomy v1 online training certificate

Appendix 4C

Ethical approval - Study 2 and 3

University of Hertfordshire UH

HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO	Srila Satoh
CC	Dr Angela Madden; Dr Rosalind Fallaize
FROM	Dr Simon Trainis, Health, Science, Engineering and Technology ECDA Chair
DATE	17/12/2020

Protocol number: **aLMS/PGR/UH/03866(1)**

Title of study: A database analysis of a family weight management programme

Your application to modify and extend the existing protocol as detailed below has been accepted and approved by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

no additional workers named

Modification: Extension of end-date of study

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Original protocol: Any conditions relating to the original protocol approval remain and must be complied with.

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 31/12/2020

To: 31/12/2022

Please note:

Failure to comply with the conditions of approval will be considered a breach of protocol and may result in disciplinary action which could include academic penalties.
Additional documentation requested as a condition of this approval protocol may be submitted via your supervisor to the Ethics Clerks as it becomes available. All documentation relating to this study, including the information/documents noted in the conditions above, must be available for your supervisor at the time of submitting your work so that they are able to confirm that you have complied with this protocol.

Should you amend any aspect of your research or wish to apply for an extension to your study you will need your supervisor's approval (if you are a student) and must complete and submit a further EC2 request.
Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A or as detailed in the EC2 request. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Failure to report adverse circumstance/s may be considered misconduct.
Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately.

Appendix 4D

Participant information sheet - Study 2 and 3

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC6: PARTICIPANT INFORMATION SHEET

1 **Title of study**

A database analysis of a family weight management programme

2 **Introduction**

You are being invited to take part in a study. Before you decide whether to do so, it is important that you understand the study that is being undertaken and what your involvement will include. Please take the time to read the following information carefully and discuss it with others if you wish. Do not hesitate to ask us anything that is not clear or for any further information you would like to help you make your decision. Please do take your time to decide whether or not you wish to take part. The University's regulation, UPR RE01, 'Studies Involving the Use of Human Participants' can be accessed via this link:

https://www.herts.ac.uk/about-us/governance/university-policies-and-regulations-uprs/uprs
(after accessing this website, scroll down to Letter S where you will find the regulation)

Thank you for reading this.

3 **What is the purpose of this study?**

The purpose of the study is to analyse the database of the weight management programme and to understand the practicalities of the weight management programme.

4 **Do I have to take part?**

It is completely up to you whether or not you decide to take part in this study. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. Agreeing to join the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason.

5 **Are there any age or other restrictions that may prevent me from participating?**

The participants must be adult staff aged 18 years or over from [redacted] who contribute to the delivery of the [redacted] programmes for families.

6 **How long will my part in the study take?**

If you decided to take part in this study, you will be involved in it for interviewing approximately 45-60 minutes. If there are any follow up questions, you may be contacted once via [redacted] within 12 months of the interview.

7 **What will happen to me if I take part?**

You will be interviewed by the researcher and asked questions about the [redacted] programmes for families. This will be a one-to-one interview and we will audio-record.

8 **What are the possible disadvantages, risks or side effects of taking part?**

There are no disadvantages, risk or side effects associated with the study. However, it will take up a little of your time.

9 **What are the possible benefits of taking part?**

There are no benefits to yourself but taking part in an interview will provide valuable information about the programme and this will help us to better understand how this is delivered to families. We will use this to support the analysis of the [redacted] database which will attempt to identify factors that are associated with successful outcomes and potentially provide a basis for planning and improving weight management program in the future.

10 **How will my taking part in this study be kept confidential?**

Your name will be asked for the consent sheet. Your name will not be used on any other documentation which will be anonymized by using a study identity number. The researcher will keep the signed consent sheet safe and return it to the University after the interview and it will be stored securely in a locked filing cabinet in the office of the researcher's supervisor. Only the researcher and her supervisor will have access to it.

11 **Audio recording**

The audio recording will be transferred to the researcher's personal password protected laptop at the end of interview day and will be deleted from the recorders. The interview data will be stored safely in the researcher's personal UH office 365 (OneDrive) and researcher's personal password protected laptop. We will use a study identity number to label the recording of your interview and your name will not be associated with it.

12 **What will happen to the data collected within this study?**

The recording will be transcribed (typed up) and information will be extracted from the typed words rather than directly from your voice. The recording will only be listened to by the researcher who carries out the interview and her supervisor and will be stored securely so no unauthorized person has access. The recording will be kept until 3 years after the study has finished and then destroyed securely. The consent sheet will be kept until 3 years after the study has finished and then destroyed securely.

13 **Will the data be required for use in further studies?**

You are consenting to the re-use or further analysis of the data collected in a future ethically-approved study; the data to be re-used will only be used in studies undertaken within the University of Hertfordshire and your name will not be associated with any data. The collated finding from this research may be published.

14 **Who has reviewed this study?**

This study has been reviewed by:

- The University of Hertfordshire Health, Science, Engineering and Technology Ethics Committee with Delegated Authority

The UH protocol number is LMS/PGR/UH/03866(1)

15 **Factors that might put others at risk**

Please note that if, during the study, any medical conditions or non-medical circumstances such as unlawful activity become apparent that might or had put others at risk, the University may refer the matter to the appropriate authorities and, under such circumstances, you will be withdrawn from the study.

16 **Who can I contact if I have any questions?**

If you would like further information or would like to discuss any details personally, please get in touch with me, in writing, by phone or by email:
Researcher: Srila Satoh, telephone number: 07549440450, E-mail: s.satoh@herts.ac.uk
Supervisor: Dr Angela Madden a.madden@herts.ac.uk
School of Life and Medical Sciences, University of Hertfordshire, AL10 9AB

Although we hope it is not the case, if you have any complaints or concerns about any aspect of the way you have been approached or treated during the course of this study, please write to the University's Secretary and Registrar at the following address:

Secretary and Registrar
University of Hertfordshire
College Lane
Hatfield
Herts
AL10 9AB

Thank you very much for reading this information and giving consideration to taking part in this study.

Appendix 4E

Consent form - Study 2 and 3

University of Hertfordshire UH Ethics Committee

UNIVERSITY OF HERTFORDSHIRE
ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC3
CONSENT FORM FOR STUDIES INVOLVING HUMAN PARTICIPANTS

I, the undersigned *[please give your name here, in BLOCK CAPITALS]*

.....
of *[please give contact details here, sufficient to enable the investigator to get in touch with you, such as a postal or email address]*

.....
hereby freely agree to take part in the study entitled *An exploration and a database analysis of a family weight management programme.*

(UH Protocol number LMS/PGR/UH/03866)

1 I confirm that I have been given a Participant Information Sheet (a copy of which is attached to this form) giving particulars of the study, including its aim(s), methods and design, the names and contact details of key people and, as appropriate, the risks and potential benefits, how the information collected will be stored and for how long, and any plans for follow-up studies that might involve further approaches to participants. I have also been informed of how my personal information on this form will be stored and for how long. I have been given details of my involvement in the study. I have been told that in the event of any significant change to the aim(s) or design of the study I will be informed, and asked to renew my consent to participate in it.

2 I have been assured that I may withdraw from the study at any time without disadvantage or having to give a reason.

3 In giving my consent to participate in this study, I understand that voice recording will take place and I have been informed of how/whether this recording will be used and stored.

4 I have been told how information relating to me (data obtained in the course of the study, and data provided by me about myself) will be handled: how it will be kept secure, who will have access to it, and how it will or may be used.

5 I understand that if there is any revelation of unlawful activity or any indication of non-medical circumstances that would or has put others at risk, the University may refer the matter to the appropriate authorities.

6 I have been told that I may at some time in the future be contacted again in connection with this or another study.

Signature of participant.....Date.....

Signature of (principal) investigator.....Date.....

Name of (principal) investigator *MISS SRILA SATOH*

Form EC3 – 1 August 2019

Appendix 4F

Topic guide - Study 2

Topic guide for staff interviews

Before the interview starts:

Ensure participant has received participant information sheet and had an opportunity to read it, to think about whether they would like to participate and to ask questions.

Have you received participant information sheet?, Have you read it?

Ensure they are comfortable and in an area that is private. Ask if they are ready to start recording.

How are you feeling today?, Are you ready to start?

If so, switch on recorders.

Stage (Time; mins)		Contents	Example questions; follow up questions will depend on the participants' answers
1 (1-2 mins)	Introducing the researcher	Name, Mode of study, University	Thank you for agreeing to participate in this interview. My name is SRILA SATOH, PhD student at the University of Hertfordshire.
2 (~5 mins)	Introducing the study	**Topic**; An exploration and a database analysis of a family weight management programme **Aims**; To understand the practicalities of the Beezee Families weight management programme	My study is **"An exploration and a database analysis of a family weight management programme"**. The aim of the study is to explore and examine an anonymized database from BeeZee Bodies programmme. To be able to do this, I need to gain an understanding of how the programme runs and about the approach that staff take when delivering. Talking with you now will help me to understand this. There are no right or wrong answers: I am interested in everything you have to say about the programme delivery.

			Please be assured that the information you give will be treated confidentially and not associated with the name of any individual person.
3 (~3 mins)	Beginning the interview	Ask general information about role in the programme	Shall we start? 1) Can you briefly tell me about your role working on the programme? -What do you do onsite with families/children -What do you do during delivery the programme? -What do you do with families/children -Apart from working onsite, is there anything else you have to do about the programme 2) How long have you done this role -How long have you been working here
4 (30-45 mins)	During interview	Ask about the BeeZee families programme which will include the practical issues and content of the BeeZee families programme, e.g. • Goals of the programme • Durations of the programme • Intensity of the intervention and follow up • Mode of delivery • Procedures and materials • Setting / Locations	3) What do you think are the overall goals of the programme? -What do you think are the objective of the programme? 4) Where do you usually deliver the programme to families/children? -Where is the programme delivered? -Is the same type of place use for each session? -Can the participants choose the location they attend? 5) How long do you usually provide the intervention for one programme? -How many weeks/months for each programme? -When does the programme start and end each year? 6) How many sessions in one programme? -How many times do you meet with families/children for one programme? -How often do you usually have sessions with families/children? -Do the participants have to attend every session? -Do you send out reminders about the sessions? -(Are all families eager to engage? Do you need to help some families more than others? What kind of things do you do to help them engage?) -Is there any incentive to attend the session? -Do you keep a record of who attends? 7) How long does a session usually take? -How many hours/minutes for one session usually take?

			-What time of the day do you usually have sessions? (Morning, afternoon, evening) 8) How do you usually deliver the programme? -What kind of delivery mode that you usually use for deliver the programme? (individual-group, face-to-face-virtual, telephone) -Is individual mean one child to one staff or one family to one staff? -How many children/families in one group? -How old are the children? Are they mix in one group? -Are there any different approach/content for deliver the programme in different age groups? -How do you group the participants? (base on…?) 9)* Could you please tell me about activities/content that took place in the sessions? -What activity do you include in the sessions? -What content do you include in the sessions? -(How do you explain to the participant? Is the content that you cover will use to help for achieve their goal?) -Is the content related to health/social/environment consequences? -What tools do you use in the sessions? (sheet, social media, WhatsApp etc.) -What sort of things do you do at the sessions? 10)* Could you please tell me about any assessment and/or monitoring of the programme and participants? -How do your follow-up the participants/ the programme? -Do you have any record for monitoring/assessment? -What are you monitor/assessment? -What do you do with the record of monitoring/assessment? -Do you have specific form for the record? -Do you use any monitoring/assessment to give them feedback? -What kind of feedback if you give to them? -Could you please give me an example of feedback? -How frequently do you give them feedback? 11) How many staff do deliver the programme in one session? - Who is deliver the programme? -How many people deliver the programme for one session -Who are they?

			12) Have you got any comment on kind of the participants (children/families) response to the programme? - Have you got any response from the participants in term of what do they particularly like? What do they really enjoy?, Is there any specific sessions or activities? -Have you got any feedback from the participants? -How do you get the response/ comment/ feedback from them? (questionnaire, sharing during the programme?) -Is there any record for the response/comment/feedback? -What about yourself, do you think which part of the programme that can help the participant in term of changing their habit? -And what do you think is their favorite session?
5 (~5 mins)	Ending the interview	Review and conclude Thank participant Remind of contact details in participant information sheet	We are nearly at the end of the interview: Are there any other activities or materials or information that we have not already covered about the intervention? Is there anything else you would like to say?
6	After the interview	Immediately on return to the University: 1. Store signed consent sheet securely 2. Transfer audio tape to secure storage using study number 3. Delete recording from recorder and back up recorder	

***Note:** More detail of prompt questions:
-Could you please give me examples of goal setting
(Ask for one in nutrition, one in physical activity, one in other areas if they have).
-Who set the goals (staff, children, parent or both)
-How frequency do you do goal setting?
-If they achieved their goal, what do you (as staff) do next? What do children/family do next?
-If they did not achieve their goal, what do you (as staff/ as children/family) do next?
-Do they have to analyse the factors if they fail? How?
-Do you help them to analyse the factors why they fail? How?
-Do you have examples of strategies that will help them to achieved their goals?
-Who will choose the strategies to overcome that barrier? (staff, children, family)
-How do you know if they succeed or not? (By review behaviour goal? How?)
-How can you communicate with them if they succeed or if they didn't
-Is there any document do you use for goal setting?
-If yes, is there any specific content on that sheet?
-Do they have to make an agreement on the sheet of goal setting?, If yes, who will agree with them (staff, family)
-Do they need to sign on the sheet?
-Do the participant have to write their goals?
-Could you please give me an example of the sentence that children have written on the sheet?
-Do you have any feedback to the participants?
-Could please give me an example of the feedback?
-Who's giving the feedback to whom (children/families or both) and how?
-Is there any incentive if they achieved their goal?
-What are the criteria for giving a prize? (achieved the challenge?, just involved?)
-Do they know about the prize in advance?
-If yes, how do you inform them?
-What is the prize? (Is it only one prize? Is there any different prize are given?)
-Are they competing against each other or just with themselves and their goals?
-Could you please give me more detail about nutrition content that you provide to families?
-Is this cover things like what will happen to them if they are eating/not eating healthy?
-What will happen to social/environment?
-What do you mean by eating healthy?

Appendix 5A

Protocol for cleansing database

Microsoft excel was used to clean the database

1. To make sure we can see all the data. Expand the column to fit the text by click home > format > auto-fit column width.
2. There were 2005 rows (1 to 2005) and 34 columns (A to AH)
3. Add column in "A column" use title "SS" and run number by type "1" in column A2 > type "=" in A3> click A2 > type "+1"> Enter > Drag from A3 to the end of data (A2005); A total number of participants was 2004
4. Sort by ID: 45 were no information > deleted. 1959 rows remain.
5. To remove duplicates (complete duplicates) by go to data > data tools > remove duplicates > click / my data has headers > select all column heading > ok. No duplicate was found.
6. Deleted column: Date of 12 MAssessment, 12MAge, 12MHeight, 12MWeight, 12MBMI, 12MWC as there were no information.
7. To change case using text function and to change text from uppercase or lowercase, insert column > =TRIM(PROPER(click text we want to change)) > enter > drop down the formula
8. Check age by sort Bage2; only have general information, no anthropometric information at baseline (B) and final (F) i.e. height, weight, body mass index (BMI), waist circumference (WC), and age. A total 28 rows were deleted, 1931 remains.
9. Sort baseline height; no anthropometric information at baseline i.e. height, weight, BMI, and WC. A total of 82 rows were deleted, 1849 remains.
10. Sort baseline weight; no anthropometric at baseline i.e. weight, BMI, WC, and at final i.e. height, weight, and WC. A total of 4 rows were deleted, 1845 remains.

10. Sort baseline weight; no anthropometric at baseline i.e. weight, BMI, WC, and at final i.e. height, weight, and WC. A total of 4 rows were deleted, 1845 remains.
11. Sort baseline age (repeat); A total of 6 rows were deleted, aged between 36.8 and 116.2, 1839 remains.
12. Sort age at baseline; A total of 20 rows were deleted as age less than 5 years and a total of 46 rows were deleted as age more than 15 years, 1773 remains.
13. Sort baseline date of assessment; A total of 37 rows were deleted because if there were no information of the assessment date, we were not know the duration time of intervention, 1736 remains.
14. Sort final date of assessment; A total of 152 rows were deleted, 1584 remains.
15. Sort final height; A total of 174 rows were deleted as there were no information of height, weight, and BMI, 1410 remains.
16. Sort gender; A total of 88 rows were deleted as 87 had no information of gender and 1 was unknown, 1322 remains.
17. Sort follow up date; A total of 8 rows were deleted as they were followed up at 0 – 1 month, 1314 remains.
18. Insert column to check height: Final height – Baseline height. A total of 36 rows (36/1314 = 2.7%) were deleted as height decreased (-41.5 to -0.1, follow up at month 2 – 5), 1278 remains

19. As per growth chart (ref), the average height increases about 6 cm per year in boy and 5.4 cm in girl.

    If it is 12 months, height increase 6 cm in boy (5.4 cm in girl).

    If it is 6 months, height increase 3 cm in boy (2.7 cm in girl).

    The follow up range in participants who increased in height >3 cm were between 2 and 6 months.

    If they were increased more than 1.5X (1.5x3) = 4.5 cm will be deleted. So, a total of 36 (36/1314 = 2.7%) rows were deleted as height increase ≥ 4.5 cm, 1242 remains.

20. Cleansing height again after analyse by considering to remove highest and lowest

    20.1. UK growth chart 2-18 years will used to create a syntax height for age for boys and girls

    20.2. Run the syntax on SPSS (Database 1242)

    20.3. Remove whoever lower than 0.4th and higher than 99.6th percentile. A total of 8 rows for people who height for age lower than 0.4th and 69 rows for people whos' height for age higher than 99.6th percentiles were deleted, 1165 remains.

    20.4. Run BMI syntax

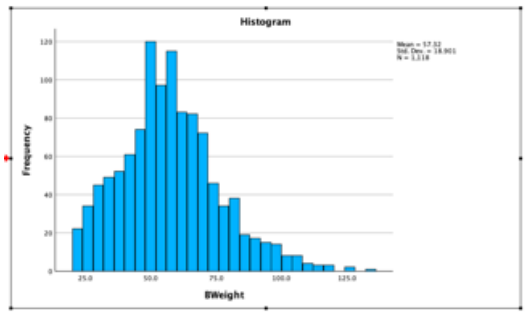
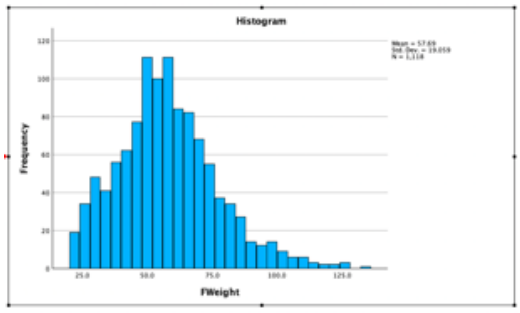
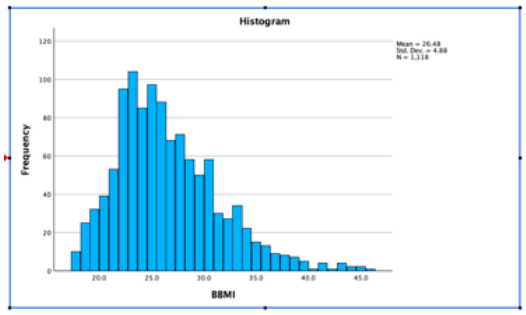
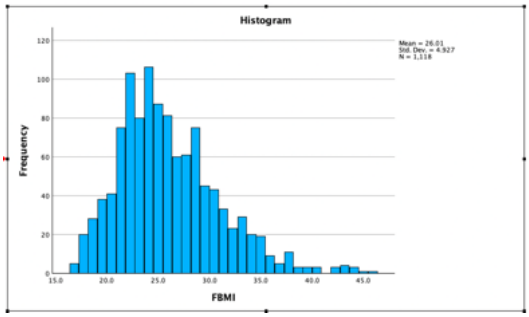
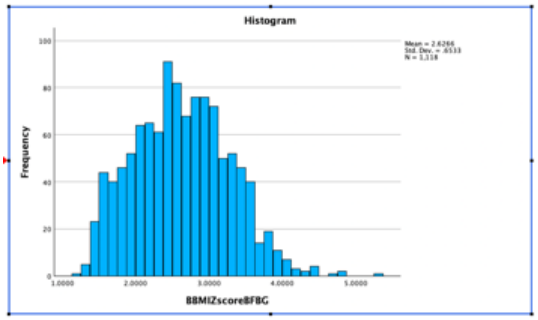
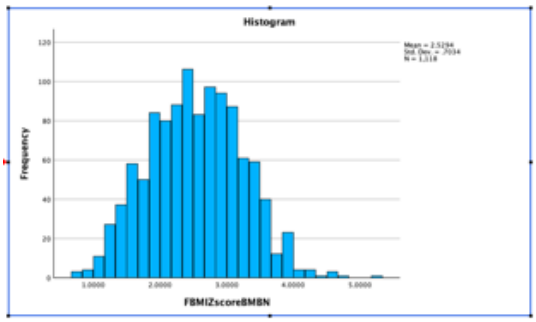
    20.5. Fourty-four rows were deleted as they are normal weight. So, 1165-44= 1121 remains.

    20.6. Two rows were deleted as final date of assessment were incorrect. So, 1121-2 = 1119 remains.

21. Sort weight change, average weight change of more than 1 kg per week. One row was deleted, 1119 -1 =1118 remains.

Appendix 5B

Thumbnails of histrograms

Baseline weight (p<0.001) 	Final weight (p<0.001) 
Baseline BMI (p<0.001) 	Final BMI (p<0.001) 
Baseline BMI z score (p=0.017) 	Final BMI z score = Normal distribution (p=0.200) 

Appendix 5C

Ethical approval

Note: See Appendix 4C

Appendix 6A

Standard for reporting qualitative research (SRQR) - Study 4

A qualitative exploration of participants' perspective of a family weight management programme for children aged 5-15 years in England.

No	Topic	Item	Reported in
	Title and abstract		
S1	Title	Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	Title
S2	Abstract	Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	-
	Introduction		
S3	Problem formulation	Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	Background
S4	Purpose or research question	Purpose of the study and specific objectives or questions	Aim and objectives
	Methods		
S5	Qualitative approach and research paradigm	Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale[b]	Methodology
S6	Researcher characteristics and reflexivity	Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	Methodology
S7	Context	Setting/site and salient contextual factors; rationale[b]	Methodology
S8	Sampling strategy	How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale[b]	Methodology
S9	Ethical issues pertaining to human subjects	Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	Methodology, Appendix
S10	Data collection methods	Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale[b]	Methodology
S11	Data collection instruments and technologies	Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	Methodology

S12	Units of study	Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	Results
S13	Data processing	Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/deidentification of excerpts	Methodology
S14	Data analysis	Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale [b]	Methodology
S15	Techniques to enhance trustworthiness	Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale[b]	Strengths and limitations
	Result/findings		
S16	Synthesis and interpretation	Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	Results
S17	Links to empirical data	Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	Results
	Discussion		
S18	integration with prior work, implications, transferability, and contribution(s) to the field	Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/ generalizability; identification of unique contribution(s) to scholarship in a discipline or field	Discussion
S19	Limitations	Trustworthiness and limitations of findings	Strengths and limitations
	Other		
S20	Conflicts of interest	Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	None
S21	Funding	Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Acknowledgment

Developed from O'Brien et al. (2014)

Appendix 6B

Ethical approval - Study 4

University of Hertfordshire UH

HEALTH, SCIENCE, ENGINEERING AND TECHNOLOGY ECDA

ETHICS APPROVAL NOTIFICATION

TO	Srila Satoh
CC	Dr.Angela Madden, Dr. Rosalind Fallaize
FROM	Dr Rosemary Godbold, Health, Science, Engineering & Technology ECDA Vice Chair
DATE	04/05/2022

Protocol number: **LMS/PGR/UH/04853**

Title of study: An exploration of participants' perspectives of a family programme.

Your application for ethics approval has been accepted and approved with the following conditions by the ECDA for your School and includes work undertaken for this study by the named additional workers below:

no additional workers named

General conditions of approval:

Ethics approval has been granted subject to the standard conditions below:

Permissions: Any necessary permissions for the use of premises/location and accessing participants for your study must be obtained in writing prior to any data collection commencing. Failure to obtain adequate permissions may be considered a breach of this protocol.

External communications: Ensure you quote the UH protocol number and the name of the approving Committee on all paperwork, including recruitment advertisements/online requests, for this study.

Invasive procedures: If your research involves invasive procedures you are required to complete and submit an EC7 Protocol Monitoring Form, and copies of your completed consent paperwork to this ECDA once your study is complete.

Submission: Students must include this Approval Notification with their submission.

Validity:

This approval is valid:

From: 04/05/2022

To: 31/01/2023

Please note:

Failure to comply with the conditions of approval will be considered a breach of protocol and may result in disciplinary action which could include academic penalties.
Additional documentation requested as a condition of this approval protocol may be submitted via your supervisor to the Ethics Clerks as it becomes available. All documentation relating to this study, including the information/documents noted in the conditions above, must be available for your supervisor at the time of submitting your work so that they are able to confirm that you have complied with this protocol.

Should you amend any aspect of your research or wish to apply for an extension to your study you will need your supervisor's approval (if you are a student) and must complete and submit form EC2.
Approval applies specifically to the research study/methodology and timings as detailed in your Form EC1A. In cases where the amendments to the original study are deemed to be substantial, a new Form EC1A may need to be completed prior to the study being undertaken.

Failure to report adverse circumstance/s may be considered misconduct.
Should adverse circumstances arise during this study such as physical reaction/harm, mental/emotional harm, intrusion of privacy or breach of confidentiality this must be reported to the approving Committee immediately.

Appendix 6C

Participant information sheet - Study 4

UNIVERSITY OF HERTFORDSHIRE

ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC6: PARTICIPANT INFORMATION SHEET

1 **Title of study**

An exploration of participants' perspectives of a family programme

2 **Introduction**

You are being invited to take part in a study. Before you decide whether to do so, it is important that you understand the study that is being undertaken and what your involvement will include. Please take the time to read the following information carefully and discuss it with others if you wish. Do not hesitate to ask us anything that is not clear or for any further information you would like to help you make your decision. Please do take your time to decide whether or not you wish to take part. The University's regulation, UPR RE01, 'Studies Involving the Use of Human Participants' can be accessed via this link:

https://www.herts.ac.uk/about-us/governance/university-policies-and-regulations-uprs/uprs
(after accessing this website, scroll down to Letter S where you will find the regulation)

Thank you for reading this.

3 **What is the purpose of this study?**

The purpose of the study is to explore what participants think about the family programme they have attended and how this might have benefited their family and which aspects have been helpful in helping to change behaviour.

4 **Do I have to take part?**

It is completely up to you whether or not you decide to take part in this study. If you do decide to take part you will be given this information sheet to keep and be asked to sign a consent form. Agreeing to join the study does not mean that you have to complete it. You are free to withdraw at any stage without giving a reason.

5 **Are there any age or other restrictions that may prevent me from participating?**

The participants must be adults from families who have participated in a [redacted] Families programme.

6 **How long will my part in the study take?**

If you decided to take part in this study, you will be involved in it for interviewing approximately 30-45 minutes. If there are any follow up questions, you may be contacted once via [redacted] within 12 months of the interview.

7 **What will happen to me if I take part?**

Participants will be interviewed by the researcher and asked questions about their views of their experience in attending the family programme. This will be a one-to-one virtual interview either via Zoom, Microsoft Teams or phone call and you can choose which method is best for you. The interview will be audio-recorded but kept secure and only listened to by the research team.

8 **What are the possible disadvantages, risks or side effects of taking part?**

There are no major disadvantages, risk or side effects associated with the study. However, it will take up a little of your time and, for some people, talking about a family programme may be sensitive. If you feel uncomfortable or upset in the interview, please tell the interviewer if you would like to stop the interview and / or recording. Support is also available from:
[redacted]
https://www.nhs.uk/every-mind-matters/mental-wellbeing-tips/
https://www.samaritans.org/how-we-can-help/

9 **What are the possible benefits of taking part?**

There are no benefits to yourself but taking part in an interview will provide valuable information about the programme.

10 **How will my taking part in this study be kept confidential?**

Your name will be asked for the consent sheet only. Your name will not be used on any other information which will be anonymized by using a study identity number. The researcher will keep the signed consent sheet safe and will protect it with a password and store it securely in a separate area to the study recordings. Only the researcher will have access to your consent sheet and only the research team will have access to the anonymized information.

11 **Audio recording**

The audio recording will be transferred to the researcher's personal password-protected laptop at the end of interview and will be deleted from the recorders. The interview data will be stored safely in the researcher's personal UH Office 365 (OneDrive) and researcher's personal password protected laptop. We will use a study identity number to label the recording of your interview and your name will not be associated with it.

12 **What will happen to the data collected within this study?**

The recording will be transcribed (typed up) and information will be extracted from the typed words rather than directly from your voice. The recording will be transcribed by a secure research transcription service used by the University of Hertfordshire. This supplier has a secure system in-house for data storage which denies access to anyone other than the authorised user. They will password protect the completed transcript before returning it. The recording will be kept until 3 years after the study has finished and then destroyed securely. The consent sheet will be kept until 3 years after the study has finished and then destroyed securely.

13 **Will the data be required for use in further studies?**

You are consenting to the re-use or further analysis of the data collected in a future ethically-approved study; the data to be re-used will only be used in studies undertaken within the University of Hertfordshire and your name will not be associated with any data. The collated finding from this research may be published but you will not be identified in the publication.

14 **Who has reviewed this study?**

This study has been reviewed by:

- The University of Hertfordshire Health, Science, Engineering and Technology Ethics Committee with Delegated Authority

The UH protocol number is LMS/PGR/UH/04853

15 **Factors that might put others at risk**

Please note that if, during the study, any medical conditions or non-medical circumstances such as unlawful activity become apparent that might or had put others at risk, the University may refer the matter to the appropriate authorities and, under such circumstances, you will be withdrawn from the study.

16 **Who can I contact if I have any questions?**

If you would like further information or would like to discuss any details personally, please get in touch with me, in writing, by phone or by email:
Researcher: Srila Satoh, telephone number: 07549440450, E-mail: s.satoh@herts.ac.uk
Supervisor: Dr Angela Madden a.madden@herts.ac.uk
School of Life and Medical Sciences, University of Hertfordshire, AL10 9AB

Although we hope it is not the case, if you have any complaints or concerns about any aspect of the way you have been approached or treated during the course of this study, please write to the University's Secretary and Registrar at the following address:

Secretary and Registrar
University of Hertfordshire
College Lane
Hatfield
Herts
AL10 9AB

Thank you very much for reading this information and giving consideration to taking part in this study.

Appendix 6D

Consent form - Study 4

University of Hertfordshire UH Ethics Committee

UNIVERSITY OF HERTFORDSHIRE
ETHICS COMMITTEE FOR STUDIES INVOLVING THE USE OF HUMAN PARTICIPANTS ('ETHICS COMMITTEE')

FORM EC3
CONSENT FORM FOR STUDIES INVOLVING HUMAN PARTICIPANTS

I, the undersigned *[please give your name here, in BLOCK CAPITALS]*

……..
of *[please give contact details here, sufficient to enable the investigator to get in touch with you, such as a postal or email address]*

…….
hereby freely agree to take part in the study entitled *An exploration of participants' perspectives of a family programme.*

(UH Protocol number LMS/PGR/UH/04853)

1 I confirm that I have been given a Participant Information Sheet (a copy of which is attached to this form) giving particulars of the study, including its aim(s), methods and design, the names and contact details of key people and, as appropriate, the risks and potential benefits, how the information collected will be stored and for how long, and any plans for follow-up studies that might involve further approaches to participants. I have also been informed of how my personal information on this form will be stored and for how long. I have been given details of my involvement in the study. I have been told that in the event of any significant change to the aim(s) or design of the study I will be informed, and asked to renew my consent to participate in it.

2 I have been assured that I may withdraw from the study at any time without disadvantage or having to give a reason.

3 In giving my consent to participate in this study, I understand that voice recording will take place and I have been informed of how/whether this recording will be used and stored.

4 I have been told how information relating to me (data obtained in the course of the study, and data provided by me about myself) will be handled: how it will be kept secure, who will have access to it, and how it will or may be used.

5 I understand that if there is any revelation of unlawful activity or any indication of non-medical circumstances that would or has put others at risk, the University may refer the matter to the appropriate authorities.

6 I have been told that I may at some time in the future be contacted again in connection with this or another study.

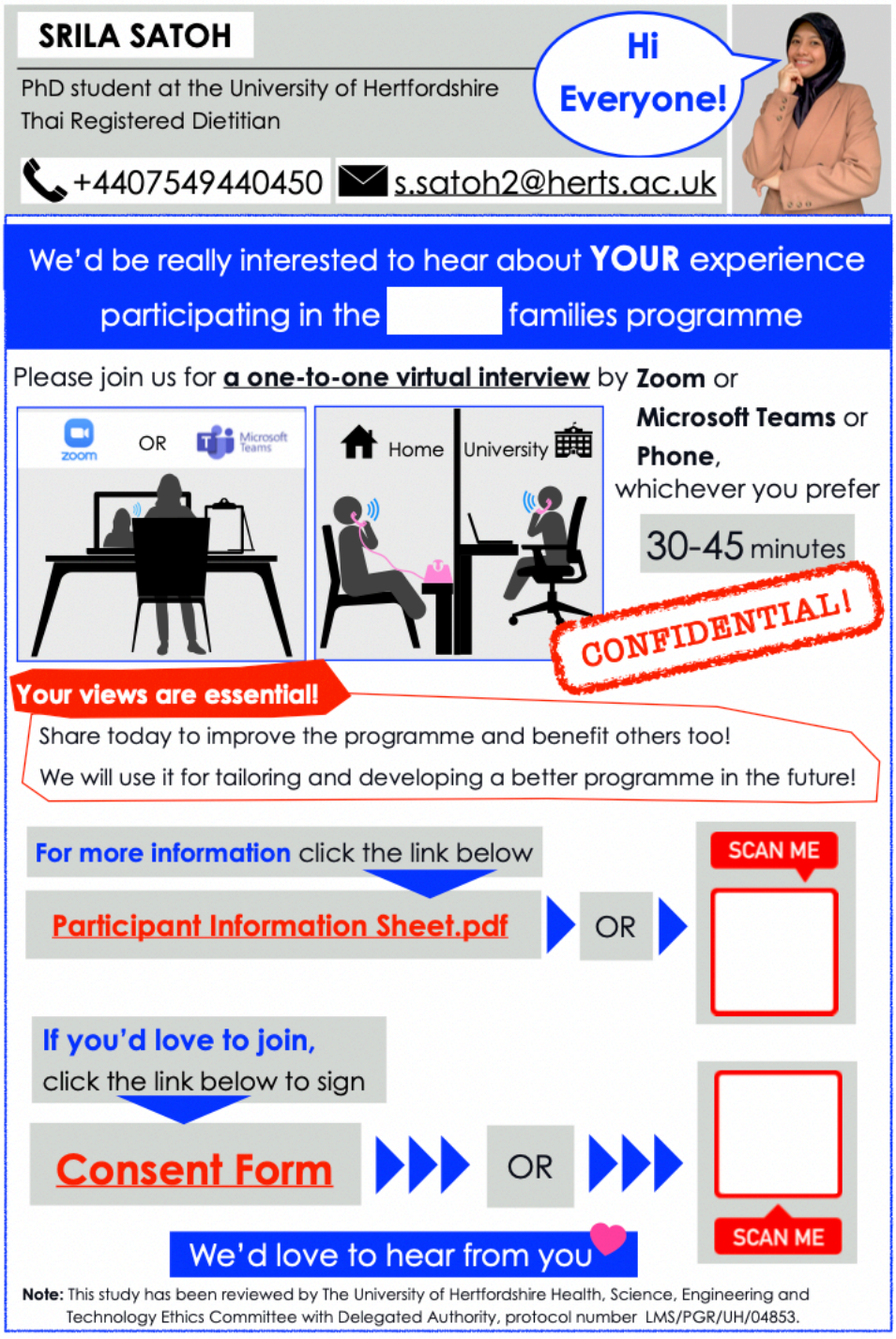
Signature of participant……Date……

Signature of (principal) investigator……Date……

Name of (principal) investigator *MISS SRILA SATOH*

Appendix 6E

Invitation letter



Appendix 6F

Indicative topic guide - Study 4

An exploration of participants' perspectives of a family programme

Indicative topic guide

Before the interview starts:

- Thank you for participating in this interview.
    - Ensure they are comfortable and in a private area.
    - Ensure participant has received the participant information sheet and had an opportunity to read it, think about whether they would like to participate and sign the consent form.
- Just to remind you that I will be recording our interview today, but the information you give will be treated confidentially. Your name will not associate with any comment you make, and your family will not be identified in any way.
- There are no right or wrong answers. I am interested in everything you will say about [redacted] Families programme you have been attending (or attended).
- May I check that you are comfortable in your location and if others might be able to hear our conversation?
- Before we start, do you have any questions?
- Ask if they are ready to start. If so, switch on recorders.

Topics (time)	Questions	Prompt questions: These questions will be asked to depend on the participants' answers
Introduction (3-5 mins)	1. Can you tell me how you found out about the programme?	1.1 Did someone tell you about the programme? 1.2 Did you find it on the internet? 1.3 Can you tell me why did you attend the programme?
	2. Where are you in the programme / How far are you in the programme? Have you finished the programme yet?	2.1 When did you start to join the programme? 2.2 Is this your first time attending the programme 2.3 Are you currently attending the programme or have you finished the programme?
	3. Can you tell me how many family members attended/attending the programme?	3.1 Who are they? 3.2 Can you tell me a bit about your child? What sort of things does he/she like doing? 3.3 Can you tell me about your relationship with them? 3.4 How old are they?
Participants' perspectives (25-30 mins)	4. Can you share, your family experience of attending the programme?	4.1 How do/did you find the programme overall? 4.2 What did you like about the programme? 4.3 What did you dislike about the programme? 4.4 How do/did you feel about the programme? 4.5 Can you tell me how other people in your family got along with the programme? (what went well, what did not go well and why).
	5. Could you please describe the sessions that you/your child (family) enjoyed most? And why?	5.1 What is your/your child (family) favourite session/activity? And why? 5.2 Which tools/advice work very well for your family? 5.3 Why do you think these tools / advice were useful for you? 5.4 What is the thing that helps you/your child (family) to follow their advice? 5.5 In the sessions, what did you find most helpful/useful for (changing your/ your child's behaviour)? 5.6 Can you tell me about (the experiment/challenge sheet)? 5.7 What kind of the experiment (challenge) worked well for your family? 5.8 Why do you think this worked well for your family? 5.9 Can you tell me about (the parent session)? 5.10 How did the parent session help you to help your family? 5.11 Why were these sessions helpful for you? 5.12 Are there any tips in the parent session that you found helpful in helping your family change behaviour?

	6. Can you tell me how your family use the tools/their advice to change your (family) daily life?	6.1 Can you tell me how the programme benefits your family? 6.2 Can you tell me your/your child daily life situations when you used tools/advice from the programme to deal with? 6.3 Can you describe situations where the programme helped your family to change? (what happened? what you have learned from the situation?) 6.4 Can you tell me how confident you are about the programme that can help your family? 6.5 Can you tell me how confident you are to apply what you have learned from the programme to your daily life? 6.6 How confident do you feel in your ability to maintain what the programme has given you? 6.7 Can you tell me what parts of the programme helped to make you feel confident? 6.8 What has changed in your family since attending the programme? 6.9 As a parent, what do you think are the future challenges for your family to live a healthy life?
	7. What do you think you want to learn more from the programme?	7.1 Can you tell me what would you like to see more in the programme in the future? 7.2 Can you tell me what would be helpful to add to the programme in order for you to help your family with changing their behaviour?
	8. If you have an opportunity to attend the programme again in the future, will you attend the programme again? And why?	8.1 Would you like to join the programme again? 8.2 Will you share/recommend the programme to others?
	9. Is there anything your child has said about the programme?	9.1 Did your child say/share anything about the cooking session? 9.2 If yes, can you tell me about that?
	10. If you can say something to anyone (friends, staff) about the programme, what would you like to tell them?	10.1 Overall, what do you think about the programme? 10.2 Can you tell me how satisfied you are with (what you have learned from) the programme? 10.3 Can you tell me how important the programme is/was to your family?
Closing (3-5 mins)	11. These are all the questions I had for you. Is there anything you would like to share?	11.1 Is there anything else you would like to share about yourself/ your child (family)? 11.2 Thank you for your time.

BLANK PAGE